Blyth, Birds. 788, 871.
--- List of Birds from Southern India sent by D. Jerdon.
Blyth, Manuscripts of the Indian & Malayan Cuculidæ p. 897. 2 p. 1095.
--- Birds, Nilgiri Hills, 970

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OF THE

ASIATIC SOCIETY

OF

BENGAL.

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VOL. XI.

PART II. JULY TO DECEMBER, 1842.

NEW SERIES.

"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science, in different parts of *Asia* will commit their observations to writing, and send them to the Asiatic Society in Calcutta; it wil languish, if such communications shall be long intermitted; and will die away, if they shall entirely cease."—SIR WM. JONES.

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PART II.

JOURNAL

OF THE

ASIATIC SOCIETY.

A Sixth *Memoir on the Law of Storms in India, being,* Storms in the China Seas, from 1780 to 1841. *By* Henry Piddington.

It naturally occurred to me in the course of my investigations on this subject, that it would be of great interest could we collect together as many of the *old* storms of past years as remain upon record; and with this view, I addressed the Hon'ble the Court of Directors of the East India Company, requesting their assistance in obtaining from their official documents, and from their old officers, such information as still existed. With their wonted, and well-known liberality in the cause of science this request was promptly complied with, and I owe to their kind assistance a mass of documents, comprising numerous extracts from logs and letters which relate to the China Seas and Northern Pacific,* besides other miscellaneous information. It is then, I need not say, to them that this memoir will owe, in the first place, most of its information, and I may be allowed to add, that as the best thanks which I could offer to them, I have endeavoured to use to the best advantage their valuable materials.

To Captain Chas. Biden of Madras, I am next indebted for a long series of logs and notices, which he has been most zealous in collecting and forwarding to me. And from Mr. Greenlaw, the Secretary

* The remainder to the Bay of Bengal, Southern Indian Ocean, and Cape of Good Hope, which will appear in future memoirs.

to the Marine Board, and Captain Clapperton, Acting Master Attendant at Calcutta, I have, as usual, received all the assistance they could afford: I must not omit to mention, that amongst several of the Hon'ble Company's retired officers who have given valuable notes, I am specially obliged to Mr. Thos. Packman, for some twenty pages of extracts and notices which he has been good enough to send me. I have been careful to note at the head of every storm the sources from which the documents are derived.

It will perhaps be thought that I have here preserved some records which afford but scanty proof of the truth of the theory of storms as applied to the Chinas Seas; but it should be borne in mind that we have to prove, *first*, that the great storms are circular ones, or nearly so; *secondly*, that they turn from right to left outside; *thirdly*, that they are progressive; *fourthly*, the tracks on which they move; and *fifthly*, the rates at which they move, and any other peculiarities. Now to shew all this of any *one* storm, requires a considerable body of evidence, and such as can rarely be procured without great trouble and a fortunate combination of circumstances; but we may prove it little by little, and separately, of several storms; and above all, we may shew that *as far as all available record extends, there is no contradiction to the theory to be found!* and by publishing faithfully, make the data available for abler hands. With these views then, I shall I trust be acquitted of accumulating useless details, and I may add, that provided our data are but authentic, we can as yet scarcely say what may be, eventually, their relative importance.

TRACK No. I, 1780.

The first storm of which I have obtained any record is the following, from a note of Captain Biden's:—

An account of the distress of the London East Indiaman, 758 tons, in a Hurricane on the Coast of China, in July last, taken from Captain Webb's *letter to the Directors of the East India Company. From the Annual Register.*—"On our arrival on the coast of China, off Macao, on July 17th 1780, after my packet was delivered to the

supercargoes there, a tiffoon came on, which had very near demolished us.

"At four in the afternoon our best bower cable parted, and the ship cast in shore, but by setting all the sail I could, I just weared her clear of the land; and as the wind was then E. N. E. we stood out to the southward under our courses, and at six had the *Ladrones* bearing N. E. At eight the wind flew round to S. E. and blew the hardest gale I ever remember. We were then in twenty fathoms water, and not being able to make any more way out, our sails all blowing to pieces, we looked upon our destruction as inevitable, without a particular act of providence; for we were driving on a lee-shore. At twelve at night the wind flew to the south, its violence still continuing, and we found the ship shoaling her water, so that every soul on board was preparing for death. At daylight we were in twelve fathoms water, with the sea, which was as much mud as water, breaking entirely over us; we then threw some of our guns overboard, and cut away the main and mizen masts, and by the time we had cleared them we were in three fathoms water, the land only about a quarter of a mile distant. We immediately cut away the fore-yard and let go the sheet anchor, which, by the mercy of God, brought us up; and as the ship touched the ground abaft it eased her to the cable, or I am well assured the *Royal George's* anchors and cables would not have held her. We then instantly let go our spare anchor with a new cable, which parted as we were veering it out, so that we had no other left. About nine in the morning the gale abated. In the evening we hove up our sheet anchor, when we found the cable stranded. What saved the ship was the having all our guns housed, her ports in, and top-gallant masts down on deck, before the gale came on. Our drift in the gale was amazing.

"I imagined it at first only about fifty miles, but to my astonishment when the gale was over, I found myself as low down as Haynan, within the westernmost island, about 3 leagues from the continent. I must have passed in the night quite close to a rock that bore S. by W. when the ship brought up. The Chinese told me that every vessel that was that night at sea perished except mine, and that they had lost all their junks and boats round the whole country, and were certain not less than 100,000 people had perished in the storm.

"We had another tiffoon in August, when all the European ships at Wampoa drove with three anchors a-head. The Chinese junks and boats then in the river were most of them sunk, and the number of poor souls that perished in this hurricane is incredible. I repaired my damages as well as I could at Canton, but I was obliged to come away with only two cables."

Captain Biden's note upon this log, is as follows: "The extraordinary drift of the *London* from near Macao to the N.E. Coast of Hainan is worthy of remark. It appears she stood to the southward about four hours when the gale flew round from E. N. E. to S. E. Allowing her to have made thirty miles in those four hours; this ship must have experienced an amazing current to the S. S. W., the distance from the Grand Ladrone to Hainan, being about 180 miles, and much of the time the hurricane was from S. E. and S."—C. B.

It seems most probable, that this was a storm travelling along the South Coast of China, or from about E. N. E. to W. S. W., and that the *London* crossed its track, and not far from the centre, at 8 A. M. I have therefore laid it down as one of the probable tracks only, though from the ship's position, and the shift of wind being so well ascertained, we may infer that we are not far from the truth. The extraordinary drift would be quite incredible, did it not also rest upon good evidence, and it should be borne in mind by the seaman as at all events a possibility in like cases. It will be subsequently seen that in September 1803, the H. C. S. *Warley* was also driven from off St. John's to the Taya Islands, or about the same distance in about 56 hours, and that other instances of this dangerous storm-current have occurred.

1793.

On the 1st, 2nd, and 3rd of Dec. 1793, the Honorable Company's Ships *Royal Charlotte*, *Triton*, and *Warley*, bound to China, by copies of their logs received from the India House, were driven from Lat. 20° 9′ N., Long. 119° E.; to Lat. 17° 29′ N. Long. 116° 38′ E. or about 220 miles to the Southward and Westward by a heavy

gale (called a Tyfoon in their logs) which began at North, veered to N. E. and N. N. E. and moderated again at North, veering when fine, to N. N. W. It is barely possible that this might have been a vortex travelling from the N. N. E. to the S. S. W. between the ships, and the Island of Luzon ; but I should be more inclined, at that season of the year, to consider it as what I have in my former memoirs styled a monsoon gale, i. e. the monsoon of the season rising to the height of a severe gale. Of this the reader will judge for himself. There is nothing in the data worth recording beyond the drift of the ships, and the steadiness of the wind during the storm, which was however so severe, that the *Royal Charlotte* lost her tiller, and the other ships several sails, &c.

TRACK No. II, 1797.

Narrative from Captain Lynns's Star Tables.

The *Duke of Buccleugh,* (burden 1182 tons), sailed from China (Macao roads), on the 15th June 1797, in company with His Majesty's ship *Swift,* Captain Hayward, and a fleet of sixteen ships.

Sunday the 18th June.—Moderate winds from S. S. E. to E. S. E., E., E.N.E., N.E. and North at noon, with hazy weather throughout. Latitude observed 21° 58′ N.; longitude per chronometer 116° 05′ E. Barometer 29° 15′. Thermometer 83°.

Monday, 19th June.—Commenced with increasing northerly wind and hazy weather; at 4 P. M. the wind increasing rapidly. In first and second reefs, handed the main-sail, struck the royal masts, and down top-gallant yards. At 7 P. M. wind N. E. by N., increasing to a heavy gale, handed the top-sails. From 9 P. M. till midnight, the wind veering from N. E. by N. to North, N. W. to West, S. W. and South, increasing gradually the whole time, when its force was tremendous, and such as no sail, I conceive, could have endured: the foresail at this time blew out of the bolt-rope to atoms, and the ship tried under bare poles until day-break, when the wind having veered to the eastward of South, began to abate. No ship in sight since 3 A. M. when the Commodore, with whom we had been scudding, and whom

we knew by his top-light, bore E. S. E. a quarter of a mile, and suddenly disappeared. The sea during the height of the gale, (its surface being such a continued spray), it was impossible to face; it searched through the weather ports, although well lined and secured; and in the working of the ship through the weather seams, to such a degree, as was incredible. Notwithstanding the force of the wind, the sea was not near so high as in common gales of wind off the Cape of Good Hope, which I attribute to the partiality of the gale with regard to its extent, but perhaps to the extreme violence of the wind preventing the sea from forming a head. Bar. 29° 00′. Ther. 76°.

In this gale (we afterwards learned) the *Boddam* was totally dismasted, lost her bowsprit and rudder, and was towed into Macao road by the *Crescent* packet, where at anchor, this ship lost her foremast and bowsprit also. Latitude by account 22° 9′ North, Longitude 117° 3′ East.

Tuesday, 20th.—Wind from S. by E. to S.E. by S., gradually abating to a moderate breeze, with fine weather at noon, when the latitude was observed 22° 27′ N., and longitude by chronometer 117° 26′ E.

For the foregoing I am indebted to Captain Biden, and unfortunately amongst the logs from the India House, those relating to this storm are omitted, though the logs relating to two of the other storms experienced by the *Buccleugh* and fleet in the Northern Pacific have been sent me, and will appear in a memoir on the storms of that ocean. The only other record I have is a notice from memory from Mr. Baynes of Falmouth,* from which it appears, that the *Boddam* and *Chester* suffered severely in it, the former vessel being dismasted, with also the loss of her rudder. We have then to consider from this notice alone, what may probably have been the track of the storm.

Mr. Redfield in quoting this storm, seems to think that the true storm set in at North. I should scarcely think so from the terms of the log, and am inclined to take its commencement from the N. E. by N. wind, at seven P. M. when the ship drifting across the track of the storm within, a short distance of its centre, will account for its veering, taking the track to be about an East and West one.

* India House Memoranda.

There is however another and a more probable reason to account for the slight anomaly, taking the storm to have begun at noon, and from the North, as Mr. Redfield supposes, which is, that at this time the *Buccleugh* was only 50 miles from the coast of China, which being high, would, as we positively know in the case of the storms of the Bay of Bengal, occasion variations in the direction of the wind, and probably influence that of the centre itself. We cannot venture upon such slender data to mark any thing more than a conjectural track for this storm on our chart, but we may be satisfied that it travelled from the Eastward towards the West, and veered according to the Law of Storms in the Northern hemisphere.

TRACKS No. III. AND IV.—SEPTEMBER 20TH to 23RD, 1803.

Documents from the India House and Captain Biden.

On the 20th to 23d of September, 1803, a fleet of the Hon'ble Company's ships, consisting of the *Warley, Royal George, Bombay Castle, Alfred, Coutts, Earl Camden,* and *Ganges,* experienced two very severe tyfoons in the China Seas. Of these ships, the first three, viz. *Warley, Royal George,* and *Alfred,* were close in with the Coast of China, and some of them were anchored off St. John's, while the last four, *Coutts, Earl Camden, Bombay Castle* and *Ganges,* were about latitude 16° N. and thus at least 6° South of the others. We should have then consequently, as it were, two fleets on opposite sides of a great storm of 6° of latitude, or say 400 miles if it was one storm, or if there were two, the two fleets still serve to define their tracks and limits. I shall subsequently give a full detail of how they do so.

My authorities are the logs of the ships from the East India House, from Captain Biden, who was a Midshipman in the *Royal George,* and the log of that ship, with a private memorandum of Captain Torin's of the *Coutts.* I commence with the logs of the ships off the Coast of China, reducing them to civil time.

No. 1.—Abridged Log of the Honorable Company's Ship WARLEY; *reduced to civil time.*

The Honorable Company's Ship *Warley* was on the 21st September, at noon, in lat. 21° 17′ N., long. 113° 7′ E. with the land about St. John's and the Madarin's Cap in sight at sunset; blowing fresh from N. N. E. to N. by W. at midnight, when she was in twenty-five fathoms water.

22*nd September*.—From midnight to noon, wind increasing fast, ship standing in to the N. E. and East with wind as before, and N. by W. at noon, when she was in thirty fathoms water off St. John's, about lat. 21° 10′ N. long. 112° 48′ E. By 11 P. M. all the storm staysails blown away; wind apparently steady from the North and N. N. E., though not marked in this log; ship hove to with her head to the Eastward.

23*rd September*.—Storm increasing, top-masts blown away, ship becoming almost unmanageable; at a little after noon, when by indifferent observation the latitude was 21° 15′ N. they let go the best bower anchor, to try to keep the ship's head to the sea; the wind is not marked, but seems to have been about E. by S. at noon.

24*th September*.—Rolled away the mizen-mast. Saw the Taya Islands at 6 A. M. Latitude at noon 20° 15′ N.

With reference to the log of the *London* at p. 607 it will be seen, that this is another instance of a ship's being blown and drifted from the mouth of Canton river to the Coast of Hainan, in about fifty-six hours.

No. 2.—*Abridged Log of H. C. S.* ROYAL GEORGE, *Captain J. F. Timins, reduced to civil time.*

The *Royal George* was, at noon on the 22d September, at anchor, with the Grand Ladrone bearing N. by E. $\frac{3}{4}$ E. three or four miles, and the Asses' Ears E. by N., strong gales from N., with squalls and hazy weather, lat. 21° 50′ N. P. M. hard gales with squalls and fair weather. Wind N. N. E. at 5 P. M. and N. E. at 9; midnight, severe gusts of wind with rain, and a heavy swell from the N. E.

23*rd September.*—A. M. very hard gales with severe gusts of wind and rain, veering away cable.

At 2 A.M. the wind marked E. N. E. At 3, blowing very hard, cut the cable and hove to (head to the S. E.) under bare poles. P. M. wind East, strong gales with heavy squalls Southerly. More moderate from 3 P. M. At 5 P. M. St. John's bearing W. N. W. three or four leagues, in twenty fathom water.

24*th September.*—At 8 A. M. St. John's bearing N. W. six or seven leagues; Cow Cock N. E. by N., wind E. by S. making sail. The *Alfred* at daylight S. by E. five miles.

No. 3.—*Abridged Log of H. C. S.* ALFRED; *reduced to civil time.*

At noon 22*nd September*, had the Grand Ladrone bearing W. $\frac{1}{2}$ S. Gap Rock South, and Asses' Ears due East. Observed that the swell was rising from the Eastward. Wind marked North. At noon working in to the anchorage; P. M. increasing breeze and cloudy weather, with a long swell from the East. At 4 P. M. anchored with Grand Ladrone bearing S.; Gap Rock S. by E.; Asses' Ears S. 65° E. making all snug. At 11 P. M. wind increased to hard gale N. N. E. At midnight drove.

23*rd September.*—Gale still freshening, and ship driving at the rate of $2\frac{1}{2}$ knots per hour, cut and stood to sea, hove to at 2 A. M. Wind at N. E. and at 4 at E. N. E., heavy gale with hard squalls and a confused sea at noon. At 2 P. M. E. S. E. At 4 made some sail. At 7 P. M. E. S. E.

24*th September.*—*Royal George* at daylight N. by W. Wind about E. S. E. and moderating.

No. 4.—*Abridged Log of the* EARL CAMDEN, *Captain Dance; reduced to civil time.*

Wednesday, 20*th September.*—Noon lat. 15° 42′ N., longitude 113° 41′, hard gales with squally weather, wind N. N. E. at 1 P.M. At 3

N. by E. At 5 N. by W. to midnight; ship trying to the N. E. by E. but making little or no way.

21*st September*.—Constant hard gales, and thick squally weather continue with a high confused sea. 2 A. M. wind N.N.W. At 3 N. W. b N. At 9, N. W. by W., 11 A. M. N. W. hove to under close reefed main top-sail, lat. 15° 51′ N., longitude 115° 27′ E. *Bombay Castle* in company, P. M. wind W. N. W. hard squalls, thick weather, and rain throughout till midnight.

22*d September*.—1 A. M. Wind West. At Noon S. W. by S. lat. 16° 17′ N., longitude 116° 23′ E. P. M. wind S. W. by S. At 5 P. M. wind South, bore up. At 7 P. M. wind S. W. At midnight S. S. W. weather moderating since noon.

23*d September*.—Monsoon weather; wind from S. to S. S. W., ship going four and five knots to the N. by W. Noon, lat. obs. 17° 01′ North, longitude 114° 4′ E.; from which time fine weather to China.

No. 5.—Abridged Log of the H. C. S. Bombay Castle, *Capt. Archibald Hamilton; reduced to civil time.*

In this ship's log there are no latitudes or longitudes marked, but as she was for the first part of the storm within a few miles of the *Camden*, we may thus take it as corroborative of that vessel's well-kept record. The ships seem to have been driven to the Southward, (they were bound *to* China it will be remembered), by the continuance of a northerly wind, which indeed is not uncommon at this season, and may be the first struggles of that part of the trade wind which constitutes the N. E. monsoon, to overcome the South-westerly one; and thus, if we admit mere dynamical causes to originate these vorticæ, giving the first impulse to them, for by a memorandum in the log, they were on the 19*th September*, in latitude 16° 2′. The *Camden's* log giving 15° 42′ for the observation of the 26th.

20*th September*.—P. M. Wind N. N. E. strong gale and cloudy to midnight, ship under close reefed top-sails.

21*st September*.—3 A.M. N. N. W. Noon N.W. b N. preparing for bad weather, blowing very hard with violent squalls and heavy head sea. At 4 P. M. lying to under mizen stay-sail. At 6, wind NW.

22*nd September.*—7 A.M. Wind S.W. b W. Noon about S.W. b W. hard squalls. P.M. S.W. b W. at half past 3 more moderate. At 5. S.W. bore up. At 8, *Camden* N. E. 3 miles; at 10, S. W. b S. moderating as with the *Camden* to S. by E. at 7 A. M. and to midnight.

24*th September.*—Fine wind. In company with the *Camden.* At 11 A. M. on 24th, saw the *Coutts* under jury-masts, and without a bowsprit.

No. 6.—Abridged Log of the H. C. S. GANGES, *Captain Moffat, reduced to civil time.*

20*th September.*—At noon Lat. 16° 59′ N. Long. 114° 53′ E. wind N.E. by N. Hard gales, severe squalls and thick weather till midnight. Ship standing to the Eastward under treble-reefed top-sails.

21*st September.*—At 1 A.M. the wind, from the courses marked was N.$\frac{1}{2}$W. and N. b W. at 3, continuing till noon when veering to N.N.W. At noon hove to with wind marked N. W. b N. At 1 P.M. under storm stay-sails, the *Coutts* bearing E.S.E. Latitude by indifferent observation and by double altitudes 16° 41′. Longitude per Chron. 116° 31′ E. P.M. wind N.W. by N. drawing round at times, as appears by the log, (for the wind is not marked, and this is deduced from her coming up and falling off,) to W. N. W. By midnight wind increasing to a heavy storm. At 5 P.M. lost sight of the *Coutts.* Staysails blowing to pieces between this time and midnight.

22*nd September.*—At 6 A.M. wind about West, and at 9, W.S.W. At noon wind about S.W. by W. blowing a violent hurricane, ship lying to under the storm mizen only, weather so thick with drift and haze cannot see a ship's length a-head. Lat. double altitude 16° 17$\frac{1}{2}$′ longitude per Chron. 117° 17′, find the drift made by time-keeper from noon yesterday S. E. by E. $\frac{1}{2}$ E. 50 miles. P. M. wind marked as S. W. blowing a violent hurricane, ship lying to under storm mizen staysail and falling off into the trough of a very heavy sea, made sail and bore away. At 4 P. M. steering N.W. to save the masts. At $\frac{1}{2}$ past 5, the fore and main staysails blowing to atoms, got tarpaulins and boats' sails lashed in the weather fore-rigging to keep the ship off the wind, which however aided very little till 9 P. M. when the storm began to abate;

wind not marked, ship running N.W. 27 miles till 8 P.M. then N.N.W. 14 miles till 10, and N. by W. 13 miles till midnight.

23*rd September.*—Wind more moderate, able to steer the ship with safety, though rolling very deep. Steering North 66½ miles, till noon, wind not marked at noon, but S. E. at 1 P. M. At noon weather moderate, heavy confused sea, rolling gunwales in, Latitude 18° 58′ N. longitude by chronometer 117° 45′. Ship having made a course of N. ¾ E. 143 miles since yesterday. P. M. wind S. E. and E. S. E. At 10 P. M. a four knot breeze, the weather having cleared up.

Noon 24*th*—Latitude 20° 40′ N., longitude 117° 41′ E.

No. 7.—Abridged Log of the H. C. S. COUTTS, *Captain Torin, reduced to civil time.*

20*th September.*—Latitude noted as 16° 57′ N.

21*st September.*—P. M. when the log commences, wind marked N. W. by N., hard gales with heavy squalls and a large confused sea. At 10 P. M. wind W. N. W. under fore-sail and mizen stay-sail with head to the North.

22*nd September.*—At 5 A. M. wind West, hard squalls. At 6, marked W.S.W. and at 7, S.S.W. In the observations it is said that at 9 A.M. the wind shifted to the S.W. and moderated until near noon, when it came on to blow again very hard with heavy squalls and rain. No observation or account marked in the log. 1 P. M. wind S.S.W. hard gale increasing to a most violent tyfoon with rain, *lightning*,* and a large confused sea. At 4 P.M. the wind S.S.W. weather fine, shrouds giving way, bore away to save the masts, lost fore-topmast; 7 P.M. lost fore-sail and broached to. At 8, main topmast blew away, at 9, lost the main and mizen masts. At 10, wind marked as South, and at 11, S. by E. Lost the bowsprit.

* The only instance in which lightning is marked in any of the logs of this storm, and therefore probably the only instance in which it occurred; for seamen rarely omit noticing it, particularly in heavy weather, to which it gives such an awful appearance.

23*rd September.*—2 A. M. lost the spare and stream anchors. At 3, the foremast fell into the waist. At daylight moderate; clearing the wreck, and by noon kept on her course under a jury mast. Latitude observed 18° 08′ N. Longitude by Captain Torin's private journal 117° 14′, Wind S. by W. at 1 P. M. when moderate breezes and fair weather. Wind S. S. E. at 10 P. M. and till midnight.

24*th September.*—At ½ past 8, saw two sail to the South, *Camden* and *Bombay Castle.* At noon one ship, *(Camden)* two miles astern. Latitude observed 18° 51′ N. Longitude 116° 52′ E.

To place our deductions from the valuable records of this storm, or storms, in a clear light, I shall preface them, as in my former memoirs, with a synoptical table, shewing for each day the relative positions of the ships, and briefly the weather they experienced.

Tabular View of the Tyfoon of 20th to 23d September, 1803, in the China Seas.

Date, Civil time.	Ship's Name.	Winds and Weather.	Lat. N.	Long. E.	Remarks.
			° ′	° ′	
Noon 20th, Sept. 1803.	Earl Camden, ..	N. N. E. hard gales and squally, ...	15 42	113 41	Increasing and veering to N. by W. by midnight and N. W. by noon on 22d.
	Bombay Castle, ..	N. N. E. strong gales and cloudy.	15 42	113 43	In company with the Camden, winds the same. Lat. on 19th 16° 2′ N.
	Ganges, ...	N. E. by N. hard gales Noon squalls and thick weather, ...	16 59	114 53	Standing to the eastward, wind veering to N. ½ W. by midnight, and N. N. W. by noon next day. Coutts in company.
	Coutts, ...	.. .. ..	16 57	.. ..	No Log for this day, but in company with Ganges.
	Warley, ...	Fine weather, ...	.. ..	.. ..	No Logs for these days, the storm not having commenced with these ships, which were standing in for the Coast of China.
	Royal George, ..				
	Alfred, ...				
Noon 21st Sept. 1803.	Earl Camden, ..	N. W. hard gales, thick squally weather and high sea, ...	15 51	115 27	Wind veering to W.N.W. P.M. and to the westward A.M. 22nd; Bombay Castle in company at noon. Hove to under close reefed main topsail.
	Bombay Castle ..	N. W. by N. blowing very hard with violent squalls,	.. ..	.. ..	In company with the Camden.
	Ganges, ...	N. W. by N. hard gales, thick weather and rain,	16 41	116 31	Noon hove to under storm staysails, wind drawing gradually more westerly & increasing. Coutts in company till 5 P. M.
	Coutts, ...	N. W. by N. The same weather and position, ..	.. ..	.. ..	10 P. M. wind W. N. W.
	Warley, ...	N. N. E. to N. by W. At midnight blowing fresh,	21 17	113 7	Working in towards the Coast of China.
	Royal George, ..	No log for this day, ..	.. ..	.. ..	These two ships I suppose had fine weather with a fresh breeze, as their logs of 22nd begin with the same.
	Alfred, ... :	No log, ...	.. ..	.. ..	

Date, Civil time.	Ship's Name.	Wind and Weather.	Lat. N.	Long. E.	Remarks.
			° ′	° ′	
Noon 22d, Sept. 1803.	Earl Camden, ..	About S. W. storm continues, ...	16 17	116 23	Hove to under storm staysails. Wind has drawn from West at 1 A. M. to SWbS. at noon and South, at 5 P. M. W. S. at 7 after bearing up, and midnight S. S. W. Moderating since noon.
	Bombay Castle, ..	About S. W. by W. the same, ...	.. ..	.. ..	Noon, Camden East 3 miles; at 5, bore up, wind S. W. and S. by E. at daylight.
	Ganges, ...	About S. W. by W. blowing a violent hurricane, thick weather, ...	16 17½	117 17	Excessively thick weather, wind has veered from West at 6 A. M. to S. W. by W. at noon & S. W. P. M., Bore up at 4 P. M. to save the masts.
	Coutts, ...	About S. W. by W. increasing to a violent typhoon.	.. ..	near the Ganges till 4 P.M.	Rain and lightning; 4 P. M., bore away N. N. W. ½ W. with wind S. S. W. ship dismasted by midnight.
	Warley, ...	N. by W. increasing fast,	.. ..	.. ..	By 11 P. M. all the storm staysails blown away.
	Royal George, ..	North, strong gales, ..	21 50	.. ..	At anchor off the Grand Ladrone P. M. increasing fast. Wind N.N.E. at 5 P. M.; N.E. at 9 and to midnight.
	Alfred, ...	North, ...	.. ..	.. ..	Grand Ladrone W. ½ S. swell increasing fast from eastward, working into the anchorage. 4 P. M., anchored 11 P. M. hard gale N. N. E.
Noon 23d, Sept. 1803.	Earl Camden, ..	S. to S. S. W. fine, S.b E. at noon, ...	17 01	117 12	Steering to the North 4 and 5 knots.
	Bombay Castle, ..	As with Camden, ...	.. ..	.. ..	
	Ganges	About S. E. moderate, ..	18 58	117 45	Very heavy and confused sea P. M. wind S. E. and E. S. E.
	Coutts, ...	S. by W. at 1 P.M. moderate,	18 8	117 14	Veering to S. S. E. at 10 P. M.
	Warley...	About E. by S. (but not marked) blowing very hard,	21 15	.. ..	Furious gale, topmasts blowing away, and anchors washed overboard; P. M. veering to S. Eastward.
	Royal George, ..	About East or E. b N. (1 P. M. East) the same weather.	.. ..	.. ..	Strong gales, but moderating from 3 P. M.

Date, Civil time.	Ship's Name.	Wind and Weather.	Lat. N.	Long. E.	Remarks.
			° ′	° ′	
Noon 24th, Sept. 1803.	Alfred, ...	About E. by S. (E. S. E. at 2 P. M.)	.. ..	.. ..	Strong gales, at 4 P. M. made sail.
	Earl Camden, Bombay Castle,	Fine, all sail set, ...	18 48	116 9	
	Ganges, ...	Fine, the same, ...	20 40	117 41	Sea very irregular, steering to the N. N. W. since daylight.
	Coutts, ...	Fair, light winds from S. E., E.S. E.	18 51	.. .	
	Warley, ...	Just making sail. Wind not marked, supposed S. to S. S. E.	20 15	.. ..	
	Royal George, .. Alfred, ...	Fine, ...			

I now proceed to the deductions to be drawn from the foregoing documents, but before I do so, I should remark, for the information of those unacquainted with the fact, that the East India Company's China ships were, though merchantmen, vessels of from 12 to 1400 tons, mounting upwards of thirty guns, with crews and officers in proportion, and these last in their day, men of the first acquirements and talents in their profession. When we find, therefore, that such ships, well found and managed as they were, suffered so much from the storm, we must recollect that their logs express pretty nearly what a good Frigate or sixty-four gun ship of the old times, would have found it: Weather in which smaller merchant vessels would have been reduced much sooner to bare poles.

It is evident from the inspection of the tables, that one of the storms was travelling from the South-eastward to the North-westward, for it began on the 20th with the *Camden, Bombay Castle, Ganges,* and *Coutts* close to the Eastern edge of the Macclesfield bank, six degrees South of the entrance of Canton river, while near the Coast of China, the ships were standing in for it with fine weather.

The table of the 20th, it will be seen, gives two directions of the wind for the Southern storm, N. N. E. for the *Camden* and *Bombay,* and N. E. by N. for the *Ganges.* Taking these as tangents, and projecting carefully for the centre of the storm from the ships' positions, they will be found to place it about the Island of Mindoro, or S. E. by E. $\frac{1}{2}$ E. of the ships, distance 380 miles. Perhaps the centre was not really so far off, as, the angle being so acute, considerable error may occur, but this is quite evidence enough to show, that the storm *did* commence to the E. S. E. of this part of the Fleet. I have not therefore marked a centre for this day, but carried the Track from that quarter.

On the 21st, there was still fine weather on the Coast of China, but with the southern division of the fleet, the storm by noon was so heavy as to bring them under close reefed top-sails with top-gallant masts and yards down, and all other preparations for bad weather. It should be noticed that these four ships of the southern division form again two smaller divisions. The *Camden* and *Bombay Castle* together, being just to the Eastward of the Macclesfield, and the *Ganges* and *Coutts,* also in company with each other, about eighty miles to the E. N. E.

of them. The winds marked in these ships' logs* both place the *centre* to the N. E. b E. of them, and as we have no cross bearing by which to lay down the distance of it, we can only do so by judging of the force of the wind, and its veering ; which with the ship farthest to the Eastward, the *Ganges*, (for we have not the log of the *Coutts* for this day, though we know she was in company with the *Ganges*) was not quick ; the wind having remained about N. W. by N. from midnight. Allowing then for the ship's drift, and for the increasing violence of the storm on the 22d, I have placed the centre at noon this day in latitude 17° 36′ N. longitude 118° E.

For the 22d, we find, that to midnight on the 21st, and to 5 A. M., on the 22d, and with the *Ganges* and *Coutts*, the wind held steady to the N. W. when it drew round to West and S. W. at noon. The log of the *Bombay Castle* shews nearly the same veering, but that of the *Camden*, marks the wind at West at 1 A. M. ; and the *Bombay Castle*, from her coming up to N. N. W. at 3 A. M., appears to have had the wind also not far from West at this time, though both ships' logs agree nearly enough at noon ; when the *Camden* seems to have had it S. W. by S., and *Bombay* about S. W., *Ganges* about S. W. and *Coutts* S. S. W. as far as can be judged from their logs. The drift of these two last vessels is laid down for the twenty-four hours between noon, 21st and 22d in the *Ganges*' log, which is most carefully kept,† as S. E. by E. $\frac{1}{2}$ E. fifty miles.

* I may notice here in strong corroboration of many of my remarks in these memoirs, the difficulty of analysing a storm from the direction of the wind considered as a tangent line to the supposed circle of it, and the ship's position as the point at which the tangent touches the circle. Thus we have, in the logs of the *Camden* and *Bombay Castle*, within three miles of each other, the wind marked as follows : for the 21st *Camden* at 2 A.M. N. N. W., *Bombay Castle* at 3, N. N. W. *Camden* at 3, N. W. by N. *Camden* at 9, N. W. by W. ; at 11 N. W. *Bombay Castle* at noon N. W. by N. and at 1 P.M. N. W. by N. *Camden* at 1 P.M. W. N. W. *Bombay Castle* (hove to) at 6, wind N. W. and so forth. It is clear that these variations arise partly from carelessness, and partly from errors in judgment in such severe weather. I shall perhaps be told here that I am looking for mathematical exactness where none can exist. I am, I own, seeking for all the exactness which can be obtained, and I desire that all our evidence should be fairly brought forward on this most important question, that it may be impartially weighed by all as well as by ourselves, and that we may not be said to have assumed any thing without giving our grounds for so doing.

† With the exception of the direction of the wind which is very frequently omitted either in the log, or by the copyist.

Now this circumstance of the wind holding steady to the N. W. for seventeen hours, and then veering rapidly, or within about eight hours, the remaining eight points, or a point an hour, till it reached the S.W. is worthy of note; particularly if we look at the drift of the vessels to the E. S. E. and N. E., according to their logs, (though in these there are some slight discrepancies and omissions, and some apparent assumptions,*) and remark the increased violence of the wind before and after noon on this day, shewing either that the storm had been really now forming, or stationary, or curving as I have laid it down. Giving this every consideration I cannot avoid concluding, that the storm, which had apparently come up from the S. E. by E., under the lee of the island of Luconia, having arrived opposite the great opening to the Pacific Ocean curved to the Westward, as I have marked it, in its progress over to the entrance of the Gulf of Tonkin; influenced perhaps by the prevalence of a N. E. wind from the Pacific. The circumstance of its altering its direction so considerably from that which it had under the lee of the very high land of Luzon, is not more extraordinary than the curves which, we know, occur in the Western hemisphere, and some about the Isle of France in our own. The storm indeed may have been really a Pacific Ocean storm, forcing its way across Luconia, from the coast of which the ships were but little more than 200 miles distant? If this was the case, we may suppose the anomaly easily accounted for. I have then, on these considerations, marked the centre for the 22d, as in latitude 17° 20′, longitude 115° 16′ E. and bearing N.W. by W. $\frac{1}{2}$ W. from the *Ganges* and *Coutts*, (which had the wind from S. W. by S. and S. S. W.) and N. W. from the *Camden* and *Bombay*, which had the wind S. W. by W. and S. W. by S. We have still the anomaly, that the *Coutts* and *Ganges*, seem, by the expressions used in the logs, to have had the wind more violent than the *Camden* and *Bombay*, but I suspect that these latter ships were really much farther to the S. E. than their positions shew, for the wind was from W. N. W. and West the

* Such as longitude marked "by chronometer" on the noon of the 22d. In weather like that then prevailing very little dependence can be placed on sights for chronometer or double altitudes, for it is said, "at noon blowing a violent hurricane, weather so thick with the haze and drift cannot see a ship's length a head. What is meant is probably the chronometer brought on by dead reckoning, but this should be noticed.

greater part of the twenty-four hours, and their drift made good in such weather, could scarcely be better than East at most. I have however given the evidence as it stands.

For the centre of the 23d we find that the *Coutts*, bearing up with the wind at S. S. W. a little after noon on the 22d, was utterly dismasted by the violence of the hurricane, by 4 A. M. on the 23d, and that at daylight it was moderating. She steered N. N. W. $\frac{1}{2}$ W. when she bore up, and ran for 31 miles on this course before she broached to. The centre of the hurricane bore at noon 22d, as we have shown, about N. W. by W. $\frac{1}{2}$ W. from her, and it was certainly travelling to the westward, so that the *Coutts*, steering N. N. W. $\frac{1}{2}$ W. and drifting when dismasted between W. S. W. and W. N. W. was pretty nearly *chasing* it! and its rate of travelling does not seem to have been high. The *Ganges* also bore away, but two hours later, and she fortunately did not reach so far towards the centre as the *Coutts*. The storm, as I have remarked, does not seem to have moderated till about day-light, on the 23d, with the *Coutts*, while it moderates at 9 P. M., on the 22d with the *Ganges*. I have taken the centre of this day, the 23rd, to be in about lat. 17° 40′ N., long. 112° E.

The *Camden* and *Bombay Castle* also bore up about 3 P. M., but as they were going only four-half and five knots, and had the weather moderating from that time, they may almost be considered as out of the storm.

If we now refer back to the table and logs, we shall find that between noon and midnight of the 22d, the wind on the Coast of China was setting in for a gale there, which may be fairly said to have begun at 10 A. M. on the 22d, with the *Warley*, which ship was then about on the meridian of St. John's, in thirty fathoms, or twenty five miles off shore.

She had the wind at N. by W., and with but little variation it continued to hang about thus, or North, (judging from her coming up and falling off,) till 4 A.M. on the 23d.

With the *Royal George*, at anchor under the lee of the Grand Ladrone, it also may be said to have commenced at the same time. She marks the wind at North, and the *Alfred*, at anchor farther in amongst the shelter of the Islands, had the swell rising from the

Eastward, and the wind North increasing to hard gale at N. N. E. at midnight, when she cut and stood to sea.

With every allowance for the effect of the high land on the vortex, we cannot I think suppose this storm to be the same, which was also at noon on the 22d blowing with such fury from S. W. by W., as to dismast the *Coutts,* &c. a few hours later; for the centre of the southern storm by 3 P. M. must have been bearing S. by E., at most, if not South from the Grand Ladrone, which, if the storms were the same, would make the wind *East* then; and it was not even E. N. E. with the *Alfred* and *Royal George,* till about 3 A. M. on the 23d, or 15 hours later! I think this a convincing proof that there were two storms, and have therefore laid down two Tracks for them, taking the northern storm to have travelled from the N. 62° E. to the S. 62° W. at about 60 or 70 miles distance from the coast, which will be found to agree well with the logs of the ships, though there may be some discrepancy with that of the *Warley,* but, first, we can only guess at the wind, from her coming up and falling off, next she was nearly or quite unmanageable, and lastly she was half embayed in the gulf between the N. E. point of Hainan and the coast of China, where the storm must have felt the effect of the high land on both sides.

The rate of travelling of these two storms is next to be considered. We can hardly assign any fixed centre for the Southern storm on the 20th, though we know the direction in which it lay, those of the 21st, 22nd, and 23rd, however, are sufficiently ascertained, I think, for us to suppose that the storm may have travelled about 150 miles between the 21st and 22nd, and about 180 miles between the 22nd and 23rd. We may allow a mean rate of about seven miles per hour, or 168 miles in the 24 hours, for these two days.

For the Northern storm we can scarcely assign any rate, for the distance of the centre on the 22nd is quite uncertain, as it is also on the 24th, so that we have no data for it. Taking about the same rate, as that of the Southern storm, or 168 miles per day, it will however, be seen, that this is not an improbable one for it.

I trust that those who may have followed me in this, perhaps somewhat prolix, detail, will remember, that I have given it for the purpose of showing how I have taken the evidence before us; for

we have no right to lay down tracks for storms, however well *we* may be satisfied that they are not far from the truth, without also shewing, for the use of others, how we arrive at our conclusions. Both storms tending as they evidently did to the Southern entrance of the Gulf of Tonkin, formed there on their South-western quadrants one of the " heavy N. W. storms blowing out of the Gulf of Tonkin," of which Horsburgh speaks. There were no Barometers apparently with any of these ships.

TRACK No. V.—1809.

The True Briton's *Storm.*

Documents from the India House.

On the 28th and 29th September, 1809, the Hon'ble Company's ships *True Briton, Scaleby Castle, Cumberland* and *Neptune,* experienced a tremendous tyfoon, between latitudes 20° and 21° North, and longitudes 113° and 114° East, or about 100 miles from the Coast of China, in which the *True Briton* foundered, and the other ships experienced severe damage. I abridge here, first, the logs of the ships, and then, placing them in the tabular form, shall make a few observations to explain the deductions from which I have laid down the Track of the storm.

Abridged Log H. C. S. Cumberland, *Capt. Wedderburn, reduced to civil time.*

27*th September.*—At noon in latitude 19° 47′ N., mean longitude of the fleet 114° 43′ E. Light airs from N. N. E. to West till midnight; the fleet in company. Much lightning to the Westward. Standing to the Northward; wind West at midnight.

28*th September.*—At 9 A. M. wind from N. N. W., fleet standing to the North Eastward, four and five knots. At noon, latitude by account of the fleet 20° 51′, longitude of the fleet 114° 54′ E. Barometer 29.13. Thermometer 81°, freshening, cloudy and squally. P.M. a very hard gale from N. N. W.; veering at 9 P. M. to N. N. E. blowing during the night, " with inconceivable fury ;" the boats, the fore-sail and other sails blowing away piecemeal at midnight.

29*th September.*—Weather continuing, lost the small bower anchor, ship under bare poles at 2 A. M. At 10 A. M. wind S. E. At noon latitude 20° 33′, longitude 114° 54′. Barometer 28.65. Thermometer 81°, P. M. wind E. S. E., at 11, East.

30*th September.*—Moderating apparently about midnight, but the log very imperfectly kept. 9 A. M. wind S. E. by E. Noon latitude 20° 58′ N., longitude 112° 15.′ Barometer 29.20. Thermometer 79°.

1*st October.*—"No observation," is the only record given for this day, by an oversight of the copyist no doubt.

Abridged Log of the H. C. S. Scaleby Castle, *Captain John Loch, reduced to civil time.*

27*th September*, 1809.—At noon in latitude 19° 48′, mean longitude 114° 43′. 5 P. M. light airs and calm at midnight.

28*th September.*—A. M. "the weather with rather a threatening appearance, though the Barometer has not fallen a great deal." At noon it is remarked again: "The Barometer fell in the last 12 hours from 29.85 to 29.50, but after the gale commenced, it fell very fast." At noon lat. 20° 55′ long. 114° 54′, wind N. N. W. P. M. N. N. W. to N. b E. at 10 P. M. From noon the gale freshened with squalls; by 2 P. M. a fresh gale, 5 P. M. blowing very hard, and by 9, "a most tremendous hurricane." At midnight boats and sails blowing away, wind marked N. E. by N.

29*th September.*—1 A. M. wind East, at 5 E. S. E., at noon not marked. Of the Barometer it is said: "The Marine Barometer began "to fall fast after 4 P. M. but before that it was not very low. Towards "midnight it had fallen to 28.30, where it continued for near 24 hours. "This was the lowest I ever saw the Barometer. The hardest of the "gale was about 2 A. M. Noon lat. account 20° 26′, long. account "114° 37′ E., wind E. S. E." Violent gale still continuing with a high sea, but began to moderate towards noon. At 5 P. M. saw a ship bearing East, with loss of mizen-mast and fore top-mast, which is supposed to be the *Neptune*. Wind E. S. E., At midnight hard squalls, ship lying to; wind S. E. since 9 P. M.

30*th September.*—Wind S. E. at day-light, and till noon. "The Barometer began to rise after daylight." Noon, latitude account 20° 21′

longitude chronometer 111° 34′, shewing *a difference of* 111 *miles! from the longitude by account.*

1*st October.*—No log given.

Abridged Log of the H. C. S. Neptune, *Captain W. Donaldson, reduced to civil time.*

27*th September.*—Noon latitude 19° 51′; in company with the fleet, winds variable and calm at midnight.

28*th September.*—At 4 A. M. lightning to the N. W., at 6 W. N. W., at noon no observation, but latitude and longitude nearly that of the other ships being in company. At noon a fresh breeze with thick rainy weather, increasing at 1 P. M. to a fresh gale N. N. W. At 5, hove to under storm stay-sails, wind North. At 6, the fleet pretty close, dark gloomy weather, gale increasing fast, with a heavy cross sea striking the ship very hard; at half-past eight, lost the mizen mast, wind about N. E. at midnight.

29*th September.*—At 4 A. M. wind East with violent gusts; at 6, E. S. E. lost fore topmast, got the main yard on deck; at noon wind about S. E. by E. Noon no observation. P. M. wind S. E. by E. Hard gales, thick weather and high sea; all hands at the pumps; at 10 P. M. wind S. E. to midnight.*

30*th September.*—A. M. wind S. E. at 10 S. E. by S., ship on her beam ends throughout the storm. Noon no observation. P. M. S. E. hard gales till midnight, when moderating.

1*st October.*—8 A. M. wind S. E. wore and made some sail at daylight; 12 hours log only given. At noon, latitude by indifferent observation 20° 48′ N.

A letter from J. B. Burnett, Esq. a Midshipman in the *Scaleby Castle* at the time of this storm, is also added to the documents from the India House, as follows. It is dated Monboddo, 6th November, 1841:—

"The account of that remarkable tyfoon, in which the *True Briton* perished, lies before me. I was then a Midshipman in the *Scaleby Castle;* the *True Briton*, *Neptune*, and *Cumberland* in company. At

* The *Neptune's* Barometer is not marked in the extract sent me, but we learn from Horsburgh, vol. ii. p. 267, that it fell in this storm from 29.85 to 28.30.

noon of the 28th September, 1809, civil time, we were in lat. 21° N., and long. 115° E. nearly, and in 64 fathoms water, running for the Lema Channel. After noon, the barometer, already low, fell fast, and the gale came on rapidly, beginning at the N. N. W., and gradually veering round towards midnight to N. N. E., at which time it attained its greatest fury, and blew a hurricane. At 4 A. M. it veered round to East, and very gradually to E. S. E., and last of all to S. E., at which point it moderated, after continuing with great violence for nearly 48 hours. I do not remember whether it was on the full or change of the moon. The sky was dark and lowering, and the drift of the sea so thick and heavy, that we could see nothing, and lay like a log absolutely helpless. The force of the wind may be inferred from the fact, that the bights of our main top-mast staysail were blown away from between the turns of the gaskets, and small double pieces of canvas out of the clues of the topsails, as they hung below the yards. The *True Briton* was never more heard of, and the other ships were all more or less roughly handled."

I now give the tabular view as before, and then the grounds upon which I have assigned the track laid down.

Tabular View of the Tyfoon of 28th to 30th Sept. 1809 in the China Seas.

Date.	Ships' Names.	Winds and Weather.	Lat. N.	Lon. E.	Bar.	Ther.	Remarks.
			° ′	° ′			
Noon 27th Sept. 1809.	H. C. S. Cumberland,	Light airs N. to West till midnight, ...	19 47	114 43	..	..	Much lightning to the Westward.
	Scaleby Castle, ..	The same, ...	19 48	114 43	..	..	The fleet in company.
	Neptune, ...	The same, ...	19 51	114 43	..	..	
Noon 28th Sept. 1809.	H. C. S. Cumberland,	N. N. W. at 9 P. M. hard gale N. N. W.	20 51	114 48	29 13	81	Gale veered at 9 P. M. to N. N. E. At midnight boats blown away piecemeal.
	Scaleby Castle, ..	N. N. W. P. M. N. N. W.	20 55	114 48	..	..	Bar. fell in 12 hours from 29.85 to 29.50, but afterwards very fast; by 9 P. M. tremendous hurricane, midnight N. E. by N.
	Neptune, ...	The same, ...	20 53	114 48	..	..	1 P. M. N. N. W. 5 wind North, ½ past 8 lost the mizen mast, N.E. at midnight—N. B. the fleet had now separated.
Noon 29th Sept. 1809.	H. C. S. Cumberland,	10 A. M. S. E. hurricane,	20 33	114 54	28 65	81	P. M. E. S. E. at 11 East, lost small bower.
	Scaleby Castle, ..	1 A.M. East, 5 E.S E. Noon E. S. E. hurricane 5 P.M. E. S. E., 9 S. E.	20 26	114 37	..	..	Bar. 28.30 at midnight, began to moderate towards Noon.
	Neptune, ...	4 A. M. East, 6 E. S. E. Noon S. E. by E. and S E. midnight.	.. ..	.. ..	..	..	Lost fore-topmast.
Noon 30th Sept. 1809.	H. C. S. Cumberland,	9 A. M. S. E. by E. moderating.	20 58	112 15	29 20	79	
	Scaleby Castle, ..	S. E. at Noon, and from daylight.	20 26	111 34	..	..	Barometer began to rise after day-light.
	Neptune, ...	A. M. and P. M. hard gales, ...	No Obs.	No Obs.	..	..	Ship on her beam ends, but moderating a little at midnight.
Noon. 1st Oct. 1809.	H. C. S. Cumberland,	No log, ...	.. ..	.. ..	..	..	
	Scaleby Castle, ..	No log, ...	.. ..	.. ..	..	..	
	Neptune, ...	8. A.M. S. E.	20 48	.. ..	..	..	10 A. M. Wore, *Scaleby* to the North.

For the first part of this storm we may speak of the fleet as one ship, being closely in company. I shall latterly, of course, separate my remarks, as the ships themselves were separated. It appears from the logs that from noon to midnight on the 27th, they made a little Northing with the variable winds, and on the 28th, from midnight to 4 P. M. when they hove to, they were going from two to six knots to the north, making a difference of latitude of 64 miles in the 24 hours, but no Easting. This northing was an important circumstance, for the storm had fairly commenced at daylight on the 28th, when the remark in the *Scaleby Castle's* log is, "A. M. At this time the weather had rather a threatening appearance, but the Marine Barometer had not fallen a great deal." The wind was at N. N. W. and N. by W. at 9 A. M. with the *Cumberland,* and it is marked at N. N. W. at noon, with all three ships. We may thus take the centre of the hurricane to be bearing E. N. E. from the fleet at this time: we have no means of ascertaining at what distance.

From about 4 P. M. on the 28th, the ships were lying to on the larboard tack in a severe gale rising to a hurricane, with the wind veering from this time, when it was N. N. W. to N. by E. and N. N. E., and N. E. by N. At midnight N. E., then East and to E. S. E. by 5 P. M. with some, and finally S. E., by noon on the 30th with them all. Some variations as to the times of veering occur of course, for to say nothing, in such weather of log board and of copying inaccuracies, the ships were now separated. We may however say, that in the 44 hours between 4 P. M. 28th and noon of 30th, the wind veered from N. N. W. to S. E. or 14 points; or a point in 3 hours. It was then clearly a hurricane passing close to the southward of the fleet, which was drifting back to the Southward, South-westward, Westward and North-westward, or round the curve of its North-western and North-eastern quadrants, and from its extreme fury, their position with respect to its centre, as above stated, and the fall of the Barometer to 28.30, where it remained for 24 hours according to the *Scaleby's* log, we may safely suppose that they were at no great distance from the centre of it, and the unfortunate *True Briton* being probably a more leewardly vessel, was carried farther to the South by

the Northerly part of the gale,* and therefore near to or *into* the centre.

I have therefore marked for this storm a track from N. 60° E. towards S. 60° W., or about N. E. by E. to S. W. by W. and between the Pratas Shoal, and the edge of soundings, which will allow the ships to have been about 50 miles from the centre of it. The curious circumstance of the great Westerly drift again occurs in this as in the *London* and *Warley's* storms, shewing clearly that the storm wave, or storm current was carrying the vessels with it with great rapidity. The *Scaleby's* log it will be noted, says 111 miles between noon of the 28th, and noon of the 30th, or 48 hours. They undoubtedly made every allowance before coming to this conclusion, and their chronometers were corrected, if any error existed in them, by their arrival in a few days in China. The impression there evidently was, that the *True Briton* might have been lost by this current carrying her on to the Coast of Hainan, or amongst the shoals in the strait between Hainan, and the Coast of China ;† for we learn from Horsburgh, p. 328, vol. ii. that in April 1810, Captain D. Ross, then surveying the China seas, was sent down to the Coast of Hainan in search of her. I shall notice more at length this remarkable current at the conclusion of these memoirs.

TRACK No. VI.

Tyfoon of 20th to 30th September, 1810.

Documents from the India House.

On the 28th to 30th September, 1810.—The *H. C. S. Arniston, Wexford, Alfred, Winchelsea, Elphinstone, Woodford,* and *Cuffnells,* bound to China, experienced a severe tyfoon in the China seas. The following are the abridgements of their logs :—

* Every seaman is aware how some vessels, in a fleet both Merchantmen and Men of War, though holding a good wind in average weather, will become much more leewardly than others, when the force of a storm depresses them beyond a certain bearing.

† The ships in this storm were all drifted close to these Shoals, as will be noted by their latitude and longitude on the 30th.

Log of H. C. S. ARNISTON, *Captain S. Landon, reduced to civil time.*

At noon, 27th September, 1810.—Latitude 17° 43′ N., long. 115° 9′ E. P. M. moderate breeze E. N. E., and hazy weather, at 3 P. M., wind N. E. At midnight strong breeze from N. N. E. with a heavy swell from the N. E.

28*th September.*—Increasing from the same quarter, ship by noon under storm staysails, latitude by account 17° 6′ N., longitude 115° 4′ E. P. M. very threatening sky and blowing very heavy; high sea rising, wind N. by W. to North till midnight.

29*th September.*—After midnight "wind veering round to the South." At 3 P. M. wind about N.N.W. by 4 about West, by 5 about S. S. W., from daylight to noon blowing most violently from South and S. S. W., with a prodigious high sea running, 6 A. M. wind marked S. by W. Noon no observation. 1 P. M. wind South, gale moderating and sea falling. At 10 P. M. wind S. E. On the following morning at daylight bore up and made all sail.

Log of the H. C. S. WEXFORD, *Captain W. S. Clarke, reduced to civil time.*

26*th September,* 1810.—Latitude 17° 13′ N., longitude not given, but nearly that of the fleet with which she was in company. 1 P. M. wind N. E. by N. Heavy clouds, squalls and rain. 2 P. M. thickening sky to the East, squally and unsettled from this to sun-set, *when it began to disperse.* 8 P. M. wind N. E. Lightning and thunder to the Northward, *the night fine* and moderate.

27*th September.*—A. M. Easterly wind with hazy weather E. by N., at 7 E. N. E., fleet standing to the northward against a heavy head swell which occasioned them to pitch deep at times. Noon latitude 17° 41′ N., longitude (of the fleet) about 115° 11′ E.* P. M. wind E. N. E. hazy weather, 5 N. E., 7 N. E. by N., blowing fresh with small rain, preparing for a gale ; heavy head sea.

28*th September.*—2 A. M. wind N. by E. Squally and increasing. Noon N by W. latitude 2 alt. 17° 6′ N., longitude 115° 58′ E. Fleet

* The mean of 4 ships not greatly differing. The Chronometer of the *Cuffnells* is omitted in the average as being evidently 30 miles too far East; she was closely in company.

much scattered. P. M. wind North. 3 P. M. hove to under storm staysails, 5 wind N. N. W. Hard gale with very hard squalls till midnight, when about N. by W.

29*th September*.—2 A. M. N. W. by N., 4 N. W., by W., 5 S. W. and at noon S. S. W., heavy seas breaking over the ship from daylight till noon, " when it blew a perfect hurricane." P. M. wind South, hove to under trysail. Wind about South till midnight, when moderating.

30*th September*.—Bore up and out all reefs at daylight. Noon, latitude 18° 24′ N.

Abridged Log of the H. C. S. ALFRED, *Captain Welstead, reduced to civil time.*

26*th September*, 1810.—Noon, latitude and longitude that of the fleet. Variable winds from N. E. to N. W. till midnight.

27*th September*.—To noon letting out reefs. Lat. 17° 45′, long. of the fleet 115° 12′. Bar. 29.95. Ther. 81°. P. M. N. E. by E. hazy; high sea from N. E.

28*th September*.—1 A. M. wind N. N. E. At 11 A. M. North, preparing for bad weather. Noon latitude 17° 27′, longitude of the fleet 116° 0′ E. Bar. 29.65. Ther. 82°. P. M. Wind N. N. E., 3 P. M. hove to, increasing storm till midnight. Wind veering to the South.

29*th September*.—A. M. Severe tyfoon. 5 A. M. wind marked S. W. and at 8 S. S. E. Saw a ship (supposed the *Elphinstone*) bearing away before the wind. Noon blowing furiously from South. Lat. account 17° 31′ N. Bar. 29.575. P. M. S. S. E., strong gale till midnight, moderating at 7 P. M.

30*th September*.—At daylight made sail with wind at S. W., noon latitude 18° 30′, longitude 116° 30′. Barometer 29.875.

Abridged Log of the H. C. S. WINCHELSEA, *Captain The Hon'ble Hugh Lindsay, reduced to civil time.*

26*th September*, 1810.—Latitude 17° 33′ N., longitude 115° 16′ E. variable winds N. Easterly till midnight.

27*th September*.—6 A. M. E. N. E. light winds, steering to the Northward, latitude 17° 47′, N. longitude 115° 14′ E. Barometer 29.92. Thermometer 81°. P. M. E. N. E. fine weather, but increasing breeze N. E., at 5 P. M. N. E. by N., at 9 high sea from the N. E.

28*th September*.—2 A. M. N. N. E. increasing; making all preparations for bad weather. Noon latitude 17° 30′ N., longitude 116°. Barometer at 8 A. M. 29.80, noon 29.70. Thermometer 80°, 1 P. M. hove to, wind about N. N. W. but not marked, blowing excessive hard. Barometer 11 P. M. 29.20.

29*th September*.—4 A. M. West, 6 A. M. S. W. bore up, and ran 36½ miles to the N. N. W. and N. by W., hove to again at 10. Noon blowing excessively hard from South; latitude account 17° 36′ N. N., longitude by account and D. R. 116° 11′ E.* Barometer 10 A. M. 29.23 ? Noon 29.36, 5 P. M. wind S. by E., gale moderating, and sea much fallen, at 8 S. S. E. 6 P. M. Barometer 29.65. Bore up at 7 P. M. and ran 6 and 7 knots till midnight, steering N. by W.

30*th September*.—By midnight fair, at noon fine, and had run from 7 P. M. on the 29th to noon 30th 119 miles N. by W. and N. by W. ½ W. Latitude observed 19° 54′ N. longitude chronometer 116° 00′ E. Barometer 6 A. M. 29.80, noon 29.90.

Abridged Log H. C. S. ELPHINSTONE, *Captain M. Craig, reduced to civil time.*

27*th September*, 1810.—Noon, latitude 17° 41′ N. longitude 115° 6′, P. M. fine and variable from E. N. E. to N. N. E. till midnight.

28*th September*.—5 A. M. N. by E. preparing for bad weather. Noon latitude 17° 16′N. longitude chronometer 115° 53′ E. P. M. strong gales N. by E. with hard squalls, 3 P. M. wind N. W. by N. At 5 North, and at 10, N. by W.

29*th September*.—1 A. M. wind N.N.W. at 3 W.N.W. at 5 S.S.W. at 6 South, at 9 S. by W. at 6 A. M. bore up under fore staysail to look for the Commodore, and ran North five miles. At 8 saw two ships to

* The Log worked back from the 30th gives latitude 17° 46′, longitude 115° 35′, and as she was going free most part of the time, it is far more likely to be correct than a dead reckoning brought forward through the storm

the S. W. lying to, hove to again. At ½ past 9, one bore up across us, gale much increased since daylight. At 10, bore up again, steering North 10½ miles. At 11, fore staysail blew to pieces, sea prodigiously high, rapid, and violent, hove to again, several seas breaking over the ship; set mizen storm stay-sail which blew to pieces, much water between-decks. Noon, water increasing fast, set the weather clue of the fore-sail to wear, but it blew to pieces; latitude by log worked back from 30th 18° 4′, longitude 115° 22′ N. P. M. "an inconceivable increase in the fury of the storm and violence of the waves, ship almost water-logged, apparently settling fast. At half-past one, cut away the mizen-mast, but the ship not wearing, yard arms in the water, and being deadly water logged, cut away the main-mast at ¼ before 2, when she paid off, though she heeled gunwales in; hove the starboard upper guns overboard. All hands at the pumps, steering N. E. At 10 P. M. wind S. by E.

30th September.—At 5 A. M. steered North for an hour, but hauled up again to N. E., moderating gradually. Noon latitude 19° 05′ N., longitude chronometer 116° 26′ E.

No farther logs are given, but the ship had afterwards fine weather like the rest of the fleet.*

Abridged Log of the Hon'ble Company's Ship WOODFORD, *Captain John Martin, reduced to civil time.*

26th September, 1810.—Latitude 17° 30′ N., winds light and variable from N. b E. and N. N. E., at midnight very black to the N. N. E.

27th September.—A great head sea N. E., out all reefs, noon latitude 17° 40′ N. Barometer 29.80. Thermometer 82°. P. M. wind E. by N. and N. E., at 8 P. M. fresh breeze increasing.

28th September.—Increasing from midnight, at noon hard gale, three ships only to the N. b E. in sight. No observation. Barometer 29.20. Thermometer 82°. P. M. wind North and N. b W. very hard gale to midnight. At 2 A. M. wind veered to W., at 4 to S. W., set mizen topsail and foresail, and bore up, steering North, but at 6 it

* The Barometer is not marked in the extract sent, but we learn from Horsburgh, Vol. ii. p. 267, that it fell in this storm from 29·85 to 28·30.

came on to blow with such dreadful violence from S. S. W. that they were taken in, and the ship scudded* under storm fore staysail. At 11 hove to under the trysail. Excessive hurricane of wind, with very thick rain and heavy sea. This ship ran from a little before 5 to 11 A. M. 27½ miles to about the N. W. b W. Noon Barometer 29.20. P. M. wind South, blowing a hurricane, at 9 P. M. South, and moderating at midnight.

29th September.—At 5 A. M. wind South, bore up and ran 29½ miles to the North, and at noon, saw four ships of the fleet from the masthead bearing S. E. At noon latitude 18° 37′ N. longitude chron. 115° 51′ E. Barometer 29.70. Thermometer 80°.

Abridged Log of the H. C. S. CUFFNELLS, *Captain Welbank, reduced to civil time.*

27th September, 1810.—Latitude 17° 46′ long. of the fleet 115° 12′† P. M. the winds and the weather as with other ships E.N.E. and N.E.

28th September.—Making all snug, noon increasing gale, latitude account 17° 12′ N., longitude 116° 0′. E. P. M. wind North, and N.N.W. towards midnight and *moderating.*

29th September.—The sea log says "middle part," (which is here from 8 P. M. 28th to 4 A. M., 29th) the wind *moderated,* and drew gradually round to the N. W., S. W. and S. S. W., when it increased to a hurricane with a high sea from the West, thick spoon-drift; wind marked S. W. at 3 A. M., and S. S. W. at 11. 1 P. M. S. S. W. and at 9 also S. S. W.; at 7 bore up, wind South, and ran 29 miles to the N. b W.; three ships in sight, *Wexford, Alfred,* and *Arniston.* Noon latitude 18° 30′ N., longitude 116° 42′ (properly 116° 12′.)

This fleet generally was so close together that it does not seem necessary to give any tabular view of the winds and weather at noon. I shall therefore only state here the views which induce me to lay down the track in the direction which I consider that of the storm.

We find that before noon on the 28th, these fine ships were sending down top-gallant yards and masts, so that we may fairly say the storm had then commenced. With two ships at 1 P. M. the wind is marked

* This is written *lay to* in the extract, but is evidently an error.

† See note at p. 633.

at North, with three at N. by E. and with one at N.N.E., but as they were dispersed over perhaps eight miles of distance this might occur. We shall not be far wrong if we take the wind to have been N. b E. for this time for the whole fleet, which it will be observed also, was upon the larboard tack standing or rather drifting to the Eastward and Southward. The centre of the storm at this time would then bear about E. b S. of them.

By 12 on the following day the wind which had veered rapidly to the N. W., West, and S. W., shewing that the centre had passed close to the Northward of them, was

With the	*Cuffnells*, ...	S. S. W.
„	*Woodford*, ...	South,
„	*Elphinstone*, (about) ..	South,
„	*Winchelsea*, ...	South,
„	*Alfred*, ...	S. S. E.
„	*Wexford*, ...	South,
„	*Arniston*, ...	South,

but as they were now much dispersed, we may take South to have been the limit of the change within the 24 hours, or 17 points, *i. e.* from N. b E. to S.

The projection of this, with due allowance for the drift, which was round the S. Western and S. Eastern quadrants of the storm circle, and without forgetting that with the ships which were farthest to the Northward the wind was at 8 P. M. S. S. E., will give about a track from the E. b N. to W. b S. for the storm, and I have so marked it.

The distressed state of the *Elphinstone*, which was at one time as near foundering as possible, and the extreme violence of the wind recorded in her log, was evidently owing to her having, by bearing up, ran and drifted more to the North-west than she appears to have done by the mere log. The *Winchelsea* also bore up, as did the *Woodford*, but neither of them had the wind so violent as the *Elphinstone*. This is accounted for by working back their logs, which though always, (and particularly with the *Elphinstone* in this case), an imperfect record, is still the only authentic one. From this it appears that both the *Winchelsea* and *Elphinstone* had an observation, and sights for chronometer on the 30th, and the logs worked back to

noon of the 29th place the *Elphinstone,* then, at least 22 miles to the N. W. of the *Winchelsea ;* which was of course 22 miles nearer to the centre of the storm, and it is at this time that her log speaks of the " most inconceivable increase in the fury of the storm." If then, judging from some of my former memoirs, in which by means of two or more shore or ship observations we can in some degree judge of the violence of the wind at given distances from the centre, we can make any estimate of the actual measured distance of the *Winchelsea* from the centre, and call it at most 40 miles? the 22 miles farther to the N. W. of the *Elphinstone's* probable position would then place her exceedingly close to it. We do not know in what ratio to the distances from the centre the violence of the wind augments, but it is evident, here, that the short distance was of such import, that it nearly involved the loss of the ship! I need not say how important this lesson is to the seaman, teaching him not to allow himself to be tempted by a fair wind into bearing up too soon, when it is not of actual necessity that he should do so.

TRACK No. VII.

Tyfoon of H. M. S. Theban and Fleet, *8th and 9th Sept.,* 1812.

Documents from the India House.

8th and 9th September.—His Majesty's Ship *Theban,* with the H.C. Ships *Marquis of Huntly, Cirencester, Elphinstone, Bombay* and *Alnwick Castle,* bound to China, experienced a severe tyfoon in the China seas, in which the *Theban* and *Cirencester* were left with only their foremasts standing. The other ships escaped without damage.*

The H. C. S. *Glatton* was at the same time about three degrees to the Southward of them, and had only a heavy or strong gale. Her log, from which some instructive inferences may be drawn, is subsequently given.

The following are the abridged logs of the fleet:—

* Horsburgh says of this storm in a note Vol. II. p. 267, that Captain Craig of the *Elphinstone,* warned by his Barometer, prepared for a tyfoon, and sustained no injury. This was also the case with others of the ships, as we shall see. The *Cirencester* was fully prepared, but lost her masts from the chain plates giving way.

Abridged Log of H. M. S. THEBAN.

7th Sept.—Noon latitude 16° 6′ N. long. of the fleet 114° 16′ E.

8th September.—4 A. M. wind W. by N.; under storm-sail. At 1 P. M. wind West, strong gales with heavy rain. Split the fore-sail. At 8, heavy gales, W. S. W., at 9, lost the main-mast, at 10h. 15m. the mizen-mast, at 11h. 15m. the fore-top-mast. Lat. at noon 16° 23′ N. long. 116° 51′. E. Midnight the wind S. W. blowing very hard.

9th September.—1 A. M. wind marked W. by S. heavy gales. Noon strong breezes, S. S. W., *Elphinstone* in sight; by midnight fair weather.

The logs of the fleet will be better and more briefly exhibited in the following table, than by abridgements, as they were all near each other:—

Tabular View of the Logs of the Fleet under convoy of H. M. S. THEBAN, *in the Tyfoon of the 8th and 9th September*, 1812, *reduced to civil time.*

Date.	Ship's Name.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Ther.	Remarks.
			Noon. ° ′	° ′			
7th September, 1812.	Elphinstone, ..	1 P.M. N.E. At 4 N. midnight N.W.bN. increasing to hard gale. ..	16 14	114 16 E.	..	..	Making every preparation for bad weather. Long. that of the fleet.
	Cirencester, ..	1 P.M. N.N.E. 3 North, 7 N.N.W. increasing from the N.W. with thick weather.	16 7	114 16	..	..	As above.
	Marquis of Huntly,	1 P.M. N.bE. increasing as with the others, ..	16 11	114 16	..	..	As above.
	Alnwick Castle,	1 P.M. N.E.bN. and about N.N.W. at 9 P.M. increasing.	16 7	114 16	..	..	As above.
	Wexford, ..	P.M. N.E., 4 P.M. North, 9 P.M. about N.bW. and increasing.	16 3	114 16	29 50	84	As above, Bar. 6 P. M. 29·45, midnight 29·40.
	Bombay, ..	1 P.M. N.N.E. 4 North, 7 N.bW. increasing; at 9 about N.N.W... ..	16 7	114 16	..	..	Preparing for bad weather.

Date.	Ship's Name.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Ther.	Remarks.
8th Sept. 1812.	Elphinstone, ...	3 A.M. W.bS. 5 W.bN., 11 W.N.W. heavy gales; 1 P.M. W.bN., 11 P.M. W.bS., midnight W.S W. blowing excessively hard in gusts, ...	Noon. ° ′ 16 20	Noon. ° ′ 114 54	..	..	Hove to under storm staysails, and latterly trysail; throughout large sea from the West, constant rain, and dark gloomy weather.
	Cirencester, ...	3 A.M. N.W., 6 W.N.W. 1 P.M. W.bN., 5 West...	16 7	.. ..	..	..	From 3 A.M. under storm staysails, and latterly bare poles; 10 P.M. lost main mast, by the chain plates giving way, also mizen mast and fore top mast.
	Marquis of Huntly,..	3 A.M. W.S.W. no other wind marked. P.M. W.b S., midnight about W. S.W.	acct. 16 11	115 19	..	..	Under bare poles.
	Alnwick Castle, ..	4 A.M. West and W.bN. Excessive hard gale from 8 A.M. 1 P.M. West 6 S.W.bW.	acct. 16 10	114 58	29·32	81	By noon hove to under main and mizen stay-sails, violent squalls and gusts.
	Wexford, ...	4 A.M. W.bN. & N.W. 11 W.N.W., 1 P.M. West, 4 W.bS. heavy gales...	.. ..	.. ..	29·20	80	From 8 P.M. hove to, Bar. 8 A.M. 29·30 noon 29·20 6 P.M. 29·15 midnight 29·15.
	Bombay, ...	1. A.M. about N.W.bN., 3 A.M. about N.W., 5 about W.N W., 9 West. 1 P.M. W.bS. and W.S. W.,strong gale as above,	16 24	114 04	..	..	From 9 A.M. hove to as above. See Capt. Hamilton's note on the storm in page 643.

Date.	Ship's Name.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Ther.	Remarks.
9th Sept. 1812.	Elphinstone, ...	1 A.M. S.W.bW. hard gale and heavy gusts till 8 A.M.—P.M. S.W.bW. moderate.	Noon. ° ′ 17 1	Noon. ° ′ 116 10	..	..	To 8 A.M. heavy gale, at 8 A.M. moderating, bore up.—P.M. saw the Theban to the W.N.W.
	Cirencester, ...	7 A.M. W.S.W. strong gales, P.M. moderating, 5 P.M. S.W., 10 S.W.bS.	16 30	116 10	..	..	Clearing the wrecks and rigging jury masts. Lying to.
	Marquis of Huntly, ..	A.M. moderating, P.M. S.W.bW.	acct. 16 31	114 58*	..	..	At 8 A.M. bore up.
	Alnwick Castle, ..	7 A.M. W.S.W. bore up, 1 P.M. W.S.W. ..	16 42	115 47	29 40	81	Barometer when lowest 20·19, but time of this not given; moderating at daylight, and bore up at 7½ A.M.
	Wexford, ...	7 A.M. S.W., 1 P.M. S.W. by W.	16 36	115 44	29·35	81	Ther. 84°, moderating at daylight as with the others.† Bar. 8 A.M. 29·20, noon 29·35.
	Bombay, ...	Wind not marked, ..	16 38	.. ..	..	..	Bore up at ½ past 10 A.M.

* 113° 58′ in the MSS. evidently an error, as she was in sight of the *Bombay* and *Alnwick Castle*, P.M.
† Perhaps?

The following remarks are from the log of the *Bombay*, Captain Montgomerie Hamilton, they give a very good epitome of the storm:—

"*9th September*, 1812, *Nautical time.*—Throughout hard gales at S. and W. with squalls and rain; towards noon more moderate. From 8 A. M. on the 8th of this month to about 5 on this day, experienced very blowing weather. From having the fresh S. W. monsoon on the 6th, the wind drew round to the Eastward with squalls, at times, drawing round to the Northward on the 8th, when it gradually freshened up with a regular fall of the Barometer, the wind coming round to the West, and blowing most severely from the W. N. W. and W. S. W. breaking up from the W. S. W. to S. W. blowing extremely hard, with furious gusts and hard rain throughout. The peculiar indications of this weather coming on were a gradual fall of the Barometer, which fell one-tenth below 29.00* the weather feeling hot and close, hotter than at an equal height of the Thermometer at this time, which was 81 degrees. When the wind was to the Eastward, it was light with a clear horizon and dusky flying clouds. The wind drawing to the Northward, the horse flies† made their appearance. Had no extraordinary swell previous to its coming on."

We have now to abridge the log of H. C. Ship *Glatton*, which as I have stated, was about three degrees to the Southward of the fleet, but nearly on the same meridian.

Abridged Log of the H. C. S. GLATTON, *Captain Jas. Halliburton, reduced to civil time.*

6th September.—The *Glatton* was in latitude 10° 28′ N. longitude 111° 12′ E.

7th September.—A. M. log for this day is not given, but working back from that of the 8th she was at noon in latitude 12° 00′ N., longitude 112° 15′ E. P. M. winds from N. N. W. variable and squally till midnight.

8th September.—From midnight strong squalls, bent storm stay-sails. 4 A. M. wind S. W., 7, W. by S. Noon blowing fresh, lat. 13° 18′ N., long. 114° 32′. E. Bar. 29.48. Ther. 81°. P. M. strong gales West,

* So in MSS., but probably an error, as 29.15 is the lowest registered depression in the log.

† Horsburgh.

steering North, 5, 6, and 7 knots, heavy confused sea. 11 P. M. hard squalls and sharp lightning.

9th September.—2 P. M. W. S. W. going 5 and 6 knots to the N. N. W. and N. by W. till noon, when in latitude 15° 30′ N., long. 114° 46′ E. Bar. 29.30. Ther. 84½. P. M. wind W. S. W. moderate, but heavy confused sea.

10th September.—Till noon the heavy confused sea continues, latitude 17° 51′ N., longitude 113° 52′ E. Barometer 29.50. Ther. 84.

We have now to consider the probable track of this storm. It is clear from its mode of veering, that it was one passing to the Northward of the fleet, and we may perhaps suppose its centre to have been at one time, from the great depression of the Barometer, not more than 40 or 50 miles distant. Its track is next to be considered.

We have not the *Theban's* log for the 7th, but as towards evening, say 6 P. M. of that day, the Indiamen had all sent down top-gallant yards, and struck the masts, we may fairly take the gale to have began by this time from N. N. W., and we find very clearly from Captain Hamilton's remark in the *Bombay's* log, which I have just quoted, that it was "breaking up" between W. S. W. and S. W., that is about S. W. by W. The drift of the fleet was about E. S. E. or E. by S. Projecting this, it gives about a W. half N. course for the centre of the storm, which I have taken. It could I think be hardly more than W. by N. and certainly was not due West.

The *Glatton* was too far to the South, and too nearly on the same meridian, to afford us any assistance in estimating the track of the storm, though it is clear it was of no great extent, since it barely reached her. Her crossing the "confused sea," which the centre of the tyfoon left behind it is curious; and an exact confirmation of what occurred to the *London Thetis,* in the *Golconda's* storm of September 1840, as will be subsequently noticed.*

The barometrical observations made on the *Wexford,* for which I am indebted to Mr. Packman's notes, are of much interest. It would seem from them, (and they are so fully corroborated by those of the other ships which have noted the state of theirs in their logs,

* See Fourth Memoir on the Law of Storms, Jour. As. Soc. vol. x. p. 905.

that we may accord them full confidence,) that the total depression was as follows:—

	Ther.	Bar.	
6th Sept.—Noon,	82	29.60	Wind westerly squalls & rain.
7th Sept.—Noon,	84	29.50	Easterly, squally, unsettled, latterly N. E.
6 P. M.	83	29.45	N. E. & Northerly.
Midnight,	82	29.40	N. Westerly heavy gusts.
8th Sept.—8 A. M.	82	29.30	Gale N. Westward.
Noon,	80	29.20	
6 P. M.	80	29.15	
Midnight,	79	29.15	
9th Sept.—8 A. M.	79	29.20	
Noon,	80	29.35	
8 P. M.	80	29.60	

From this it appears, that from noon on the 6th, to 6 P. M. on the 7th, when we have taken the gale to begin, the depression was 0.05 only in 30 hours, though it had fallen 0.10 in the 24 hours between noon of the 6th and 7th. We then find it from 6 P. M. of the 7th to 6 P. M. of the 8th, or in 24 hours, falling 0.30. It is useful to notice these variations, because they afford a valuable lesson to those who will take the trouble to reflect on them. The *Glatton's* Barometer also gave her, by a fall of 0.18, full notice of the passage of the storm. I shall refer to these subjects more at length in a separate memoir.

TRACK No. VIII.—*Tyfoon of 28th and 29th October* 1819.

Document from the East India House.

By Capt. Probyn, H. C. S. MINERVA.

The H. C. Ship *Warren Hastings* on October 25th 1819, was in latitude 18° 56′ N., longitude 119° 6′ E., when a fresh gale commenced from N. E.

26th October.—Noon latitude 19° 42′ N., longitude 118° 21′ E., increasing gale from N. and N. E.

27th October.—Lat. 19° 58′ N., long. 118° 2′ E., strong gale N. E.

28*th October*.—Lat. 19° 52′ long. 118° 2′ E., strong gale N. N. E. to N. N. W. with drizzling rain and a high sea.

29*th October*.—Lat. 19° 50′ N. long. 118° 51′ E., severe gale N. W. with rain.

30*th October*.—Lat. 20° 9′ N., long. 118° 59′ E., gale increasing in violent gusts to a tyfoon, and shifting round from N. N. W. to South Westward, and S. E., with thick weather and a high confused sea.

31*st October*.—Lat. 20° 21′ N. long. 118° 29′ E., gale moderating from N. E. The thick weather prevented any observation for five days. The wind shifted during the height of the tyfoon, the duration of which did not exceed twelve hours.

This single document, is the only one I have relative to this storm, still, with the assistance of the ship's positions, as the centre evidently passed over, or close to her, it enables us to ascertain its track on that day at least, the 30th, with tolerable certainty, to have been from the E. by S. to the W. by N. coming in, as it undoubtedly did, from the Pacific Ocean. How much of the N. E. gale of the preceding days was part of the tyfoon, and how much the setting in of the N. E. monsoon, we cannot in the absence of any Barometrical observations pronounce. With the N. E. monsoon, the Barometer would have probably risen, while with the storm it would have sunk. It does not seem to have been of excessive violence.

I have marked its track, as shewn by the shift, to the E. by N., and crossing the ship's position at noon on the 30th.

TRACK No. IX.—Lord Castlereagh's *Tyfoon*.

From the Calcutta Journal of February, 1821.

The following brief though distinct notice of a small tyfoon, (for from its violence and change it certainly was entitled to be called one,) is remarkable and useful, as shewing in how low a latitude these may be encountered in the N. E. monsoon. I have not met with any farther notice of it, and mark its track as an East and West one, from the change stated in the account. The longitude of the ship is not given, but it is not of consequence, for in that latitude owing to the shoals and the coast of Cochin China, ships are mostly

about the meridian of 109° E. We shall subsequently notice other instances of the N. E. monsoon tyfoons about this latitude.

"The *Lord Castlereagh* left Whampoa on the 24th November, 1820, and on the 29th, in about latitude 12° N. about 9 A. M., she encountered a heavy gale of wind, which soon increased to a severe tyfoon from the North. She was kept before the wind till about half-past 9, when she broached to. The mizen-mast was then cut away, and she scudded again. At noon she again broached to, when the crew could do nothing. The wind abated a little about 1 P. M., but in half an hour veered to the Southward, and soon increased to all its former violence; so that the vessel became unmanageable and a mere wreck, with every sail blown from the gaskets, the crew could not keep the deck. At 5, the gale began to abate, and between 11 and 12, the weather became moderate.—*Calcutta Journal, February,* 1821.

TRACK No. X.

Tyfoon of the 19th October, 1821.

Documents from the East India House.

18th and 19th October, 1821.—The H. C. Ships *General Kydd* and *General Harris,* bound to China, and in company with each other, experienced a severe tyfoon in about latitude 18° N., long. 112° 30′ E., or upon the meridian, and a little to the Northward of the Paracels. The following are their logs:—

Abridged Log of the H. C. S. GENERAL KYDD, *Captain Alexander Nairne, reduced to civil time.*

15th October.—Noon latitude 19° 28′ N. Hainan Head, bearing N. 11 W. to S. 76 W.

17th October.*—By noon latitude 17° 59′ N. A smart breeze from N. E. P. M. wind N. E. by N. standing eight knots to the E. S. E., increasing to a gale with hard gusts before midnight. Wind about N. N. E.

18th Oct.—A. M. increasing to noon, (wind about N. N. E.) making, all snug for bad weather. No observation. P. M. increasing from NbE.

* Log of the 16th is not given.

ship under storm stay-sails, all of which with several of the other sails were blown away from the yards before midnight. Strong tyfoon with violent gusts, a tremendous sea and incessant rain, sea making a clear breach over the ship. Under bare poles from half-past 7 P. M. and wind veering to about N. E. by midnight.

19*th October.*—A. M. heavy tyfoon, sea breaking over the gunwale, and boats washing away. At noon it still continued in severe gusts and tremendous sea. No observation. Wind about E. S. E. P. M. S. E. by E. At 5, gusts not so frequent and hard. Wind about S. E. by S.

20*th October.*—Moderating fast at 4 A. M. By 9 made sail, wind S. E. by E. Noon latitude 18° 21′ N. longitude 112° 40′ E. Barometer in the height of the tyfoon at 28.65, but only this single notice of it.

Abridged Log of the H. C. S. General Harris, *Captain Welstead, reduced to civil time.*

15*th October.*—Latitude 19° 30′ N. High land of Hainan N. N. W. Taya Islands N. by E. Log of the 16th not given.

17*th October.*—At noon in company with the *General Kydd*, latitude observed 18° N., longitude 112° 30′ E. Bar. 30.00. Ther. 85°. Standing S. E. by S. with a 5 knot breeze from N. E., P. M. to midnight squally. Barometer at 9 P. M. 29.90.

18*th October.*—Increasing wind, about N. N. E. and N. E. by N. Noon hard gale and making all snug. No observation. Bar. 9, A. M. 29.70. P. M. Wind marked North, and at 7 P. M. N. E., hard gale with violent squalls throughout, losing sails, boats, &c.

19*th October.*—The same weather 10 A. M. Wind East. Cut away the main-yard which was adrift. Noon no observation. Bar. 28.75. Ther. 82°. At 2 A. M. wind S. E. by E. 1 P. M. shipping seas so heavily to leeward and over all, that it was necessary to heave the lee quarter deck guns and carriages overboard to make a passage for the sea ; bulkheads of cuddy washed away. 5 P. M. wore under bare poles. Wind about S. E. by E. to midnight.

20*th October.*—7 A. M. moderated from the same quarter or about S. E. The log remarks, " During this tempest we have experienced a

most extraordinary, and providential current in favour to the N. E. Barometer in the height of the tyfoon 28.75." Ther. 82°. Lat. observed 18° 21′ N., longitude by chronometer 112° 43′ E.

If we take this storm to have begun about North, and to have ended at S. E. with the drift as made good by the observations, it will upon projection give a track about from N. 74° E. to S. 74° W. for the centre, which may probably have passed within about 40 or 50 miles of the ships. The singular anomaly of a N. E. current is very remarkable.

TRACK No. XI.

H. C. S. Macqueen's *Tyfoon of 14th and 15th September*, 1822.

Document from the India House.

Log reduced to civil time.

The H. C. S. *Macqueen* bound to China was on the 12th September, in latitude 17° 35′, longitude not given, and on the 14th September at noon in latitude 20° 25′ N., longitude 114° 50′ E. Squally, thick cloudy weather, and second reefs in the topsails. Wind at 11 A. M. N. W. but variable. P. M. swell from the North. 3 P. M. increasing fast from N. W. and N. W. b W. and preparing for bad weather. At 6, increasing to a tyfoon, and storm stay-sails blown away. Midnight a tyfoon about South.

15th September.—Moderating towards day-light, when the ship bore up with the wind at S. E., latitude at noon 20° 53′ N. In addition to the log, there is also a memorandum by Captain Bax, who was second officer on board the *Macqueen*, but he states the wind to have veered by the East to S. E. which would make the centre pass to the South of the vessel, whereas by the log it evidently passed to the Northward of her position, and I have preferred the log as a written record, the memorandum of Capt. Bax being apparently from memory. There is no wind marked in the log except N. W. at 1 P. M., but from the coming up and falling off of the ship, it is clear that the wind veered as I have stated. I have, however, in consequence of this discrepancy, marked the track as doubtful, meaning

thereby, that its *position* is so, though its direction is well enough ascertained, *i. e.* both log and memorandum agree that the storm began at N. W. and ended at S. E. This, with allowance for the ship's drift, will give a track about from S. 57° E. to N. 57° W.

Capt. Bax's memorandum adds, The "above-mentioned tyfoon came on exactly as described by Horsburgh, commencing the strongest to the Northward, and veering round to East and S. E.

"For two days previous, it had been nearly calm, and numerous horse-flies covered the rigging, which Horsburgh mentions as the usual forerunners of such storms. The Barometer fell very low, and gave due notice, and the ship was prepared by its warning, but I have not a memorandum of the fall of the Barometer."

TRACK No. XII.

H. C. S. Castle Huntley's *Tyfoon of 25th to 27th Sept.* 1826.

Document from the India House.

The H. C. S. *Castle Huntley*, bound to China, experienced a severe tyfoon in September, 1826. The following is an abridgment of her log, reduced to civil time :—

24th September.—Noon, latitude 14° 17′ N., longitude 114° 10′ E. P. M. moderate and variable. Winds between N. and N. N. W. with squally weather and lightning to the Eastward towards midnight.

25th September.—A. M. squalls increasing from N. N. E., and at 10 A. M. under close reefs and reefed fore-sail, with a heavy breeze from N. E. At noon down top-gallant-yards. Latitude, indifferent observation, 14° 30′ N., longitude 114° 30′ E. Barometer 29.55. Thermometer 84°. P. M. fresh gale N. E., 5 P. M. hove to under storm stay-sails, heavy puffs N. E. at 7 P. M. Midnight N. E., violent squalls with thick rainy weather.

26th Sept.—At 1 A. M. Wind N. E., 7 A. M. N. E. At noon about E. N. E. No observation. Barometer 29.00 and falling. No appearance of the weather moderating. 1 P. M. wind E. by S. a heavy gale, and by 6 P. M. S. E. by E. About 1 P. M. Barometer began to rise, though the gale was by no means abated till midnight. 11 P. M. wind marked S. E. by E.

27th September.—5 A. M. Wind E. by S., Noon S. E. by E. again. At 6, saw the Triton Sand-bank, bearing about E. S. E., distant 10 miles; 7, made sail. At 10, by the bearings, latitude 15° 50′ N., longitude 111° 12′ N. Noon Bar. 29.53. Ther. 83°. P. M. fresh breeze from S. E. and fine. At 1 30 P. M. Discovery Shoal from N. to E. A northerly current of 47 miles for the last 24 hours.

To this log is appended the following important note: "Mr. Wise, "formerly an officer of the *Castle Huntley*, remarks, that when this "tyfoon commenced, the ship was to the East of the Macclesfield "Shoal, and drifted during it upwards of 300 miles* under bare poles, "having sighted the westernmost of the Paracels before the gale "terminated."

There can be no doubt that this was a storm passing to the South of the ship; and as the gale veered from N. E. to S. E. b E., while the drift of the ship was from noon the 25th to 10 A. M. on the 27th N. 67½° W. 210 miles, this when projected gives the centre of the storm a track of from S. 77° E. to N. 77° W., which is probably not far from the truth. The Barometer falling only to 29.00, though the tyfoon was severe, shews that the distance of 70 miles from the centre which this projection allows when it was nearest to the ship, is not excessive.

The projection will also furnish us with an approximation to the rate of travelling of the centre of this storm. The drift from noon 25th to 10 A. M. on the 27th, is as I have said 210 miles, and the centre, (the wind being N. E.) at the first epoch, bore S. E. from the ship, and at the latter S. W. by S. Assuming that at about noon on the 26th the centre bore due South, (wind being between E. N. E. at 10, and E. by S. at 1 P. M.) we have thus three lines of bearing for it, and taking the distance of it to be as I have before stated, it will be found that it must have travelled about 180 miles, or 7½ miles per hour in each of the 24 hours.

The extraordinary drift is a phenomena of the highest importance to navigation, and it is evidently analogous to those experienced on the South Coast of China, both probably occasioned by the "storm wave."

* Note.—So in MSS. The measured drift is 210 miles between Noon 25th and 10 A. M. 27th. Mr. Wise's calculation seems made from an earlier hour on the 25th.

I shall not forget to notice this subject at the conclusion of the present memoir.

1827.

The object of the present memoir being not only to present details of well-ascertained storms, but also to record such imperfect knowledge as may reach us of other tempests in the China Seas, in the hope, that these notices may one day elicit others, I make no apology for inserting two notices from the valuable memoranda sent me by Mr. Packman, through the Honorable the Court of Directors.

H. C. S. Scaleby Castle, *China Sea off Palawan.*

27th October 1827.—After having had for the three or four previous days, strong breezes from the N. W. to S. W., with squalls and rain, and continual thick weather, so that we could get no sights for latitude, either by day or night, it came on to blow a fresh gale in the latter part of the 26th, continuing to the 27th, and moderating on the following days with fine weather, when we obtained sights and ascertained our exact position; we were then at anchor amongst the Paraguas, off the Coast of Palawan; we had moderate Westerly winds for the next three or four days, as we stood to the Northward. Lat. about 9° 00′ N., long. 118° 00′ E.

2nd and 3rd November.—H. C. S. *Scaleby Castle.*—Variable light airs. Latitude observed 13° 56′ N., longitude per Chron. 119° 20′ E.

4th November.—Moderate breezes from the N. W. in the first and middle parts, latterly fresh from the Northward with hazy weather. Latitude observed 14° 22′ N., longitude 119° 27′ E. Blowing a fresh gale from the Northward in the first and middle parts, latterly moderating with fine weather throughout, and on the following day moderate Northerly breezes and cloudy weather. Lat. observed 14° 12′, longitude per Chron. 119° 19′.

The foregoing two storms do not furnish us with any fair data from which to deduce a track, but the first *may* have been the Southern half of a storm passing a couple of degrees to the Northward of the ship's position.

in the chart, and the second seems very probably to have been also a storm travelling towards the ship, but from which she escaped by running to the Northward so quickly.

1828.

Extract from the Log of the H. C. S. Marquis of Camden, *towards China, reduced to civil time.*

Document from Captain Wylie.

2*d Oct.* 1828.—At noon in latitude 19° 9′ N., longitude 116° 26′ E., cloudy weather; increasing breeze from the N. E. with squalls of rain at times. Ship standing to the North and N. N. E.. P. M., and to midnight variable light airs, and calms with heavy rain.

3*d October.*—At half past 12, breeze increasing to a gale at N. E., hove to under main stay-sail, hard squalls and heavy rain. No observation. The gale still continuing; 3, wore ship, wind *about* N. E. At midnight wind decreasing.

4*th October.*—A. M. moderating and veering to the Eastward. At noon latitude 17° 17′, longitude 115° 13′.

Again on the 7th October.—The *Marquis Camden* was at noon in latitude 19° 7′ N., longitude 115° 43′ E., blowing hard in heavy squalls and rain; increasing P. M. to a gale at N. E., with a head sea reducing her to close reefed top-sails.

8*th October.*—By noon the wind had veered to N. W., heavy rain and high sea continuing, wind being about N. by E. at 1 A. M., and North or N. by W. at 7. It is marked at N. W. at 11. Latitude about 18° 10′, longitude 116° 40′ at noon. P. M. a gale from N. W. ship striking topgallant-masts.

9*th October.*—From midnight gale continuing, but at daylight moderating a little. Noon latitude 18° 47′, longitude 117° 52′. E. P. M. gale from N. W. continuing with a heavy sea throughout.

10*th October.*—Wind gradually veering back to N. E. at noon, when in latitude 19° 21′ N. and latitude 118° 22′ E. and continuing so, with squally unsettled weather, till the 13th, when the land was made.

There are no Barometrical observations with this log, and it is therefore very uncertain if these storms were rotatory ones, or, though so early in the season, the effect of the monsoon's setting in heavily,

which by the weather they had to the Coast of China, I should incline to believe it was. The veering of the wind from N. E. to N. W. at first inclines us to believe, that it may be part of a circular storm, but as it never came farther to the Westward than N. W., I am upon the whole inclined to believe, that the whole was the conflict of the two monsoons, rather than the effect of rotatory storms, and I have not therefore marked even a conjectural track for these. We shall see in 1837, Track No. XXV. in the log of the *Ariel*, another instance of this sort of *vibration* of a heavy monsoon between N. W. and N. E. at its first setting in.

TRACKS No. XIII. AND XIV.

Tyfoon of 8th and 9th August, 1829.

Documents from the India House, and from Colonel Reid's Work.

9th August, 1829.—A strong tyfoon, though of short duration, was experienced at the entrance of Canton river, by which the H. C. Ship *Bridgewater* was driven on Lintin Sand and dismasted. The *Herefordshire* also at anchor, in company with her, fortunately rode out the storm in safety. Three other ships, the *Charles Grant, Lady Melville,* and *Buckinghamshire,* also bound to China, were about on the meridian of Canton, and in latitudes from 16° to 19° N. They also experienced bad weather on the 8th and 9th ; but, as I shall subsequently shew, this was certainly not the same storm, though Col. Reid, to whom an incorrect copy of the *Charles Grant's* log had been given, supposes it might have been so.

Abridged Log of the H. C. S. BRIDGEWATER, *Captain T. Manderson, civil time. From Col. Reid's Work, p.* 277, *of* 2*d edition.*

9th August, 1829.—At anchor with Lintin Peak N. ½ W. Peak of Lantoa S. E. West Point of Tungcoa N. EbE. ½ E. Wind, first part variable from Northward and squally. 2 A. M wind Northerly, and Barometer falling fast. at 8 A. M. Barometer 26.30, and on the decline. At 9, wind marked Easterly blowing hard, and veering to the East; let go a second anchor at 10, wind E. S. E. Violent gusts, parted the small bower, let go the sheet, riding with two cables out upon each anchor. Noon, Barometer 29.17, with very thick weather, tyfoon increasing,

bent the small bower to the spare anchor; preparing to strike yards and top-masts. Having driven into four fathoms water on the edge of Lintin shoal, after consulting the officers, cut away the masts, brought up in three and half fathoms in soft mud. P. M. wind decreasing, midnight moderate.

10th August.—1 A. M. wind marked S. E. with passing squalls and rain.

Abridged Log of the H. C. S. HEREFORDSHIRE, *Captain Hope, civil time.*

From the India House.

Sunday, 9th August, 1829.—At anchor, Lintin Peak N. N. W. the *Bridgewater* in company, first part a fresh breeze from the North, increasing in the middle part to a most severe gale, with tremendous heavy gusts. At 3 P. M. gale abating very fast. At 11 A. M., observed the *Bridgewater* driving at times till 1 P. M. At half past 2, saw her with all her masts gone, sent our boat on board of her, and found she had three and half fathoms water alongside. Throughout the gale cloudy weather, with heavy rain.

Extract of a letter from Mr. E. Ford, then Chief Officer of the HEREFORDSHIRE.

From the India House.

8th August, 1829.—Anchored in the Chinese waters, Lintin bearing N. N. W., weather remarkably close and sultry. In the night, a fresh breeze sprung up from the North, which drew round to East, increasing towards noon, (on the 9th), to a most severe gale, with tremendous heavy gusts, so much so, that the *Bridgewater* was driven on shore. At 3 P. M. gale abating. At 6, moderate and fine weather.

Barque INNORE *in Macao Roads, civil time.*

Sunday, 9th August, 1829.—Had dark squally appearance from the N. E. At 2 A. M. hard squalls. At 4, making preparations for a tyfoon. At 11, being fouled by a Portuguese brig, slipped to run into the harbour, but at noon grounded. P. M. clearing up. Midnight, wind East, with cloudy weather.

Abridged Log of the H. C. S. Lady Melville, *Captain R. Clifford, bound to China, reduced to civil time.*

From the India House.

8th August.—At noon latitude 17° 30′ N., longitude 114° 2′ E. p. m. wind N. W. by W., freshening to a strong gale at midnight, when it was at W. by S.

9th August.—6 a. m. struck top-gallant-masts. At 10 a. m. wind S. S. W. more moderate. Noon latitude account 19° 14′ N., longitude 114° 15′, p. m. S. S. W. fresh breeze. At 5, S. by E.; a heavy swell throughout.

Abridged Log of the H. C. S. Charles Grant, *civil time.*

From Col. Reid.

In the communications from the East India House, I am referred to Col. Reid's work for this log. As remarked p. 654, Col. Reid has been apparently misled by the log of the *Charles Grant* having been sent to him as if kept in civil time, whereas it was really kept, like that of the *Lady Melville*, now before me, in nautical time; for the latitudes, as will be seen agree within 5′ (one ship being probably that distance ahead of the other at noon,) and if the a. m. and p. m. in the first column of the log printed in Col. Reid's works be changed, the winds will then agree, as recorded by the *Lady Melville's* log just given.

8th August, 1829.—Light airs S. by W. to N. W. by W. Noon latitude 17° 35′ N. Barometer 29.55. Thermometer 85°. *Lady Melville* in company, p. m. wind N. W., and at 11 p. m. N. W. by W., freshening to midnight, when the fore and mizen top-sails were handed.

9th August.—1 a. m. wind marked West. 4 a. m. W. by S. Noon no observation. Bar. 29.40. Ther. 83°. Nothing further recorded.

Abridged Log of the H. C. S. Buckinghamshire, *Capt. Glasspoole, bound to China, reduced to civil time.*

From the India House.

8th August, 1829.—Noon latitude by account 16° 4′ N., longitude 113° 37′ E. Wind at 4 a. m. West, 5 and 6 knot breeze. p. m.,

W. N. W.* 5 P. M. W. by N. moderate, but threatening. At 9, wind West, at 10 W. by S., Midnight W. S. W. increasing; ship going $7\frac{1}{2}$ knots to the North.

9th August.—A. M. fresh gale with squalls and rain, and much lightning to the S. E., wind not marked. 6 A. M. under bare poles with hard gusts and heavy rain. 7, set the main-top-sail. 8 A. M. wind S. W. by W. At 10, set fore and mizen-top-sails. 11, wind S. W. by W. At noon S. S. W., latitude observed 18° 25′ N., longitude 114° 4′ E.

I have before observed, that these logs appear to me to relate rather to two storms, and I now proceed to shew why I think they do so, but to afford my readers the same means of judging which I have had, I give here the log of the *Lady Melville*, and a comparative table of the winds and weather experienced by all the five ships.

Log of the H. C. S. LADY MELVILLE, *Capt. R. Clifford, bound to China, nautical time.*
From the Records of the East India Company.

H.	Courses.	K.	F.	Winds, &c.	Sunday, 9th August, 1829.
1	N.bE. ½ E.	6	..	N.W.bW.	N.B.—On the 8th Aug. at noon, lat. 17° 30′ N., long. 114° 2′ E.
2	.. .. ..	6			
3	N.bE.	6	..	Fresh breeze down royal yards, in 1st reef topsails.	First part increasing breeze, middle strong gale, more moderate toward latter part.
4	.. .. ..	6			
5	.. .. ..	5	4		
6	.. .. ..	4			
7	N.bE. ½ E.	5	4		
8	.. .. ..	5	4	Cloudy.	6 A.M. the ship pitching heavily, sprung jib boom, split main topsail, furled it and fore topsail.
9	.. .. ..	4			
10	N.bE.	4	4	Freshening, close reefed topsails, down top gallant yards, W.bS. ..	
11	N.bW.	5			
12	.. .. ..	5			
1	.. .. ..	2			
2	.. .. ..	2			
3	.. .. ..	5			
4	.. .. ..	5			
5	.. .. ..	5			
6	.. .. ..	5			
7	North.	3	..	Struck top gallant masts, in flying jib-boom. ..	
8	N.bE.	4			
9	.. .. ..	2			
10	N.bW.	2	..	S. S. W. set foresail & fore & mizen topsails 3 reefs.	
11	.. .. ..	4			
12	.. .. ..	7	..	.. ..	Lat. account 19° 14′ N. Long. account 114° 15′ E. Bar. 29·40. Ther. 83°.
		109			

* MSS.—N. W. which is evidently wrong, the courses being marked N.½E., N. by E., and North to midnight.

H.	Courses.	K.	F.	Winds, &c.	Monday, 16th August, 1829.
1	N.bW.	7	4	S.S.W. Hazy.	First and middle parts a fresh breeze, latter more moderate, with squalls, rain, and heavy swell throughout.
2	.. .. ..	7	4		
3	.. .. ..	7			
4	.. .. ..	7			
5	.. .. ..	7	..	S.bE. up top gallant masts and yards, out 3d reefs, cloudy.	
6	.. .. ..	6	4		
7	.. .. ..	6			
8	.. .. ..	6	4		
9	.. .. ..	7			
10	.. .. ..	7	..	Crossed royal yards.	
11	.. .. ..	6	4		
12	.. .. ..	6	4		
1	.. .. ..	7	4		
2	.. .. ..	8	..	Squally and rain	
3	.. .. ..	8			
4	.. .. ..	7	4		
5	.. .. ..	7	..	Out reefs.	Saw the land from the mast head, bearing N.N.W.
6	.. .. ..	6	4		
7	.. .. ..	6	4	E.S.E.	
8	.. .. ..	6	4		
9	.. .. ..	6	4		
10	.. .. ..	3	4	Variable, squally & rain.	
11	.. .. ..	7			
12	.. .. ..	7	4		

Comparative Table of the Winds in the Tyfoons of 8th and 9th Aug. 1829.

Date Civil Time.	Bridgewater and Herefordshire. Lintin.	Lady Melville.	Charles Grant.	Buckinghamshire.
8th Aug. 1829.	4 A.M.	.. .. ..	.. .. ..	West.
	Noon, ..	17·30 N. 114·2 E.	17·35 N...	16° 4′ N. 113° 37′ E.
	1 P.M.	N.W.bW. freshening.	.. .. .. N.W. ..	N.W.
	5	.. .. ..	.. .. ..	W.bN.
	9	.. .. ..	.. .. ..	West.
	10	.. .. ..	.. .. ..	W.bS.
	11	.. .. ..	N.W.b W.	
	Midnight, ..	W.bS. ..	.. .. ..	W.S.W. increasing.
9th Aug. 1829.	1 A.M.	.. .. ..	West, ..	
	2 Northerly. ..	.. .. ..	.. .. ..	
	4	.. .. ..	W bS. ..	
	6	Struck top. gal. masts.	.. ..	Bare poles.
	.. .. ..	.. .. ..	.. .. ..	S.W.bW. making sail again.
	10 E.S E. Tyfoon,	S.S.W. made sail.	.. .. ..	
	11	.. .. ..	.. .. ..	S.W.bS. moderating.
	, ..	19 14 N. 114·15 E.	.. .. ..	S.S.W. 18·25 N. 114·4 E.
	1	S.S.W. ..	.. .. ..	
	3 A.M. moderating	.. .. ..	.. .. ..	
	5	S.bE. ..	.. .. ..	
10th Aug.	1 A.M. S.E. ..			

First, we will take the Lintin records. From these it is clear, that the storm there may be called one lasting about 6 hours only, *i. e.* from 9 in the morning to 3 in the afternoon of the 9th, and during this time, as remarked by Col. Reid, being from N. E. to East, E. S. E., and S. E. We may thus take it to be at noon on the 9th at its full fury at E. S. E. when the centre must have borne about S. S. W. from the *Bridgewater* and *Herefordshire*, and by 3 P. M. it was at S. E., when the centre was of course bearing S. W. from them, and they were then nearly out of its influence; for it is stated, that the boat of the *Herefordshire* was sent on board of the *Bridgewater* at ½ past 2 P. M. Now the bad weather from the N. W., West, and S. W., which was experienced by the other three ships, *i. e. Charles Grant, Lady Melville*, and *Buckinghamshire*, began with those ships before midnight, between the 8th and 9th; and at 1 A. M. on the 9th, when it should be noted that the wind was at least West, and to the Southward of West with some of them. The centre then at midnight, between 8th and 9th, should have borne North from them, and as the wind was about S. S. W. by 10 A. M., the centre bore W. N. W. from them at that time, and they were all not far from the meridian of Lintin. The *Lady Melville* indeed was making sail again at this time. Yet it was at 9 A. M. that the storm was *commencing* with the *Bridgewater*, say from the E. by S., which would give the centre bearing S. by W. from her, and from its violence and fall of the Barometer, much nearer to her than to the ships at sea; and at 10, when, as we have noted, they were making sail with a S. S. W. wind, it was blowing a tyfoon at E. S. E. at Lintin. No projection will reconcile this, and no allowances from the anomalies produced by the land, will account for the discrepancies in time, I think. We know that the ships at sea had nothing to alter the fair course of the storm, but as will be seen by the chart, the high land on the Eastern shore of the river, and that of the large island of Lantao, may have greatly influenced the direction of the wind.

Again, if the storm experienced by the ships at sea had occurred *later* than that at the anchorage, we might suppose it to have been, as in the instances of the *Ariel* and *Marquis Camden*, a disturbance or *vibration* of the usual monsoon, (this being the height of it,) occasioned by the storm to the Northward; but it does not seem so probable that

this disturbance preceded the tyfoon, not at least by so great an interval of time as from ten to twelve hours.*

Upon the whole, then, I should be inclined to suppose, that there were two storms, of which the centre of that of the ships at sea, bore North from the *Charles Grant* and *Lady Melville*, at 1 A. M. on the 9th, and as it was not severe, and not felt at Lintin, it was probably of small extent. I have then marked a conjectural track for it in No. XIV., from S. 78° E. to the N. 78° W., and those who study the subject, will agree with, or dissent from my views as they please. I have laid down the Lintin storm as coming from East, the height of it appearing to have been about noon, when the centre would have borne S. S. W. from the ships; but this is almost conjectural, for amongst high rocky islands like those at the entrance of Canton river, the wind may have been modified in many ways. The storm of the ships at sea I have laid down as passing from the E. S. E. to the W. N. W., though from the absence of any registry of the Barometer, except at noon, we cannot say when the storm fairly began or ended; but with due allowance for the run of the ships in the interim, I think it may be taken as far to the Southward as this.

The Waterloo's *Storm.*

Document from the East India House—Mr. Packman.

26*th August*, 1829.—The H. C. S. *Waterloo* appears also to have been within the range of one of those E. S. Easterly storms, about a degree farther to the Southward, than the ships in the former article. The following is the memorandum sent me, but I have not marked a conjectural track from it, as no other document has been obtained relative to this storm, which indeed we could scarcely notice as one, but for the remarkable fall of the Barometer.

H. C. S. Waterloo, *in the China Sea.*

26*th August*, 1829.—A brisk monsoon in the first and middle parts with squalls and rain, in the latter variable from the N. W., and

* Even supposing the storm to have come from the N. E. still it cannot be reconciled, as to distances from the centre and intensity, with the times, so that all things considered, two separate storms is the most probable supposition.

cloudy weather. Lat. observation 14° 15′ N., long. per Chron. 113° 29′ E. Thermometer 83°. Barometer 29.75.

27*th August.*—Variable wind, but mostly from the N. W. with squally weather and rain throughout. Lat. 15° 21′, long. 114° 01′ E. Thermometer 81½°. Barometer 29.64.

28*th August.*—Variable winds from the North and N.E. with squally weather and heavy rain and lightning from the Eastward in the middle part. Latitude observation 15° 36′ N., longitude per Chron. 114° 50′ E. Thermometer 83°. Barometer 29.50.

29*th August.*—Variable N. W. winds in the first part, veering round to the S. W. and South in the middle and latter, and increasing to a fresh gale with frequent squalls and rain; following days strong and pleasant breezes from the S. Eastward till our arrival at China. Latitude observation 16° 29′ N., longitude per Chron. 115° 06 E. Thermometer 82°. Barometer 29.25.

TRACK No. XV.

Tyfoons of September, 1831.

Documents from Mr. Redfield and the India House.

The year 1831 seems to have been one in which several tyfoons were experienced in the China seas. We have records, though imperfect, of one in September, and of two in the month of October. The following is Mr. Redfield's abridgment from the Canton papers of the notices then published. I have but one memorandum of this storm from the India House, with, however, a very useful note appended to it by Captain J. K. Forbes, of the H. C. S. *Thames.*

Canton Tyfoon of September 23*d*, 1831.

The American ship *Galen*, from the Sandwich Islands, bound to Canton, encountered bad weather off the Bashee Island on the 21st of September, and on the 23d, near the Lema Islands, lost her mizen mast, fore and main-top-masts, &c.

The British barque *Agnes* from Singapore, also lost her fore-mast on the 23d, and was obliged to cut away the remaining masts. She

was at anchor on the 27th, about nine miles Southward of the Grand Ladrone.

H. C. Ship *Hertfordshire* and Danish ship *Norden*, arrived on the 25th [from the Southward] and experienced no bad weather; the latter reports that on the 24th, a very violent swell was running down from the North-eastward, but the barometer indicated no change, and neither of these vessels were aware of the tempest till their arrival at Macao.

At *Canton* early in the morning of the 23d September, commenced a *hard northerly gale*, which continued without intermission for twenty-four hours. The tide rose to a great height, and much damage was sustained; an official return to the authorities at Canton states, that after it was past, *one thousand four hundred and five* dead bodies were picked up along the coast. The gale was far more severely felt at *Macao* and Kumsing-moon, where it is described as having been truly dreadful.—*Canton Papers.*

We may fairly deduce this to have been a storm of small extent, running down the South Coast of China, about parallel to our Track No. I, which course I have therefore assigned it as a conjectural one, marking it No. XV.

At Whampoa, on the 23d September, 1831.—A severe tyfoon was experienced in China, in which several vessels were lost, and great mischief done on shore. At Whampoa, where it was severely felt, the wind, says Captain Forbes, H. C. S. *Thames*, drew round from N. to E. and S. E., but was not of such violence as to be called a hurricane there.

Captain Forbes adds here a valuable note as follows:—

Note.—I would here beg leave to mention a circumstance, which may be useful in a practical point of view on such occasions. I left the H. C. S. *Thames*, (which I then commanded,) at Whampoa, on Sunday evening the 18th September 1831, to proceed to Macao in the ship's launch, arriving there next day. Before leaving the ship, I happened to look into *Horsburgh's Directory*, page 10, of the "Introduction and general remarks upon winds, &c. article 'Change of the Moon'," and said to be written by an *ingenious Frenchman*. By the rate there laid down as to the chances of hurricanes, I found that there was a great chance of one at the time it actually occurred at Macao, (on the 23d September,) so I ordered two large anchors and cables to be put into the launch, instead of those in common use. By this, I unquestionably saved my boat, and probably her crew, besides another ship's launch which broke adrift, and was saved by holding on by the *Thames'*."

Storm of 5th and 6th October, 1831.
Notes from the East India House.

5th October.*—H. C. Ship *Farquharson*, Captain Campbell, lying at Whampoa, had a strong gale from the *Westward with severe gusts. Weather too severe for a craft to lie alongside.

6th October, 1831.—H. C. S. *Lowther Castle*, at anchor in Whampoa reach. A severe gale commencing at North, veering round to the East, and then moderating, with incessant hard rain throughout. Barometer fell to 29.17.

TRACKS No. XVI, XVII, AND XVIII.

MANILLA, PANAMA'S *and* FORT WILLIAM'S *Tyfoon of 23d, 24th, and 25th October*, 1831.

Documents from Col. Reid, Capt. Biden, and the Voyage of La Place.

Between sun-set of the 23d, and sun-rise of the 24th October, 1831, a tremendous tyfoon was experienced at Manilla, in which almost all the ships at Cavite, and those lying at the bar, before Manilla, were driven on shore. The American ship *Panama*, and the English ship *Fort William*, also experienced severe storms in the China seas, about the same time. I have first given their different logs, reduced to civil time where necessary, and then a table from which I should deduce, that the Manilla storm, and that of the *Panama*, were undoubtedly one storm, but that of the *Fort William* a different one.

Log of H. M. Frigate CROCODILE, *Captain R. Bancroft, in Manilla Bay. Abridged from Col. Reid's Work, p.* 284, *2d edition.*
Civil time.

23d October, 1831.—Sun-set, increasing breeze and cloudy, veering more Northward from the N. E., at which quarter it had previously been. At 7, veered to 75 fathoms. At 8: 30, down top-gallant-masts, and let go the best bower. At midnight very severe hurricane, with heavy rain and high sea, bent the sheet-cable over all, not being able to get it out of the hause hole.

* This date and the wind at West, are so in the MSS. before me, but both are contradicted by the next extract, a memorandum from the *Lowther Castle's* log, in which the wind, at all events, is probably right.

24*th October.*—A. M. wind marked N. by W., tyfoon very heavy, with incessant rain and high sea. At 1h. 40m. its extreme rage abated, and shifted to the N. E., the sea became less violent, and the ship rode more easily, but very heavy squalls. No Barometrical observations are given.

Tyfoon of 27*th October,* 1831,* *at Manilla.*

Abridged from the Notes to the Voyage of La Favorite, *Capt. La Place, Vol. I. p.* 552.

27*th October,* 1831.—One of these hurricanes ravaged the Colony in a frightful manner. It began at midnight, and lasted four hours. The wind began at N. N. W., and ended at E. N. E. When at North the tyfoon blew with a fury, which no inhabitant had ever seen equalled. The air "seemed on fire." All the vessels at anchor before Manilla and at Cavite went on shore, and were mostly lost. The English Frigate *Crocodile* only, with excellent chain cables, and in about the same anchorage as the *Favorite,* held on, and sustained but trifling damages. The destruction on shore was frightful.

At the Laguna, (thirty miles East of Manilla,) the hurricane was still more severe, though sheltered by high mountains to the North.

M. La Place remarks also, and this is a fact well known at Manilla, the evident relation which the volcanoes have with the hurricanes. Scarcely one occurs in which some volcanic phenomena are not observed, and these are sometimes very violent.

Log of the Ship Fort William, *reduced to Civil time.*

From Captain Biden.

The ship *Fort William,* Captain Neish, bound from China to Manilla, arrived at Singapore on the 12th instant, under jury masts, having been totally dismasted in the passage, probably by the Manilla tyfoon. We have been favoured with the following abstract of the log of that ship, which details the particulars:—

* There is a difference of dates here, but there is no doubt the storms are the same.

Abstract from the Log of the Ship FORT WILLIAM.

"*Sunday*, 23*d October*, 1831.—Our Canton Pilot left the ship, when we hauled to the Eastward, being bound to Manilla."

Monday, 24*th Oct.*—At 8 A. M. passed between the Asses' Ears and the Lema. Strong breezes and cloudy weather from the N. N. E., double-reefed the top-sails and reefed the main-sail. At noon, strong breezes and increasing sea. No land in sight.

P. M. Blowing strong, and sea still increasing; sent down the top-gallant-yards and masts, wind N. E.; steering E. S. E. At 11 P. M. hard squalls and high sea; clued up the top-sails to close reef them. Midnight, weather getting worse, furled the top-sails, and struck top-gallant-masts.

25*th October.*—At 4 A. M., a sea struck, and carried away the starboard quarter cutter. Daylight blowing a perfect hurricane; furled the main-sail. Noon, hard gales and thick drizzling rain. No observation.

P. M. Blowing a dreadful gale, with violent squalls; the sea still increasing. At 8 P. M. the main-mast went over the starboard side, about 14 feet above the deck, and the mizen-mast immediately followed, falling nearly right aft on the poop, the top just clearing the stern, carrying away with it the larboard quarter cutter, stern boats, davit, &c. &c.; cut away all the wreck with every possible despatch, and soon got clear of it. During the night the gale still continued, and the ship labouring excessively, expected the fore-mast to go every moment.

26*th October.*—At 4: 30 A. M., the fore-top-mast went, and at 8, perceived the fore-mast badly sprung under the fore-castle. Several of the chain-plates and shrouds gave way, the fore-mast immediately went over the larboard bow, sprung the cat-head, and carried away the head rails, bumkin, &c. &c., and struck the ship a violent blow under the water, which shook her, as if she had struck a rock. Cut away every thing, and got clear of all the wreck without, (we hope), seriously injuring the hull, and she made no water, and now being obliged to choke the rudder amidships, for which we had been under very great apprehension during the whole gale. Noon, gale abating, and sea still very high. No observation. Ship labouring so excessively, that we dare not cast loose the booms to prepare jury-masts.

27*th October.*—Fine weather; latitude observation 18° 25′ N., longitude 114° 31′ E.

28*th and* 29*th Oct.*—Ship again under command of her helm, and found that we could just weather the Paracels and Bombay Shoal, with a steady Easterly wind; resolved to make the best of our way to Singapore.

November 2*d.*—Passed in sight of Pulo Sapata.

Saturday, 12*th Nov.*—Arrived safe at Singapore.

Storm raged in lat. from 21° to 18° N., and from long. 114° to 116° E.

During the whole of the tyfoon, the Marine Barometer never fell below 29.60."

The following is the account of the *Panama's* part of the storm, as given by Mr. Redfield:—

"*Extract from the private Journal of Wm. F. Griswold, Esq. Master of the ship* PANAMA, *on a voyage to Canton, October,* 1831.

October 23*d, (Nautical time,) lat.* 9° 17′ *N., lon.* 117° 16′ *E.,* wind came out at southward and continued until 10 p. m., then died away and commenced from the Northward with a heavy head sea. Forenoon, breeze from N. W. and clear weather. *Latitude* 9° 45′ *N., longitude* 117° 25′ *E.*

October 24*th.*—Pleasant breezes from N. W., and hazy steady weather. A sea rolling from the Northward. I suppose there has been a gale in the China sea, which has not yet reached us. Evening, wind rapidly increasing and Barometer falling from 29.75 to 29.40. Midnight reefed top-sails.—9 a. m. double reefed do.—barometer 29.20. Ends with tremendous gale from the westward and heavy sea—barometer 29.10. *Lat.* 11° 15′ *N., long.* 118° 20′ *E.*

October 25*th.*—Heavy gale W. S. W.—barometer 29.05 Gale hauling to the southward. Evening more moderate. Made a little sail. Wind at 7 p. m. from south-westward; 11 p. m. from southward. In the morning at 5 o'clock the wind came out at S. E. (barometer at 29.10) and blew a perfect hurricane. Hove to under mizen staysail; barometer at 1 p. m. 29.05, 4 *p. m.* 29.00, 7 *a. m.* 29.10, 8 *a. m.* 29.20. I believe this fall of the Barometer to be, in this latitude, very remarkable.

This gale was on the 24th and 25th October, civil time, and from its peculiar features and double fall of the barometer, there appears something like the falling in of two hurricanes on the same track. It was, doubtless, in whole or in part, the same hurricane that visited Manilla on the night of the 23d of October, and which is noticed by Col. Reid. The irregularities of the storm *may* have been caused by its passage over the Philippine Islands, the Panama being then off the

Strait of Mindoro, and about 210 miles from Manilla. I have deemed it not improbable, that this storm was the same that visited the Bay of Bengal on the 31st of the same month, and was so destructive at Balasore, and on the neighbouring coast. The course from the Panama's position to Balasore is about N. 73° W., and the distance, say 1920 miles, which would give a rate of progression of $11\frac{1}{2}$ nautical miles per hour: which coincides with other storms which have formerly been examined. It is important to ascertain if this storm crossed the Burman empire, immediately previous to its appearance in the Bay of Bengal."

Comparative Table of the Winds and Weather in the Manilla Tyfoon of 23rd October, 1831.

Date.	H. M. Fr. Crocodile & Fr. Frigate Favorite, Manilla.	Ship Panama.	Ship Fort William.
23rd Oct. 1831.	By midnight a Tyfoon from the North, veering from N.bW. and N.N.W. to N.E. ..	Noon 9·17 N. 117·16 E. five PM. pleasant breeze N. W. & heavy Northerly swell. Evening increasing, Barometer 29·40 from 29·70.	Left the land, strong breezes N.N.E. and cloudy weather.
24th Oct. 1831.	A.M. N.bW. ending at N.E.	9 A.M. Bar. 29·20. Noon tremendous gale from West. Bar. 29·10. Lat. 11·51 N. Long. 118·20 E. P.M. W.S. wind. Bar. 29·05. 7 P.M. S. Westward 11 P.M. &c.	Noon no land in sight. P.M. blowing strong from N.E. Midnight gale N. E.
25th Oct. 1831.	.. .. ..	5 A.M. wind S.E. Bar. 29·10. Hurricane 1 P.M. Bar. 29·05, 4 P.M. 29·00, 7 A.M. 29·10. 8 A.M. 29·20.*	Daylight a hurricane. P.M. dismasted. Noon 26th abating. 27th, 18.25 N. 114·31 E.

If we carefully consider the foregoing Table, we shall I think agree with Mr. Redfield in thinking, that the Manilla storm and the first of those of the *Panama* were undoubtedly the same, and that it was travelling up from the E. S. E. through the Straits of Mindoro upon about a W. N. W. course. The *Panama's* second storm, which it will be noted was from the S. E., may have been the N. E. quadrant of another storm crossing Palawan, or it may have been an irregularity caused by the junction of the *Fort William's* and the Manilla storm.

* A.M. in Mr. Redfield's pamphlet, P.M. is I suppose meant.

For, as to the *Fort William's* storm, she may be said to have been driven in it on about a S. by E. course, from latitude 25° to latitude 19°. and to have been dismasted about latitude 20°, with the wind at N. E., while the *Panama*, which vessel could not have been in more than 13° 30′, or at most 14° N. had her second storm at S. E., being then at least seven degrees to the S. E. by S. of the *Fort William*. If the storms were the same, the *Panama* should have had the wind S. Westerly, for a S. Easterly wind would require her to have been nearly on the same parallel as the *Fort William*. If the storm had been one also travelling up from the S. E. by S., or S. S. E. *towards* the *Fort William*, it might, it is true, have been, as it was, a tremendous gale at N. E., but at its close it would have veered or shifted to N. W. or S. W., according as the centre passed to the East or West of her position. Nothing of this sort occurred, and it is therefore clear, that the *Fort William's* was a separate storm at N. E. and veering to the Eastward, sufficiently to enable the ship to bear up for Singapore when disabled: whether it was a circular storm, or only the monsoon setting in late with a heavy gale, we cannot, in the absence of the Barometrical observations, decide.

We have unfortunately no records from any ship which might have been at this time in the intervening space between the *Panama* and *Fort William*, or say about latitude 17°, and not far from the meridian of the Macclesfield Shoal. If we had, I think it not improbable, we might have found that the coalition of the two storms might produce a third with a curved track, like our Nos. III. and XXIII.

It is at all events some corroboration of them to find, that the forces which *might* produce such curved tracks have occurred.

I have, then, with these views, assigned an E. S. E. to W. N. W. track, No. XVI., for the Manilla and *Panama's* first storm, a conjectural one No. XVII. from the S. E. to the N. W. for the *Panama's* second storm, and one No. XVIII., (also conjectural, because it *may* have been the monsoon, and our data are imperfect), for the *Fort William's* storm.

TRACK No. XIX.—Tyfoons of 1832.

Documents from Mr. Redfield, Captain Biden, &c.

There appears to have been also during this year two severe tyfoons in the China seas in this year, the one in August, and the other in

October. The following is from the Chinese Repository of August, 1832:—

Tyfoon, 3d August, 1832.

2*d*.—Evening, wind from Northward. Thermometer 92° and Barometer beginning to fall from 29.60 or 70, but not much wind during the night.

At daylight of the 3d, wind fresh. Barometer fell till it reached 28.10, (with some 27.90). In 1809, (*True Briton's* storm,) it fell to 28.30 only. This storm was far more severe, and was much longer from the North. A Dutch vessel sunk between Lintin and Macao. The *Spartan* driven to sea, saved about 40 of her crew. The tyfoon appears to have extended fully 200 miles from N. to S.

Mr. Redfield has collected the following notices of this storm:—

Canton Tyfoon of August 3*d*, 1832.

At *Macao* the wind set in from the *north*, and reached its greatest height about 1 p. m.; continuing with the same violence till 5 p. m., when it *veered suddenly to the southward*, but with diminished strength. When the fury of the gale was exhausted, the quicksilver rose at the rate of three-tenths per half hour. *Barometer, August* 2*d*, 8 *a. m.* 29.68;—8 *p. m.* 29.34;—*Aug.* 3*d*, 8 *a. m.* 29.34;—5 *p. m.* 27.88. Other land barometers differently adjusted, fell to 27.96 and 28.05.

At *Cap-shuy-moon* the gale began at N. and N. W., between which points it blew with tremendous violence; shifting, towards the conclusion to S. E., whence it blew more moderately. The *Barometer*, in the early part, *fell to* 28.20.

The American ship *Don Quixote* left on the day before the tyfoon; and returned on the 5th with loss of mainmast.

Since the tyfoon, the British brig *John Biggar*, from Manilla, has come in dismasted. The Spanish brig *Veloz*, also from Manilla, has arrived with loss of mainmast.

A letter from the commander of the Dutch ship *Fair Armenian*, which foundered about thirty miles westward of the Grand Ladrone, says:—"On the evening of the 2d instant, we made the Grand Ladrone, and on the morning of the 3d, it came on a tyfoon blowing off the land; this about noon increased to a tremendous height and dismasted us; unshipped and broke our rudder, and carried away a great part of the bulwarks. The gale was at its height about 4 or 5 p. m., and after dark gradually moderated."

The *Edmonston, Caledonia, Esperança* and *Italy* have come in without damage. The *Caledonia* on the 3d, when in *latitude* 17° *N., longitude* 113° 50′ *E.*, experienced a *strong gale from W. veering to S. W. and S.*, with a heavy and confused sea. *The barometer fell to* 28.50. The *Edmonston*, on the same day, when within seventy miles off the land, felt the *same weather*, which brought her under bare poles for four hours.

At the *Bocca Tigris*, the weight of the tyfoon, which in *Canton and Whampoa ranged from N. to N. E.*, was felt about 4 or 5 p. m.; the *barometer standing at* 29.10. About 6 p. m. the quicksilver rose, and the gale began to abate.

At *Canton, August, 3d.* Blowing hard at N. and N. E., with violent gusts; *barometer* 29.15; and for the most part rain. *August 4th.* First part blowing hard, *wind S. E. barometer* 29.70;—middle and latter parts strong breezes and fine weather.—*Canton papers of August*, 1832.

Extract from the Journal of an American Shipmaster, bound to Canton. "August 2d, 1832, (nautical time,) *latitude* 18° 34′ *N., longitude* 114° E.; *barometer* 29.56. First part light and baffling winds *from E. to N. E. and N.* and hazy:—middle part the same:—At 4 *a. m. calm, barometer* 29.59:—At 4.30 a. m. a breeze sprung up from W. N. W.;—made all sail by the wind. Latter part and end, strong W. N. W. wind and rough head sea. Took in the royals, flying-jib, and fore and mizen-top-gallant sails. *Bar. at noon* 29.40. The weather, however, looks very fine, and the breeze is steady at W. N. W. *latitude* 19° 54′ *N., longitude* 130° 50′ *E.*

August 3d commences with a strong steady breeze at W. N. W. and hazy weather, barometer falling fast. At 2 p. m. down to 28.98, but not the least unfavorable *appearance* in the clouds, sea, or weather. [The ship was at this time running into the path of the gale, from its southern side.] I must acknowledge that the rapid fall of the mercury, within the last ten hours, has alarmed me not a little, and we are now preparing for the worst of weather.—At 4 *p. m. barometer* 29.25 and the wind freshening; single reefed topsails. The old tars who have seen sail carried on this ship through thick and thin in the stormy regions of the southern ocean, now look at each other with amazement at such preparation for apparently nothing. Towards evening the weather begins to look unfavorable; the sun went down in a body of clouds, deeply tinged with red; not the rich and variegated tints that give rise to pleasurable sensations to all who look upon them, but the fierce, glaring, angry red that creates distress in the bosom, particularly of a mariner. After sunset the moon (at the 2d quarter) could be seen at intervals through the clouds that are driving *from the N. E.* at the rate of twenty knots, and the lightning *shooting up* from every point of the compass. *At* 8 *p. m. barometer* 29.15. Took in all sail, but the close reefed fore and main top-sails and fore-top-mast staysail; the wind still steady at W. N. W. Sounded in 45 fathoms, the *Grand Ladrone bearing N. N. W.* 38 *miles.*

At 10 *p. m. the wind suddenly shifted to W. N. W.* [N. N. W.?] *in a squall.*—Heavy rain and distant thunder until 5 a. m.:—*Had continued shifts of wind all round the compass.*—*At* 7 *a. m.* a steady gale very severe, from about N. W. and constant rain:—hove to under the reefed main-top-sail:—*At* 8 *a. m. barometer* 29. *!!*—Latter part and end, the real genuine, unadulterated Chinese *Tyfoon;* a steady roar and constant rain; took in the main-top-sail.

August 4th. (P. M. of 3d.) The first quarter of this day extremely severe gale and thick weather.—*At* 2.30 *p. m. barometer* 28.88; shortly after which it began to rise:—*at* 6 *p. m.* 29.05;—*at* 8 *p. m.* 29.08, and moderating.—During the night, *hard gale from N. W. to W. S. W.* and torrents of rain.—*At* 4 *a. m. wind S. W to S. S. W.* and hazy:—made sail and by 5 a. m. had royals and studding sails set. During the day passed a number of wrecks, and when we arrived, (5th,) found that the hurricane had been very severe, and caused immense destruction."—*New York Journal of Commerce.*

I have given these logs as they stand in Mr. Redfield's pamphlet, but I should be inclined to think, that the *Caledonia's* storm might be nothing more than a monsoon gale, of which we have so many examples, and which like those of the Bay of Bengal, may be more liable to happen when a circular storm is travelling across in the leeward part of the Bay or sea.

The "American ship master" whose name is not given, seems to me, when he experienced his shift of wind at 10 P. M. of the 3d, to have been just on the limit between the Macao tyfoon and the monsoon gale of the *Caledonia,* for it was certainly not the centre, which at 5 P. M. was at Macao, and if it had travelled to the Southward to reach the American ship, would have left that place with a gale from the N. E., or S. E., or East, whereas by taking the Macao tyfoon to have extended to about this latitude only, which gives it a semi-diameter of 75, and consequently a diameter of 150 miles, and the *Caledonia's* storm as a moonson gale, the steady *breeze* at W. N. W. &c., which the American ship had in latitude 20°, (or half way between the *Caledonia* and Macao,) until he ran into the Southward, half of the storm is clearly accounted for.

On these grounds, then, I have marked for this tyfoon, an East and West track, No. XIX. though it should be borne in mind, that it might really have been a point, or even more to the North or South of East and West, but we have no data, from which to say positively that it was so.

TRACK No. XX.

The MOFFATT'S *Tyfoon.*

The October tyfoon was experienced by the H. C. Chartered ship *Moffatt,* Captain Cromarty. The following is from a Singapore paper, and sent me by Captain Biden. I have here and there abridged those parts which are not essential to our research, and reduced the whole to civil time :—

Singapore, Thursday, 8th November, 1832.

The Company's Chartered ship *Moffatt,* Captain Cromarty, bound for China, put in here the day before yesterday, having lost her main and mizen-masts, and fore-top-mast, and having suffered many other injuries during a violent and protracted hurricane, which she encountered in the China seas within a very few degrees of her destination.

We have been favoured by the Captain with the perusal of the log-book kept during the period of the tempest, from which we are at liberty to give the following details of the various disasters which the ship sustained. The hurricane lasted five days :—

Monday, 22d October. Course E. by S.

"Wind N. E. by N. hard gales, vessel going under close-reefed top-sails. Furled fore and mizen-top-sails and courses, set the storm mizen and main-try-sails. At 11 P. M., heavy hurricane; split the main-try-sail, and furled the main-top-sail. At 1 A. M., increasing hurricane, with much sea, the ship labouring very much, carried away the main-top-mast. At 2, a heavy sea struck the ship, and carried away the starboard quarter boat; the wreck of the main-top-mast in swinging about stove the cutter, and injured the long boat severely. At 5, a dreadful hurricane; the mizen-mast went by the board. At 9, the main-stay gave way, replaced it with much danger and difficulty. At 11, the hurricane continued, the ship labouring very much, and the sea making a continual break over her. P.M., wind veering from N. to East, hurricane still continuing, making every effort to get the wreck of the main-top-mast on deck; the reefed mainsail got adrift, and blew to pieces. 4 P. M., ship labouring very much. The sea washing over the ship's deck incessantly. At 8, ship

lurching very heavily, the main-mast went by the board. When the main-mast fell, one of the top-sail sheets got entangled with the waste anchor, and brought it right on deck.

23*d October*.—At 1 A.M., hurricane abating a little. At 5, hurricane still abating, but a dreadful sea, and the ship rolling very heavily. Carried away the fore-top-mast. At 11 and 12, weather moderating, set the foresail to endeavour to steady the ship, people employed in clearing the wreck. Lat. per observation 17° 9′ N., long. 113° 30′ E. P.M., wind from N.E. to E., employed clearing the wreck. At 7 P.M., hard gales with heavy rain, ship rolling very much, and shipping a great deal of water over all. One pump constantly going. At 10, severe hurricane, which continued until next morning.

24*th October*.—From the continued heavy rolling of the ship, almost every thing, both in between decks and hold got adrift, and it was almost impossible to stand on the deck. P. M., wind from N. E. to N. Hurricane continued throughout the day; the ship labouring very much, and requiring to be pumped every hour.

25*th October*.—Hurricane continued, pumping every hour; shipping great quantities of water over all. Noon latitude 14° 20′ N., longitude 109° 53′ E. At 5 P. M., finding the ship to have driven a long way to the Southward and Westward from the commencement of the hurricane, and also considering the disabled state of the ship, and impracticability in its present state of effecting a passage against a strong N. E. monsoon, bore up for Singapore." No mention is made of the barometer in this ship's log.

The Dutch ship *Esperançe* of Batavia, from China, is the only arrival since the gale."

As the *Moffatt* was bound to China, she of course stood to the N. W. as long as she could on the 22d with the N. E. by N. gale, and was then driven back when lying to and disabled, so as to be at noon on 23d in latitude 17° 9′ N., when the storm again increased and drove her to latitude 14° 20′, just clearing the Paracels; but from the winds veering *from N. to East* on the 23d, and then moderating before another storm set in, we should at first be inclined to take this for two storms, but it seems more probable, that it was one from the N. E. of very slow progress; and that the ship ran into it again by setting her fore-sail, and then drifted with it for a time; for had

the storm passed her she would have had fine weather, and the wind probably from the S. E. We cannot say also if it was not, though so very violent, a monsoon gale, which the season might well admit of, and the want of Barometrical observations tends to perplex our judgment the more. I have therefore marked only a conjectural track from the N. E. for this storm.

1833.

TRACK No. XXI. *Storms of the Brigs* Bee *and* Virginia.

Documents from Capt. Biden, and Capt. Willie.

We have records of two considerable storms in the China sea, in this year, of which one at least was a true tyfoon, I think. The first was a storm occurring in August, in which the brig *Bee* was lost, the brig *Virginia* bound up the China sea, narrowly escaping it; and the second was a storm experienced by the H. C. S. *Lowther Castle*, of which a memorandum was obtained for me from her commander, by the Hon'ble the Court of Directors. I give here the documents, with the usual abridgments.

Extract from the Log of Mr. Willie, Mate of the Brig Virginia, *bound to China, reduced to civil time.*

26*th August*, 1833.—Light 3 and 4 knot breezes S. W. to S. E., steering N. E. and N.E.bN. At noon latitude 15° 44′ N. P. M. breeze decreasing to a calm at midnight.

27*th August*.—5 A. M. light breeze, N. N. W., all sail set. At daylight *a bank of heavy black clouds in the E. S. E.* At 8 moderate, breeze North and cloudy. Till noon veering between N. N. W. and North. At noon, fresh breeze N. W. and N. Latitude observation 16° 10′ N., longitude account* 114° 26′ E. P. M. increasing from N. W.bN., and at 7 P. M. N. N. W. At 8-30 squally and rain, preparing for bad weather. At midnight fresh gale at N. W., with heavy squalls and rain at times.

* No longitudes are given in the Log, I have therefore, as the vessel's true position is of importance, worked it back from the Grand Ladrone.

28*th August.*—At daylight wind about N. W., thick stormy weather all round, with a heavy confused sea. At 9 A. M. increasing to a hard gale about N. W., at noon no observation. Latitude by account 16° 56′ N. longitude account 115° 26′ E. P. M. throughout hard gale with squalls and rain, veering from W. N. W. at 1 A. M., to West at 4, and S. W. at 7, wind *about* S. W.bS. at midnight.

29*th August.*—1 A. M. wind S. S. W., 4 A. M. South; daylight dark gloomy weather, scudding under bare poles with a heavy sea. Noon continued gale with thick cloudy weather. No observation. Latitude by account 18° 36′ N. longitude 115° 10′ E. P. M. wind Southerly throughout, weather moderating, squalls less frequent. Heavy confused sea.

30*th August.*—A. M. moderate, noon latitude observed 20° 8′, long. account 114° 17′. Ran N.bW. 86½ miles to—

31*st August.*—When at 8 A. M. Grand Ladrone bore North 6′ or 7′ distant.

Loss of the Brig Bee.

Copy of a Letter, dated Canton, September 21*st*, 1833.

I am truly sorry to announce to you the total loss of the good brig "*Bee*" and all her cargo, on the morning of 30th August, 1833, she having foundered with us, after a series of heavy gales and one tyfoon near the South Coast of China, in about latitude 21° 30′ North, longitude 112° 50′ East, about 15 miles off the Island of Huilingshan. All hands saved, except one man, who was drowned at the time she filled with water.

On the morning of the 28th August, we left the Capsing-moon, bound to New South Wales, in fine trim, and, I can safely say, every thing comfortable on board. We had hardly gone 20 miles, when it came on to blow very hard from the N. E., which obliged us to run to sea, and gain an offing before night, which we did, and at 6 P. M. hove to, a tremendous sea running at the time. We most fortunately rode out this gale very comfortably without any damage, and next morning, 29th August, it began to moderate a little, and the wind hauled round to the Southward, which was a very good wind

for me, as I intended to go out by the Bashee Passage. I therefore made sail under close-reefed top-sails and courses, steering East about six miles per hour till noon, when we observed, in latitude 21° 7′ N., and estimated longitude 113° 20′ E., a very heavy sea running, but the brig going along nobly. About 1 P. M. a tremendous gust of wind came on from the S. W., which laid the brig on her beam ends; I fortunately got the fore-top-sail, fore-sail and main-sail in before it struck us, but the main-top-sail was shivered to pieces; it then blew a perfect tyfoon, with a sea which I cannot describe striking us in all quarters; the bulwarks were very soon washed away on both sides, and a number of articles washed off the decks; some of the tremendous seas striking us under the counter and abaft, I began to be afraid that if it continued long, some of these seas would stave the counter in, or start some of the butt-ends abaft. Still the good old brig, although lying half the deck in the water, and the awful seas breaking over her, made very little water indeed. The Barometer was now 28.50. About 6 P. M. still blowing I may say a hurricane, and the sea in pyramids about us, I found the brig making more water, but nothing to be alarmed at. At midnight the same kind of weather, and found she was making more water. Immediately set to both pumps, and continued till 4 A. M., the brig gaining on us fast. At 4 A. M., found there was four feet water in the hold; immediately made what possible sail we could, for the purpose of running back to Macao or in with the Coast, as I expected we could not be far from it, supposing, from the sudden leak that the brig must be stove or have started a butt. I got the fore-top-sail on her and fore-sail, steering N. E., when she had gone about five miles, both pumps going, she came up in the wind against the helm, fell over her side, and filled with water immediately; we had hardly time to save ourselves by laying hold of the main rigging. Mr. Hays, the Chief Officer, and some of the men, were cutting the lashing of the long boat and of the other boats at the time; most providentially for him he got hold, but one poor fellow missed his, and we never saw him more. About 6 A. M., it cleared up a little, and we saw the land bearing W. N. W. of us, found that the wreck was driving fast towards the shore, all the people in the main rigging and chains, the sea making a clear breach over us; we all stripped of our clothing to a shirt or frock, in case we might be wash-

ed away, so as to be lighter in swimming, and there we hung in a most miserable state from 6 to about 11 A. M., when we were driven into the surf by the sea and current. Having the fore-top-sail set, and fore-sail hanging down, it assisted us greatly in getting sooner in shore, and most miraculously and providentially, we were driven into a very small sandy Bay, on each side of which were tremendous precipices of rocks, where if we had gone, all hands would have been dashed to pieces, and none left to tell the tale; but the mercy of God is great, and I am truly thankful for the saving of our lives. When we got into the surf, it was running so very high, and carrying every thing before it, that those of the people who could swim well, got hold of some boxes and spars, and took to the water for their lives. The brig very soon went all to pieces in the tremendous surf, and every body was washed hither and thither; most fortunately they all got on shore safe, but bruised." After being plundered and suffering much, the Captain and Crew reached Canton.

Captain Biden adds to this Log, the following Remarks

I was at Macao during the hurricane in which the *Bee* was wrecked, it raged with great violence accompanied with incessant rain, the sea broke over the Praya Grande, and doors and windows on the ground floor of the houses on the Praya Grande were in many instances burst open with the violence of the wind and sea together. The shipping in the Cum-sing-moon and Cap-sing-moon rode out the tremendous gale with yards and topmasts struck and with two anchors a-head. Several ships at Whampoa Reach dragged their anchors, and although the Chinese were as usual well prepared, by hauling their boats into every islet and creek between Macao and Canton, much loss and damage was sustained on the river.

We will now consider the track, which I have assigned to this storm.

The data for it are complicated by two circumstances, the first that we do not know, with the *Virginia*, when the S. Westerly monsoon replaced the S. Westerly gale, (which she found as of course on the S. E. quadrant of the storm,) and with the *Bee* that a storm coming, as this undoubtedly did from the S. Eastward, and impinging upon the high South Coast of China at so direct an angle as it must have done, must have been subject, at short distances from the Coast, (and the *Bee* was only 42 miles from the nearest point at noon on the 9th,) to great irregularities; of which we have abundant instances.

At noon on the 27th, the *Virginia* was just on the S. E. edge of the Macclesfield Shoal, and the "bank of heavy clouds in the E. S. E. was, I have no doubt, the outer barrier of the storm, travelling up from the S. E. between her and the Coast of Luconia.* To noon the next day, 28th, she made a course of 75 miles to the N. Eastward, and thus neared the track of the storm, but as the wind held to the N. N. W., she could only, fortunately for her, make this distance; but we find that the gale was veering rapidly with her, or 6 points in 7 hours, while she was hove to; or from noon on the 28th till 9 P. M. when the wind was so far to the South, that she could scud; a proof, that it was travelling up with great rapidity, and probably passing near her position. It had, moreover, I am inclined to think, not arrived at its full violence at that time. We find that as it ought to do, it began with the *Bee* from the N. Eastward when just outside, and that it veered to S. W., when she was laid on her beam ends. There is the anomaly of the wind being *South first*, and then becoming N. W. but as I have said we cannot account for these anomalies when so near the land.† Upon the whole then, I think we shall not be far wrong if we assign, as tolerably ascertained, a course from S. 40° E. to the N. 40° W. for this storm.

We should not forget that it is *possible* there may have been two storms, one from the E. N. E. and another from the S. E., which may have united near the *Bee's* position, and have caused the temporary moderating and Southerly wind which tempted her to make sail, the burst from the S. W. being the combined effect of both; but for this assumption, we have no sort of authority.

TRACK No. XXII.

LOWTHER CASTLE'S *Storm.*

Memorandum of the LOWTHER CASTLE'S *Storm from the India House.*

12*th October*, 1833.—H. C. S. *Lowther Castle* proceeding up the China sea. Latitude 16° 30′ N., longitude 117° 53′ E. Noon, Barometer 29.72, Thermometer 83°.

* See Col. Reid and various logs in my memoirs for instances of these banks of clouds.

† I have omitted to notice another source of uncertainty as to the *Bee's* position before noon of the 29th. I mean the heavy current to the Westward, which we know prevails at times on the South Coast of China in these storms.

Experienced a very severe gale commencing at N. W., and veering round to the E., and then abating in violence. It blew so hard while it lasted, that it brought us under a close reefed storm mizen try-sail, being compelled to take in the storm main and mizen stay-sail. The Barometer fell during the gale to 29.42 at 8. P.M. Shortly after which the gale moderated, and the Barometer gradually rose to 29.69. At noon on the 13th October, Thermometer 84°.

The *Lowther Castle's* storm, though apparently of small extent and of short duration, is a very remarkable one, both for the fall of the Barometer and the peculiar veering of the wind from N. W. to East, which, with allowance for drift, will give a track of about from N. 12° E. to the S. 12° W., which is much nearer the meridian than any we have yet found coming from the N. E. The memorandum is scanty enough, but I have thought it proper, on account of its probably peculiar nature, to mark a conjectural track for it, as serving to warn the seaman at this season of the year, that such small storms *may* arise. It seems certain enough, that we have rotatory storms of all sizes, and the only question in my mind is, *If the very small ones obey the same laws as the large ones, at sea and on shore?* or if not, where the difference begins? what is the law for the smaller ones? and what the cause of the difference? These questions I propose to investigate on a future day, and to do more than to advert to them here, would be somewhat foreign to our present subject.*

1835.

TRACK No. XXIII.

The TROUGHTON'S *Tyfoon, July* 1835.

Two severe Tyfoons occurred in the China seas in this year, during the height of the N. W. Monsoon, being those of the *Troughton* and the well-known one of the *Raleigh*; as the first occurring, I give that of the *Troughton*.

* As an analogous instance of a small storm of great violence, but in travelling about *from* SbE. to NbW. see Second Memoir on the Law of Storms, Jour. As. Soc., 840, vol. ix. The Cashmere Merchant's Storm.

The *Chinese Repository* for July 1835, Vol. V. p. 151, gives the following account of this storm, in which this unfortunate vessel was disabled, being afterwards plundered by the Chinese fishermen and Ladrones:—

"*8th July*, 1835.—The English bark *Troughton*, Captain James "Thompson, from London, and last from Singapore, arrived this day "in distress. It appears that on the 3d July, in latitude 20° 21′ N., "longitude 112° 53′ E., she experienced a very heavy gale from the N. "E., which was succeeded by a more violent wind from the S. W. The "wind blew to pieces the double reefed main top-sail, and from the "labouring of the ship in the cross sea the main mast gave way, carry-"ing with it the fore and mizen masts, the waves breaking completely "over the deck. During the three following days, the crew were "worn out by pumping, and working at the rigging of the jury "masts. By this time she was near the Mandarin's Cap, when "she was plundered." Details of this and of the sufferings of the crew are given at length, but these do not belong to our subject.

This unfortunately meagre record (for our purpose) allows us to do no more than to assign a conjectural track for this tyfoon, for from the changes of the wind it evidently was one. I have, therefore, with allowance for her drift, given it one conjecturally from the S.E.bS. to the N.W.bN., as it would clearly have been one from S. E. to N. W. had the vessel remained stationary while the N. E. storm lasted; and I have made the line of track to pass 60 miles to the S. W. of the latitude and longitude given on the 3d, as the ship must have drifted to, at least, that distance to the S. W. into the path of the storm, so as to have had the centre passing over her.

TRACK No. XXIV.

The Raleigh's *Tyfoon, August* 1835.

I was at first inclined to omit the details of this storm as appearing almost a useless repetition, but my object being to collect here *all* the details of *all* the storms in the China seas of which any record exists, it would have been imperfectly fulfilled, had I not inserted the results of the valuable labours of Mr. Redfield and Col. Reid, relative to this remarkable storm. The following, then, is copied from Mr. Red-

field's Pamphlet, and I need not say, that the track is that laid down by him :—

The facts which have been chiefly relied on for establishing a South-western course for this gale, are contained in the report of H. M. S. Raleigh, which was overset and disabled in this gale, in the China sea, when under bare poles, which report I have as follows :—

" H. M. Brig *Raleigh*, August 1, 1835.—Working out of Macao Roads at noon S. E., end of Formosa N. 85° E., 340 miles. Fine weather all day. August 3d at noon, S. end of Formosa N. 82½° E., 252 miles. Fine weather all day. August 4th, 10h. 20m. A. M. close reefed top-sails and courses, 12h. 30m. P. M. barometer fell from noon 15.100: took in main-sail and fore-sail—at 9h. 30m. got all snug, vessel going through the water between three and four knots ; barometer 29.40, falling ; at 7h. 30m. wind veered to N. N. E. and tyfoon commenced ; at 8 P. M. barometer 29.36 falling ; 8h. 30m. tyfoon increasing ; 10 P. M. close reefed fore try-sail and set it, tyfoon veered to N. E. with a heavy sea ; at midnight tyfoon increasing ; barometer 29.04, falling.

" August 5th, 3 A. M. tyfoon veered round to E. S. E. still increasing in violence ; 6H. 30M. barometer 28.25 ; 8 A. M. tyfoon increasing ; 9h. 30m. A. M. if possible blowing heavier, ship went over ; in this awful situation ship lay for about 20 minutes ; 9h. 50m. lower masts went by the board and ship righted with seven feet water in her hold ; barometer did not fall lower ; at noon tyfoon moderated a little ; at 6 P. M. tyfoon more moderate, with a heavy sea ; midnight, strong gusts of wind with heavy sea from South."—*Abridged from Canton Register of March* 14, 1837.

See also the log of the *Raleigh*, as it appears in Col. Reid's work, which contains a sketch, shewing the position of the *Raleigh* as given in the log, and illustrating the direction of the wind. Col. Reid has also given the position of a schooner, which encountered the tyfoon in latitude 18° 2′ N., longitude 15° 50′ E., of which I had previously received no account. I will now submit such evidence as I possess, in addition to the account furnished by the *Raleigh ;* adding also a sketch and figure, illustrating the course and progress of the tyfoon, and which was prepared and stereotyped some months since in reference to furnishing an account of this hurricane.

At Macao, where the tyfoon was experienced on the 5th and 6th, many houses were greatly damaged ; also many lives were lost in the inner harbour, and some vessels driven on shore. The direction and changes of the wind at Macao are not stated ; but we are favored with the following valuable table of the state of the barometer during the period of the storm:—

5th August.		H. M.	Barometer.	H. M.	Barometer.
H. M.	Barometer.	0 45 A. M.	28.30	6 45 A. M.	29.12
1 0 A. M.	29.47	1 20 ,, (lowest)	28.05	7 45 ,,	29.20
2 30 P. M.	29.28	1 25 ,,	28.08	8 15 ,,	29.21
5 0 ,,	29.20	1 45 ,,	28.20	8 45 ,,	29.23
7 20 ,,	29.12	1 55 ,,	28.30	9 30 ,,	29.27
9 0 ,,	29.08	2 0 ,,	28.37	10 25 ,,	29.30
10 20 ,,	28.95	2 25 ,,	28.56	11 0 ,,	29.34
10 45 ,,	28.90	2 45 ,,	28.68	2 0 ,,	29.42
11 5 ,,	28.85	3 10 ,,	28.75	and continued rising to 29.65, at which point it usually stands during fine weather."—*Canton Register, August* 15.	
11 30 ,,	28.75	3 40 ,,	28.83		
11 53 ,,	28.65	4 10 ,,	28.90		
6th August.		4 45 ,,	28.97		
0 15 A. M.	28.50	5 10 ,,	29.02		
0 30 ,,	28.40	6 0 ,,	29.08		

This table affords in itself good evidence of the passage of the centre of the vortex near to Macao.

At Canton (60 miles North of Macao,) the tyfoon began on the evening of the 5th, after three or four days of very hot weather, with Northerly winds, and continued throughout the night and the next day. Its violence was greatest about 2 o'clock on the morning of the 6th. The following is an account of the state of the Barometer and Winds at Canton.

This relates to " fine weather" of the S. W. monsoon; the mean of the Barometer for July and August being at Canton 0.40 inch lower than for December and January in the N. E. monsoon. This Barometer at Macao appears to stand about 0.15 or 0.20 inch lower in its adjustment than that used at Canton for the reports in the Canton Register, the mean of which for five years is 30.027. Many if not most of the common ship Barometers stand too low in their adjustment.

		4th August.	
9 A. M.	Barometer	29.79	N. W. fine weather.
4 P. M.	,,	20.70	N. by W. moderate breeze.
		5th August.	
9 A. M.	,,	29.62	Wind N. and N. W., fair weather.
4 P. M.	,,	29.54	,, unsettled rain and fresh breeze.
12 P. M.	,,	29.37	,, N. blowing hard and in heavy gusts.
		6th August.	
5 A. M.	,,	29.34	Wind N. E. blowing hard with heavy rain.
9 A. M.	,,	29.51	,, S. E. ,, ,,
11 A. M.	,,	29.58	,, blowing hard, moderating.
5 P. M.	,,	29.70	,, S. E. ,,
11 P. M.	,,	29.85	,, S. E. ,,

7th August.

8 A.M. *Barometer* 29.94. *Wind S.E. cloudy. Compiled from the Canton Register.*

On Wednesday the 5th instant, a tyfoon swept over the city of Canton. It began in the evening and continued throughout the night and the next day, blowing its best about 2 o'clock in the morning. The damage done by the tyfoon at Canton is small, but not so at Kumsingmoon, Macao, and elsewhere on the coast.—*Canton Paper.*

The American ship *Levant*, Captain Dumaresq, which arrived on the 7th of August, the day after the gale, came in with royals set, from Gasper Island, in fourteen days, having had light winds all the way up the China sea, and *did not feel the tyfoon.* This important fact is stated in the *Canton Register* of *August* 11.

Extract from a private letter from on board the ship *Lady Hayes*, which left Macao roads a day or two before the storm, and returned to Kumsingmoon after the gale.

"Early in the morning of the 5th, we observed indications of bad weather. At 10 A. M. the wind freshened a little from the same quarter, it had been for the last twenty-four hours, viz. North, so we thought it best to turn her head back again to look for shelter, fancying ourselves to be about thirty-five miles off the land. We carried a press of sail until noon, when we found we had too great a distance to run before we could get into shelter, and expecting it would get so thick that we could not see our way; so we turned her head to sea, and clapped on as much sail as she could stagger under, *steering S. E. by E.* The wind being then at North, we were desirous of getting as far off the land as possible, expecting the wind round to the Eastward, there being a most *tremendous swell* from that quarter. *At* 4 P. M. it was blowing in severe gusts, and shipping a good deal of water, and the ship becoming unmanageable. About 8h. 30m. *the wind began to veer to the west*, but continued to blow as hard as ever, till midnight, when it *drew round to South*, and moderated a little. It continued to blow hard from that quarter until noon of the 6th, when it moderated fast, and we began bending other sails in room of those that were split. When the gale commenced, which we consider it did *at* 1 P. M. *on the 5th*, we were about twenty miles East of the Lema; where we were when it ended, it is hard to say as we saw nothing till the morning of the 7th, when we made Mondego Island. We hardly think we could have had the gale so heavy as those inside, and what is most extraordinary, the wind with them veered to the *Eastward round to South*; but with us it veered to the Westward; for had it veered to Eastward, we should most likely have been driven on shore among the Islands, as we could not have been more than fifty miles off the land (?) at 8 P. M. on the 6th.—*Abridged from the Canton Register of August* 18.

On the reduced chart, which is given herewith, the tracks of the *Lady Hayes* and the *Levant* are laid down by estimate from the printed accounts.

The small dotted circle B., surrounded by the storm arrows, is supposed to indicate the position of the centre of the storm at the time the *Raleigh* was overset; and the position of the latter should be marked somewhat nearer this circle, according to the latitude and longitude of the *Raleigh* on the 5th, which Col. Reid has given in her long. The course of the storm appears to have been N. 72° W., and its centre is supposed to have been opposite the *Raleigh*, about 8h. 20m. A. M. on the 5th; but this cannot be ascertained with precision, as the indications of the Barometer do not appear to have been closely watched and recorded during this terrific period of the storm.

Having shewn the rotatory character of these tempests, I consider the depression of the Barometer which attends them, as being due to the rotative action; and the point of greatest depression as indicating the true centre or axis of the storm. From the evidence now before us, we arrive at the following facts :—

1. That the *Raleigh* met a gale which set in with the wind at N., *veering round by the E. to E. S. and South.*

2. That at the harbours and roads "inside," (Macao, Kum-sing-moon, &c.) as well as at Canton, the gale occurred *at a later period;* and the wind *also set in at North, and veered to E. and S. E.*, in a manner similar to that reported by the *Raleigh.*

3. That with the ship *Lady Hayes*, off the islands near Macao, the wind also set in at North; but the ship steering S. E. by E. under a press of sail (and doubtless falling off with the heavy sea from Eastward) and wind, towards the middle of the gale, began to *veer towards the West, whence it drew round to South* towards the close of the gale.

4. That the violence of the wind was apparently greater with the *Raleigh*, than with the *Lady Hayes.*

5. That the gale was experienced by an English Schooner, August 5th, in latitude 18° 2′ N., longitude, 15° 50′ E. ; but the *Levant* arriving on the 7th in her course through the China sea, *did not encounter the gale.*

6. That the fall and rise of the Barometer at Macao and with the *Raleigh*, and the strength and changes of wind with the latter, were such as are often exhibited near the centre of a hurricane; and that the minimum depression of the Barometer occurred about *seventeen hours later at Macao* than with the *Raleigh.*

These facts seem to establish the following conclusions :—

1. That the tyfoon advanced *in a Westerly direction.*

2. Negatively—that it did *not* pass through the China sea, from N. E. to S. W., nor on the opposite of this course.

3. That it was a *progressive whirlwind storm*, turning to the left, round its axis of rotation.

4. That its centre of rotation passed to the *Northward* of the *Lady Hayes*, and to the *Southward* of the *Raleigh* and of Canton, and the an-

chorages near Macao; and nearly on the line A. B. C. as marked on our chart.

5. That the rate of its progress was about *seventeen nautical miles per hour.*

6. That the extent or diameter of the violent part of the gale, as deduced from its duration and rate of progress, was about four hundred nautical miles, or equal to six or seven degrees of latitude.

7. That the latter induction agrees with the geographical evidence, which has been obtained of the visitation of the storm.

The progress of the tyfoon being taken at 17 miles per hour, it follows that the excess of velocity of the wind at E. with the *Raleigh,* over that of the wind at W. with the *Lady Hayes,* supposing the rotation to have been in a circle, would be more than thirty miles an hour; allowing nothing, however, for difference of retardation of the surface wind, and not taking into the account the additional retardation which the West wind of the *Lady Hayes* must have been subject to, in its recurving course over the land. If a circle be drawn on the chart around each of the points B. and C., with a radius equal to 3 or $3\frac{1}{2}$ degrees of latitude, these circles will comprise, somewhat nearly, the field of action of the storm at the two periods of 9 A. M. of the 5th, and 2 A. M. on the 6th of August.

The progressive velocity and course of this tyfoon is nearly the same as that of the Trinidad hurricane of June, 1831; and the rate of progression also corresponds nearly to that of the Antigua hurricane of August 12th, 1835. See Tracks Nos. I. and V. on my chart of the courses of hurricanes in the April No. of the *Nautical Magazine,* 1836.

This examination of the case before us, appears to shew, that the direction of rotation, and the course of progression of this tyfoon, which crossing the China sea, agrees with those of the hurricanes of the West Indies; and that its course was not controlled, or materially influenced, by the existing South-west monsoon."

1836.

I have only the following notices of a storm in this year, from the *Chinese Repository*:—

About 29th July and 1st August, 1836, a severe gale was experienced on the South Coast of China, which was very destructive to the shipping in the China seas. The bark *Susanna* of Macao, and the *Admiral Buyskes,* a Spanish ship, were lost with a part of their crews. Apprehensions were felt for two or three other ships, the *Hormasjee Bomanjee, Hamoody,* and *Margaret Graham.*

The *Repository* of September says, in reference to this: The *Hormasjee Bomanjee, Hamoody,* and *Margaret Graham,* are given up

as lost. On the 31st July, at 10 A. M., the *Alexander*, Captain Wilson, from Macao to Singapore, was wrecked in latitude 10° 28′, longitude 111° 27′ E. No lives lost, but no property saved. The *Hamoody* is said to have reached Manilla.*

TRACK No. XXV.

Tyfoons of the ARIEL *and* VANSITTART, 16*th to* 22*d Nov.* 1837.

I have been favoured by Capt. Burt, with the Log of the ARIEL, *of which the following is an abstract reduced to civil time.*

15*th November*, 1837.—The Barque *Ariel*, bound to China, was at noon in latitude 15° 1′ N., longitude per chronometer 116° 15′ E. with fresh gales from N. N. E., hazy weather and heavy sea on; having increased to this from a steady breeze at midnight of the 14th, vessel standing to the EbS. going 7 and 8 knots. P. M. wind marked N. E. and to 10 P. M. standing to the East; gale increasing rapidly to midnight. At 10, wore to the Northward.

16*th November*.—Wind N.E. to noon; heavy cross sea running very high. At 8, wore to the East, lost mizen-topmast. Noon hard gales N., mountainous sea, latitude observation 15° 8′ N., longitude 116° 45′. Wind about N.N.E., P. M. wind N.N.E. to midnight.

17*th November*.—Gale still increasing and "every appearance of a dreadful tyfoon. Barometer still high at 30.10, and Sympiesometer as usual. Daylight wind hauled to the North in a tremendous squall; 10, blowing awfully hard, and sea beyond description. Noon tyfoon blowing dreadfully, wind N. W. and sea like pyramids all round, could not look to windward, for the wind, rain, and sea blowing on board; the ship frequently lurching half the main rigging, and oftentimes the bowsprit under water. Barometer fell to 29.80. P. M. wind West, a most dreadful tyfoon blowing, ship in a most perilous situation. At 2, wind N. W., and then for two hours till 4 P. M. I really cannot describe the scene; the ship rising with difficulty to several of the lurches got all ready to cut away the masts. At 4

* These are too vague to mark any track from, but they may serve as memoranda. I shall be glad to receive the logs of any vessels which may have experienced this storm.

P. M., the ship lay over so much, that half the lower yards were in the water, saw that she was settling down and upon her beam ends, the water being up to her main hatch. Cut away the main-mast, which carried away the mizen-mast and fore-top-mast with it. Ship righted, three feet water in the hold, sea breaking over us in all quarters. At* —— P. M. the Barometer began to rise, and was at 29.90; and at 6 P. M. at 30.10; during the whole of the night it still blew tremendously, wind veering from N. W. to W. S. W. and South, with constant rain.

18*th November.*—At day-light still blowing hard, and an awful sea running. At 10, wind hauled to S. E., when it began to moderate. Noon, strong gales from the S. E. and sea running, but every appearance of the gale breaking up. Set storm-fore-staysail and hauled up to North, supposing we were well to the West of the Scarborough Shoal, in the neighbourhood of which we must have been all night.

"During this awful tyfoon, the Barometer gave no indication of its approach, for we were under bare poles a long time before it fell, it being all the time at 30.10, then it fell to 29.80, and again it rose to 30.10—15—25 to 35, still gale blowing as hard as ever, and at noon it was at 30.90." No observation. P. M. strong gales from S. E., hauling to East. At 3 P. M. gale again increasing with threatening appearance all round. 3h. 10m. saw the breakers on the Scarborough Shoal, one or two miles off, bearing N. W. by N. to E. N. E., sea breaking mountains high upon it; bore up to the W. S. W. to clear it. 6 P. M. severe gales from the N. N. E. with dreadful weather, sea washing over us in all quarters. At 10, hove to, vessel being very uneasy, and at times severely struck by the sea. Midnight very severe gales from the Northward, with continued rain and an awful sea.

19*th November.*—Day-light the same severe gales and dreadful weather with constant rain, and so thick, we could not see the length of the ship. Wind N. N. W. and tremendous sea. Noon moderating, and wind hauling to the N. N. E. From noon 18th, Barometer *rose* from 30.35 to 31.30. P. M. wind marked N. E. Strong gales, constant rain and awful sea, which we were shipping all over us. After

* Blank in MSS.

consultation with the officers, bore up for Singapore at 3 P. M., running West till midnight.

20*th November.*—Midnight gale increasing again, and heavy seas breaking fore and aft, hove to again till daylight, when severe gales from N. N. W., bore up and scudded under the storm staysail. Noon more moderate, but blowing hard with an awful sea. P. M. strong gales from N. E. with heavy rain, sea falling a little. Midnight more moderate.

21*st November.*—Noon fresh breezes from N. E. to midnight, with dark squally weather, but decreasing wind and sea.

22*d November.*—Decreasing to light breezes from E. N. E. and fine; a long, heavy, turbulent sea on. Noon, light Easterly winds and a heavy sea. Latitude 12° 38′ N., longitude 112° 5′ E.

Memorandum of the VANSITTART'S *Storms off the Coast of Luconia, 17th to 22d November* 1837, *by Capt. Macqueen, then commanding her.*

From the East India House.

"17*th November*, 1837.—In latitude 15° 55′ N., longitude 119° 30′ E., my ship, the *Vansittart*, encountered a severe gale of wind, commencing at sunset with tremendous gusts from the N. W. with lightning and rain. About midnight it blew a perfect hurricane, the wind gradually veering round to the S. W., which caused a very heavy sea. Next morning the weather moderated with the wind at S. E.; made sail, and at noon on the 18th, sighted Cape Bolinao. At 6 P. M. on the 19th, the gale recommenced with increased fury from the N. E. and continued with little intermission for the four following days."

I should observe here, that I have copied this memorandum literally, for reasons which will hereafter appear.

In considering the foregoing storms, I shall first commence with those of the *Ariel*, (for as I shall afterwards shew, they are different from those of the *Vansittart*,) and of course with that first in date.

The *Ariel's* position is fortunately well ascertained on the 16th by observation, and on the 18th by working back her run from 3h. 10m. P. M. when she sighted the Scarborough Shoal. Her drift made good, then, during this 48 hours is S. 75° E. 62 miles, which agrees as nearly as possible with what appears from careful projection to have been, up to this time, the track of the storm, *i. e.* about on a line S. 75° E. to N. 75° W. Another instance in addition to those before quoted of ships being sometimes drifted round the quadrant of a storm, so as to arrive, at the conclusion of it, at a point in the first storm circle, opposite to that at which it commenced with them. The *Ariel* appears also from the terrific violence of the wind, the pyramidal sea, and the rapid veering of the wind from North at day-light of the 17th to about South, at midnight of the same day, or 16 points in 18 hours, to have been drifting close past the centre.

From this time, however, it appears, that the storm must have curved away to the W.S.W. and S.W., so as to bring the ship upon its North Eastern quadrant, and the wind consequently to S.E., at which it remained from 10 A. M. on the 18th till 3 P. M., when the sight of the breakers on the Scarborough obliged them to bear up. By 6 P. M., they had again severe gales from the N.N.E., the wind having hauled round by the East. I consider that this was the beginning of a second storm, but that it was, as will be shewn in the log of the *Vansittart*, a storm occasioned by the N. E. monsoon setting in with the force of a gale, and not a rotatory one, for the ship though suffering very severe weather, had the winds constantly between N. N. W. and N. E. only, till they obtained fine weather, though running to the Westward. Had this second gale been a circular storm, it must have overtaken and passed them when hove to, when it would have veered either by the East or West, but this *vibrating* of the winds, as above, is like that of a strong monsoon gale, disturbed on its course by the *Vansittart's* and *Ariel's* storms, and we have I consider, no data whatsoever from which to consider it a circular storm; I have thus not marked it on the chart.

We now come to consider the *Vansittart's* storms. These it is evident could not be the same as the *Ariel's*, for the ships were at least 170 miles apart, the *Vansittart*, bearing N. E. by E. $\frac{1}{2}$ E. from the *Ariel* at noon on the 16th, when this last had an awful tyfoon at

N. W. with its centre close to her; that of the *Vansittart* beginning only at sunset on the 17th—the memorandum which I have exactly copied evidently relating to civil time,* though it is not said so.

The *Vansittart's* second storm is, I think, also clearly a monsoon gale, as there is no account of its veering or changing. I have therefore marked her first storm, conjecturally only, parallel to our track No. V. as passing Cape Bolinao, and travelling to the W. S. W.

The singular phenomenon of the Barometer's giving no warning, remaining so high, and falling so little in such a terrific tempest, is most remarkable. Our first care is of course to ascertain, that it really occurred, before reasoning about it. I wrote to Captain Burt, who was then Chief Officer of the *Ariel*, requesting to know if there was any reason to mistrust the Barometer in any way? if they had compared it on arriving at Macao? &c. His answer is as follows:—

"We had no reason to mistrust the Barometer, as it had always indicated any change in the weather correctly. I am not aware whether Captain Warden compared it with any other in Singapore or not; he was then in command of the *Ariel*. It is not the same glass we have at present. It was on board the ship 18 months after the tyfoon, and we always found it true."

There seems then little doubt that the anomaly did really occur; the question then is, "To what can it be attributed?"

If, as I have shewn, we suppose the two storms approaching the same point, the *Vansittart's* from the N. E., and the *Ariel's* from the E.S.E., with a heavy N. E. monsoon behind the former, blowing through the whole extent of the trade wind across the Northern Pacific, and unchecked, except partially by the N.W. point of Luconia, we shall have three causes, all tending to augment the atmospheric column not far to the Westward of where the *Ariel* was on the 16th. I can see no other more simple or more probable explanation. It is however an anomaly to be carefully borne in mind by the seaman, and by all who investigate the *Law of Storms*, and the more so, that even the Sympiesometer also gave no indication of the approaching mischief.!

* If we were to call it nautical time, "sunset of the 17th" would be sunset of the 16th civil time, but there is still a discrepancy wholly irreconcilable, for the *Ariel* had then had her tyfoon blowing for at least 6 or 9 hours from the N. N. E. The high land of Luzon cannot have occasioned all this anomaly.

1838.

For this year the only notice I have obtained of, apparently, a severe storm, is the following from the *Chinese Repository* of September 1838.

The bark *Claremont* having sprung a leak, foundered near the Ladrones on the 24th September. She encountered a gale on the 22d in lat. 19° 2′ N. and long. 114° 50′ E. As this gale is not noticed as having occurred in China, it was probably either of small extent if the *Claremont* suffered from its Southern quadrant, or one passing to the Southward of this latitude if she had the Northern quadrant of it. We cannot even conjecture its track from this notice, but as before observed, the date is always a record worth preserving.

1839.

The SUNDA'S *Storm.*

The British bark *Sunda*, by an account printed in the Canton press, saw on the 7th October, 1839, at 6 P. M. the land of Tyloo, N. E.bN. distant about 35 miles, weather very unsettled, and Barometer falling fast. All preparations for bad weather were made, and at 9 o'clock, the wind suddenly veered from N. N. W. to N. E.bE. and blew a strong gale, when many of the sails were blown from the yards. At 3 A. M. of the 8th, it blew a hurricane accompanied with a tremendous sea. At 8 A.M., it abated a little, but the sea more violent, and tossing in all directions; from this time the wind continued to abate, but it still blew a strong gale with a heavy sea till the 10th, when it became moderate, the wind from the N. E. Vessel very much disabled by the loss of her top-masts and sails. On the 11th, it was fine, at 4 A. M. saw the Taya Islands W. S. W., distant 8 miles, when she bore up and anchored under the lee of one of them, but in the evening it again came on to blow from the E. N. E., when the cable parted, and she was wrecked. The crew were kindly treated and sent to Canton by the Chinese authorities.

I am inclined to consider this storm as only a violent monsoon gale, for there seems to have been no veering of the wind which could authorise us to consider it a rotatory storm. We have many cases in which the monsoon does sometimes set in with a gale rising almost to the force of a hurricane, and the season was sufficiently advanced for an early monsoon to begin. In Mr. Redfield's table of

the changes of the monsoons, compiled from the *Canton Register*, it appears that in 1831 the change took place between the 1st and 14th October, and in 1830, from the 5th to the 12th October. This valuable document comes down only I regret to say to 1835, and I have not been able to find any source from which to continue it, or at least to ascertain the setting in of the monsoon for this year.

TRACKS No. XXVI AND XXVII.

The THETIS *and* GOLCONDA'S *Tyfoons.*

In No. CXIX of the *Journal of the Asiatic Society*, I published as my Fourth Memoir on the Law of Storms, accompanied by a chart, a detailed investigation of these two storms, in one or both of which, (for she might very possibly have been caught at their junction,) the unfortunate *Golconda*, with the head-quarters of the 37th Madras Native Infantry, and 300 troops on board, appears to have foundered.

In this it is clearly shewn, from the logs of the Ships *Thetis of London* and *Thetis of Calcutta*, which were almost in company with the *Golconda*, that they fell in, about the Macclesfield Bank, with *two* storms, one of which travelled from the S. 78° E. to the N. 78° W. passing about 100 miles to the North of the Macclesfield, and the other travelled from S. 10° E. to about the North 10° W.* Of the three Ships, the one, the *Thetis of London*, to all appearance perfectly aware of his position, with an excellent Simpiesometer and Barometer on board, the first oscillating *for twenty-four hours* before the gale! hove to at the right time and place to avoid running across the track of the storm, and received no injury. The second, the *Thetis of Calcutta*, with less warning, having no Simpiesometer on board, and being tempted by a fair S. West wind, ran on till she was in great danger, and finally lost her mainmast, had three feet water in her hold and was in great danger of foundering from her pumps being crushed by the fall of the mast.

The third, the unfortunate *Golconda*, which was but a short distance ahead, was in all probability lost by running into the centre of one of the storms.

I subjoin as an epitome of the evidence upon which this conclusion

* This and the Lowther Castle's Storm p. 679, are the first Storms I have met with, the track of which was so near the Meridian.

is founded, the comparative table from the logs of the two *Thetis'*, and must refer those who are desirous of further details to the memoir itself, in which I have endeavoured scrupulously to discuss the evidence, so as to have no shadow of doubt that there *must* have been two storms, and that their tracks cannot have been far from where I have laid them down.

Tabular View of the Hurricane of 22nd to 24th September 1840, *in the China Sea, as experienced by the ships* THETIS OF LONDON *and* THETIS OF CALCUTTA.

Date.	Ships' Names.	Winds and Weather.	Lat. N.	Lon. E.	Bar.	Simp.	Ther.	Remarks.
			° ′	° ′				
19th Sept. at Noon.	London Thetis,	Light Southerly. hot and sultry weather	14 26	113 39	29.94	0	86½°	
	Calcutta Thetis,	Light SW. airs and fine,	11 44	111 15	29.79	0	92°	
20th Sept. at Noon.	London Thetis,	Calms and Light SE. airs, sultry, ...	14 53	114 9	29.90	0	87	At Midnight squally weather.
	Calcutta Thetis,	SW. and WSW. airs and fine, ...	12 40	111 57	29.79	0	89	
21st Sept. at Noon.	London Thetis,	Light NW. winds, gloomy and close, ...	15 57	115 9	29.87	29.30	84	Noon rain, thunder and squally; wind NW. Simp. very unsteady during this 24 hours.
	Calcutta Thetis,	Light from WNW. till 7 P.M. at 7 breeze freshening from NNW. thick cloudy weather, ...	13 20	112 40	29.70	0	89	

Date.	Ships' Names.	Winds and Weather.	Lat. N.	Lon. E.	Bar.	Simp.	Ther.	Remarks.
			° ′	° ′				
22nd Sept. at Noon.	London Thetis, ...	NNW. Increasing breeze and sea,	16·20	115·30	29·64	29·12	85½	Threatening; sea rising; glass falling, and wind increasing; hove to.
	Calcutta Thetis, ...	W. by S. strong breezes, ..	14·55	114·55	29·56	0	86	Increasing with gloomy weather; running to the NE.
22nd Sept. at Midnight.	London Thetis, ...	WNW. violent gale, terrific squalls, ...	0	0	0	0	0	Bar. still falling.
	Calcutta Thetis, ...	SW. Increasing and incessant squalls; running to the NE. and NW. since noon, ...	0	0	0	0	0	Sea getting up from SW.
23rd Sept. at Noon.*	London Thetis, ...	SW. almost a hurricane,	16·40	116·15	29·20	28·73	0	No abatement.
	Calcutta Thetis, ...	SW. furious tyfoon, lying to, ...	15 50	115·13	28·80	0	0	High sea; lost mizen topmast.
23rd Sept. at Midnight.	London Thetis, ...	About South, moderating fast, ...	0	0	29·50	0	0	Bore up at 5 P.M. Sea higher than in the gale.
	Calcutta Thetis, ...	SW. Heavy tyfoon, squalls not so frequent, ..	0	0	0	0	0	Sea very cross.
24th Sept. at Noon.	London Thetis, ...	SSE. Moderate, ...	18·25	117·20	29 80	0	81½	Fine and squalls, wind SE. and moderate to Macao.
	Calcutta Thetis, ...	S. Gale breaking, ...	17·14	115·35	29·40	0	0	AM. Rolled away the main mast, &c.; at 8 PM., wind SSE.

* Golconda probably lost about this time.

1840.

The Oneida's *Tyfoon.*

October 1840, *from the Singapore Free Press.*

The following notice of a tyfoon in the China seas was elicited by the public notice of the Indian Government, of October 1839, published at my solicitation, requesting information from all persons on the subject of storms. It is, unfortunately, the only account we have of this storm, and though a good one, wants so many of the data from which to lay down its track, that all we can do is to notice it as a heavy tyfoon from *about* East or E. S. E. in *about* latitude 18° 40′ to 19° North, and *about* on the meridian of the Paracels.

TO THE EDITOR OF THE SINGAPORE FREE PRESS.

Dear Sir,—Noticing in your paper a request on the part of the British Government for information relative to storms, it seems incumbent upon me, visiting this port to repair damages sustained in one, to make a few observations, which though they may not be sufficiently close to aid the cause of science much, may be of interest to the general reader, or seaman, to whom I shall more particularly address them. I sailed from Canton on the 13th of October, and lost sight of the land about 5 P. M. Through the night and the next day the wind was N. E. and steady, and the general aspect of the weather was that which we see on sounding, or when the atmosphere is lit up by the reflection from ' green water,' as termed. At 9 P. M. I noticed the mercury to have fallen 20 parts of an inch from its usual standard at Canton for October, but apprehended no change, as it is liable to fall on approaching a lower latitude, and the weather continued good, wind having hauled about N. N. E. At 11 P. M. the barometer was 29.70, with more wind and a small swell from the Northward. At 3 A. M. it had fallen more, and appearances were changing in the thin misty clouds that were hurrying over and as fast collecting again. At 4 A. M. the mercury stood 29.50; and to be on the safe side, I double-reefed the topsails, furled the main sail and jib, and sent the royal-yards down, expecting an ' Easterly Gale.' At 5 A. M. the barometer had fallen lower, and the gale

coming on thick and fast, without any indications to windward of more settled weather, I was forced to expect a hurricane against my previous opinions, supported as they were by the season, and the absence of those earlier indications, save the swell, that are usually considered a prelude to these tempests. Supposing in that even, that the wind would haul to the West as it then had to the North, brought the ship to three points, or S. W. by W., put preventers upon the yards, determined to carry sail at every hazard, and run from the gale as the rotary theory would seem to intimate,—but there was more to be feared from the North Paracel Shoal, inside, or to the West of which, I suppose we were. The top-gallant-yards were coming down between this and 7 o'clock, when it was full late to reduce sail; and the mizen-top-sail being in and the others upon the cap, I knew no end more conducive to our safety, than to carry on and let them blow away, which they soon did in a yaw to windward, leaving the fore-top-mast-stay-sail to veer under, which brought us round in a lurch that put at rest all further exertion to secure anything to leeward, or do much elsewhere, for the air was full of foam and spray. At 10 o'clock I found the wind had shifted within the last 20 minutes to W. S. W. and blew much harder than before, carrying the ship well over, or as near on her beam-ends, as is generally understood by that term when applied to ships laying in violent tempest that have not entirely capsized. I had not seen the barometer since last noted, for the passage to it was lumbered up, and I was more intent upon the compass, and thinking of the shoal, to leeward; but the Mate, who succeeded better, said it was 28.36′. One of the lee cabin dead-lights at this time burst open, and I believe the ship might have been lost from that cause alone, had no one been present, or the hinges have gone; for that side was under water. At 11 o'clock the mercury was up, but it was doubtful when it had moderated. At 12 P. M. it certainly had, and at 2 P. M. we were looking about us again. (We found the jibboom and appendages carried away, and a whole suit of sails from 'top to bottom,' for those that were furled had blown from the gaskets, and those sent down could not be secured to leeward and were lost—other spars, bulwarks, &c. were gone.) At noon of the next day, after sailing through the night and forenoon $1\frac{1}{2}$ to 2 knots West against the swell, I found we were twenty miles North of the *North Paracel Shoal*, and on its meri-

dian, which shewed that the S. W. current I had expected, and which is usually provided against in this vicinity, did not exist, and gave cause for the smoothness of the water that favoured us during the gale. We found the ship strained and badly chafed about the upper works and rigging, and not in a fit condition to enter the Indian ocean. This ship is considered one of the best built of American vessels, and probably any other; it may therefore not be improbable that more serious accidents have happened to others less favoured, if any were within the range of its influence

Whatever opinion may be entertained about the generation and motions of winds—it is not a new thing that deep gulphs, narrow passages, high lands, and extensive shoals, exercise a great influence over them; and the spot in consideration may be indebted to its known propensity for gales to that cause alone, as also the gulph of Mexico and California on the opposite side, and other deep indentations of coast.

Yours, &c.

George Barrell,

Master of the American ship Oneida, lately from China.

Singapore, Nov. 2, 1840.

TRACK No. XXVIII.

Magicienne *and* St. Paul's *Tyfoon.*

The following are the only notices I have been able to procure of this remarkable storm :—

30*th November*, 1840.

Magicienne *and* St. Paul's *Storm.*

The *Ariel* left Macao roads on the 30th November, having had fine weather with N. E. breezes on the 29th. At noon 30th, latitude account 20° 46′ N., longitude 113°, fine 7 knot breeze N. E.

Loss of the French Frigate Magicienne.

During the week some indistinct rumours had reached this place (Singapore) regarding the loss of the *Magicienne*, which have received unfortunate confirmation by the arrival of the *Iberia* from Manilla;

and the following brief particulars have been handed us by a gentleman, who has derived them from an authentic source.

On the 27th Nov., which was just a month after her departure from this port for Manilla, the *Magicienne* encountered a very strong gale in the *Palawan Passage,* which by the 29th had increased to a tyfoon, in which she lost her masts, and received so much damage in her rudder that she became unmanageable, and about 2 A. M. on the same day, she was carried by a strong current on to the Bombay Shoal,* to the N. N. W. of *Palawan;* and in this state borne on by a terrible sea, was dashed on the reef, where she instantly went to pieces. The crew immediately betook themselves to the construction of rafts, to reach a safe shore; but fortunately on the third day, the whole ship's company were picked up by two English vessels, the *Mysore* and *Clifford,* and the French vessel *Favorite,* on board of whichthey were conveyed in safety to Manila, where they arrived on the 15th instant. The French Corvette *Danaide,* left Manila on the 3d instant, for the scene of this disaster, with the intention, as was supposed, of recovering every thing that could be saved from the wreck, and had not returned by the 26th.—*Singapore Free Press,* 31*st Dec.* 1840.

The American Ship St. Paul.

The following account of a severe gale, which the American ship *St. Paul* encountered in the China sea, on her way from Manilla to this port, where she arrived in the course of the week, has been handed us for publication:—

"The American ship *St. Paul,* G. Pevice, commander, sailed from Manilla on the 26th November, having fine weather and the wind at from E. to N. N. E. until the 29th, sea account; the wind then freshened into a strong gale at N. E. Latitude 12° N. longitude 112° 23′ E. On the 30th at 4 P. M. brought the ship under close reefed top-sails until 6, when she came to the wind, having lost her sails. The sea and wind continued to increase, and at half-past 6 P. M. the sea was making a complete breach over her, washed away the quarter boat, and so strained the ship as to cause a leak under her starboard quarter. At 7 P. M. the top-masts went by the

* Lat. 9° 26½ N. long. 116° 54′ E.

board, being blown away—ship lying with lee rail under water until 1 A. M.; wind blowing a hurricane from N. E. Both pumps at work, the men obliged to be lashed to keep them ageing. The weather moderated at 1 A. M. for a short time, when the wind shifted to the N. W. and blew with still greater fury, and from thence suddenly shifted to S. W. at 3 A. M., blowing a complete hurricane, heavier than at any time before. At 6 A. M. the wind hauled round to S., and then to S. S. E., and it began to moderate at 8 A. M. During the gale the barometer ranged as follows:—

At noon of the 29th, (sea account,)	29.70
4 P. M. 30th	29.60
6 „	29.40
8 „	29.40
11 „	28.40
2 A. M.	28.30
3 „	28.20
Noon.	29.55

[*Singapore Free Press, Dec.* 24.

We may from these accounts deduce, I think fairly enough, that *La Magicienne* was dismasted in the N. W. quadrant of a storm of which the centre did not pass far from the Bombay Shoal. The frigate was probably drifted upon the shoal by a N. W. current occasioned by S. Westerly wind in the S. E. quadrant of the storm, or by a N. Westerly current, created by the S. E. wind in its N. Easterly quadrant, according as she was to the S. E. or the N. W. of the shoal. The last is the most probable, because the usual track lies within the shoal.

We may take the centre then, in the absence of better data, to have passed over the Bombay Shoal, and about noon on the 29th, and we find that at 3 A. M. on the 30th, civil time, it had passed the *St. Paul*, which ship might then be about in latitude 11° N., longitude 111° E.

This gives a track of N. 75° W. and S. 75° E., and a distance of 360 miles in the 15 hours, or 24 miles per hour. This rate of travelling is also higher than any we have yet obtained for either the China Seas or Bay of Bengal, but it is not an excessive one compared with those of the Western hemisphere, and if we admit the two ships to have experienced the same storm, which is quite as probable as that

there were two of them, we cannot be very far wrong as to this part of our estimate.

Another remark to be made, and it is one of much importance, is, that throughout this long period of years, this is the only instance in which we find a storm in so low a latitude as that of 11° N. the *Castlereagh's* Track, No. IX, being in about 12° N. The curves of those of the *Ariel* and *Moffatt,* if their storms reached so far, are only conjectural here, and reach the Coast of Cochin China in 12°, while the *Castle Huntley's* storm, Track No. XII, and the Calcutta *Thetis'* cross the usual route in 13°. We may then, as this space is as much crossed as any other part of the sea, infer, that when storms do occur so low as the latitudes of 10° or 11° N., they are of extreme violence, and perhaps (at least in this instance) also, they travel with great rapidity.

1841.

TRACK No. XXIX.

Hong Kong Tyfoon of 21*st July*, 1841.

In this year we have three remarkable tyfoons. Two in July, of which the centre passed close to Hong Kong, where great damage was done to the fleet lying there, and one which seems to have raged in about lat. 14° 20′ in November. Of this last I grieve to say, our records are very imperfect, though I personally applied again and again to parties, who could have afforded me such as would have enabled me to lay down a certain track for the storm.

The Hashmy's *Hurricane at Hong Kong, July* 1841.

21*st July,* 1841, *civil time.*

First part thick cloudy weather, with an increasing breeze from the N. W. and squally, glass falling; 4 A. M. hard gusts from Northward, made all snug, increasing with tremendous gusts, let go the sheet and veered to 60 fathoms on the bowers, a barque astern in the way. 11 A. M. the tyfoon at its height, Barometer 28.90, Symp. 28.65,

wind veering to the Eastward. The spray and mist of the sea only allowing us to see the mast-heads of the ships nearest to us, and completely concealing the hulls. Tyfoon drawing to the South and moderating, (time not mentioned,) several vessels dismasted and on shore; great mischief done at the town, *James Lang* and *Prince George* lost.

Tyfoon of 21*st July.*

The following Table is copied from the *Canton Register* That for the storm of the 26th, from the same source, I have given afterwards, to avoid confounding the documents relative to the two Storms:—

Wednesday the 21*st.*

8	0	A. M.	29.42	N. W. showery and fresh.
9	30	,,	29.32	N. W. Fresh wind.
10	0	,,	29.25	N. Rainy.
11	0	,,	29.15	N. Rainy and squally.
12	0	,,	29.03	N. E. Strong wind.
1	0	P. M.	28.96	N. E. Gusts.
2	0	,,	28.92	E. N. E. Hard gusts
3	0	,,	28.94	E.
3	30	,,	29.04	E.
4	0	,,	29.10	E. Misty.
5	0	,,	29.21	S. E. Rain and gusts.
6	0	,,	29.27	S. Hard puffs.
7	0	,,	29.34	S. Rain moderating.
8	0	,,	29.38	S. Rain moderating.
9	0	,,	29.45	S. Rain and high breeze.
10	0	,,	29.53	S. Rain and high breeze.
11	0	,,	29.54	S. Rain.
12	0	,,	26.54	S. Fresh breeze.

The wind from the North in the first tyfoon was remarkable for its strength and duration. The effect upon vegetation in Macao was very destructive, every thing appearing as if it had been scorched;

the air was filled with salt spray. Fortunately, the greater part of the rice crop in this vicinity had been harvested.

Captain Fraser, of the *Good Success*, in a letter dated 24th July, says, that on Thursday 22d, blowing strong from the S. S. E. they picked up a Portuguese, from whom they learned that he had belonged to the *Rose*, from the East Coast to Macao, which had foundered about three days before, at noon. *Grand Ladrone*, bearing N. ½ E. 29 miles, hove to and saved the crew of a junk. In the late severe weather we had not a tyfoon, being well to the Southward, but a heavy gale from S. W. with a tremendous sea.

The *Louisa* Cutter, bound to Hong Kong from Macao, left on 20th July, and at 10 P. M. the wind freshened till after midnight. On the 21st at daylight, it was blowing a gale from N. W. to N. N. W. By 3 P. M. the wind had veered to E. and S. E., and she was totally wrecked on the islands on the Western shore of the river. The Commodore and H. B. M. Commissioner, Mr. Elliott, who were passengers, narrowly escaped with their lives.

The ship *Ruby* on 15th July, 1841, was lying in Shih-poo harbour, on the East Coast of China, latitude 29° 2′ N., longitude 121° 40′ E. and had on that day at daylight Barometer falling. At 10, wind veering from N. E. to N. W. with heavy rain and a strong swell setting into the harbour. Made preparations for bad weather. Noon Barometer still falling, having sunk since the preceding evening from 29.80 to 29.20. P. M. weather finer, and at midnight quite fine and glass rising.

Abstract of the Log of the Brig KITTY, *Captain Willie, lying in Hong Kong Harbour, civil time.*

20*th July*, 1841.—Latterly light breezes, dark cloudy weather, and threatening appearance.

21*st July*.—Begins with the same. At 1h. 30m. strong gusts of wind from the Northward, with lightning in the West. Prepared for a tyfoon, wind N. N. Easterly, Barometer having fallen from 29.60 to 29.40. At 6h. 30m., heavy gusts from N. N. E. with rain, a tyfoon evidently approaching. Let go the best bower and veered to 90 fathoms. At 10 A. M., Barometer 29.10, blowing a furious hurricane from the

N. E. Let go sheet anchor, wind veering to the S. E. (time not noticed.) At 6 P. M. moderated to a gale from S. E., Barometer rising, and at midnight 29.40.

22*d July*.—From 1 to 6 gale moderate, but still in heavy gusts, at noon fine.

For this track I take the storm to have really veered from N. W. to S. E., as it did with the *Louisa* in the more open part of the river, and at Macao we find that the wind was at N. W., when the Barometer had already sunk to 29.32, which is far below the usual average at this season. At Hong Kong also it seems fairly enough to have begun at N. W., though in an enclosed anchorage with much high land to the N. E. of it, and beyond that on the continent of China, we must not look with any great nicety as to the exact point from which the wind may blow, particularly in the first part of a storm. A shift from N. W. to S. E. gives about a N. E. and S. W. track to the storm.

The bearing and distance of Shih-poo, where the *Ruby* was lying, from Macao, is about N. 40 or N. 42 E. 688 miles, and we see that a storm was probably passing from the N. E. to S. W., at 50 or 100 miles distance from her anchorage, at noon on the 15th. From noon 15th to noon 21st are six days, which time, if these storms were the same, it took to force its way over the high lands intervening between Shih-poo and Macao, which would give it 112 miles in 24 hours, or $4\frac{3}{4}$ miles per hour.

This is assuming it to have pursued a nearly straight course. If the mountain ranges forced it to take a curved track round the Coast, the rate of travelling would then be higher. We have, I think evidence enough, (see Third and Fifth Memoirs, *Journal of the Asiatic Society*, Vol. IX. p. 1049, and Vol. X. No. 121 1842, p. 20,) to shew that considerable retardation does occur, when storms meet with high land on their inland course, and thus there is no improbability in supposing the *Ruby's* Barometer to have been announcing to them the passage of the Macao storm.*

* I mention here a practical result, to which I may advert in another Memoir. If China was a country under European dominion, a telegraph might, when these storms strike the Eastern Coast, warn those on the Southern, that they were coming, and in India we might often attain the same advantage. Our children may see this done.

TRACK No. XXX. *Hong Kong Tyfoon of the 26th July,* 1841.

Log of the Ship HASHMY, *lying at Hong Kong, 26th July* 1841, *civil time.*

2 A. M. Wind freshening from N. N. E. with sudden gusts, and threatening appearance, made all snug and veered away. 9 A. M. Tyfoon with fearful gusts, wind shifting rapidly to E. and S. E., furious gusts from S. E. with sudden lulls, time not marked. Barometer 28.40. Symp. 28.20. Glasses rising rapidly. In the evening, the wind moderated with heavy rain, wind S. W., possibly the Monsoon. It is a singular circumstance in this Tyfoon, and shewing the small extent of the vortex, that a ship at anchor in the Lantao Passage, had the tyfoon commencing at North, and shifting round to the Westward, while with us at Hong Kong, at about 15 miles to the Eastward, the wind shifted by way of East. The vortex must then have been very close to us, and its effects could not have been felt any distance from the land, as a ship came in from the Southward the following day with her royal yards across.

Extract from the Log of the Brig KITTY, *Capt. Willie, lying in Hong Kong Harbour, civil time.*

25*th July,* 1841.—Latter part dull cloudy weather, 6 h. 30 m. threatening appearance in the S. E., 7h. heavy gusts, at midnight calm and fresh breezes N. E. and North.

26*th July.*—Begins with fresh breezes from the Northward with lightning in the N. N. W. At 1h. sudden strong gusts of wind varying from N. N. E. to N. N. W. At 2h. 30m. A. M. a strong tyfoon from N., attended with furious gusts of wind and constant heavy rain. At 3, veered away and made all snug. 6 A. M. wind shifted to N. E. At 8 A. M., wind E. S. E. Barometer 28.605. 9 A. M. wind S. E. At 10, South, tyfoon still blowing furiously with constant heavy rain. Noon, wind varying from S. E. to S. Barometer 28.605. 3 P. M. more moderate, but heavy gusts at times. The same to midnight, gusts from S. and S. E.

27*th July.*—Moderating from midnight.

The following is the Barometrical Table at Macao, which, by the way, does not begin soon enough, for, if possible, the fall should always be watched from the usual average till it again returns to the same point. There are many very interesting questions connected with the more or less gradual or sudden falls and rises of those instruments, which observers can much contribute to solve by attending to this remark:—

Barometrical Register at Macao, Monday, the 26th July, 1841.

"	7	30	A. M.	29.17 N. W. Rain.
	9	0	,,	28.94 N. W. Heavy rain.
	10	0	,,	28.94 W. High wind.
	10	40		29.00 S. W. Rain and high wind.
	11	0	,,	29.08 S. W. Ditto.
	0	25	P. M.	29.25 S. W. Ditto.
	1	0	,,	29.33 S. S. W. Moderating.
	2	0	,,	29.37 S. Gusts.
	3	0	,,	29.40 S. Less wind.
	4	0	,,	29.44 S. Heavy rain.
	5	0	,,	29.49 S. Ditto.
	6	0	,,	29.53 S. Ditto from wind.
	7	0	,,	29.58 S. High breeze.
	8	0	,,	29.58 S. Rain.
	9	0	,,	29.64 S. Ditto.
	10	0	,,	29.68 S. Ditto.
	11	0	,,	29.70 S. Fresh breeze.
	12	0	,,	29.70 S. Ditto.

The above Table shews, that the wind on the 2d day veered from N. round to W. and S. W., but at Whampoa and Hong Kong, we have been told it veered from N. round to E. S. E. and S. W., this would indicate, according to the theory of Redfield, that the vortex passed between Macao and Hong Kong.

That the centre was *at one time* between Hong Kong and the Lantao Passage, there can be no doubt; as also, that this small tyfoon, for it appears to have been of limited extent, was one coming up from the S. E.bE., or about from the Grand Lema to the centre of Lantao

Island, its right hand quadrants, close to the centre, taking Hong Kong, while the left hand ones at different distances struck the ship in the Lantao Passage and the town of Macao. I have therefore given it that track, as one tolerably well ascertained for the only part of its course of which we have any notice, and marked it as No. XXX upon our chart.

Ardaseer's *Tyfoon of November*, 1841.

For this tyfoon, I have only, I regret to say, the following Documents:—

Abridged Log of the Barque Ariel, *Captain J. Burt, reduced to civil time.*

The *Ariel* left Macao roads at noon, 16th November, 1841, with moderate North breezes and fine weather. P. M. to midnight wind North to 3 P. M., and N. E.bN., afterwards stood to S. and S. S. W., 6 and 7 knots, with fresh breezes and cloudy at midnight.

17*th November.*—4 A. M. strong breeze and thick weather, noon fresh gale, (about N. N. E.), and thick weather with a cross sea, latitude account 19° 31′ N., longitude 111° 51′ E. P. M. strong breeze N. N. E. and thick rainy weather, 8 strong gales, increasing to severe gale at midnight when under bare poles.

18*th November.*—3 A. M. wind marked North. 2h. 30m. gale moderating. Day-light moderate, noon latitude observation 16° 09′ N., longitude 110° 09′ E. In the last two days a current of 70 miles to the S. W.bS.

Macao, 29*th July*, 1842.—The late arrivals report the occurrence of excessively heavy weather in the China Sea in the middle of November; the *Water Witch* encountered very hard gales for successive days, which nearly exhausted the crew; and the following extract of a letter from Capt. McIntyre, of the *Ardaseer*, will inform our readers of the narrow escape which that vessel had from foundering:—

'Left Singapore, Nov. 2, 1841; calm, anchored; noon on the 3d passed *Pedra Branca*; entered *Palawan Passage* on the 8th; wind shifted to the Eastward, determined to try the China Sea; passed *Pulo Supato* on the 11th with a S. W. gale; 13th, wind shifted to the

Northward; prepared for a gale; 14th and 15th, fine Northerly winds and clear weather. At midnight on the 16th, being then in latitude 14° 30′, longitude 114° 40′, the Barometer fell from 30 to 29. Sent down top-gallant yards, close-reefed and furled the top-sails, reefed and furled the main-sail. At 3 A. M., blowing a hurricane from the Northward; furled the fore-sail; spanker blown away; sea making a breach over all; 8 A. M., clouds rolling on, and the wind like the noise of thunder, sea confused and running mountains high; hove the ship to under bare poles; 9 A. M. thrown on our beam-ends, ship settling fast; and put the helm up, which she refused; little after 9, cut away the masts, and ship righted, sea at the time nearly swallowing us up; but the ship did not make an inch of water. Now under jury masts, and hope to make Manilla, as wind has been from the Westward for three days. Cabin filled with water; letters, chronometers, sextants, &c., all destroyed; cargo all right.' Ardaseer, at Sea, latitude 14° 50′, longitude 117° 15′.

SINGAPORE, 10*th December.*

Another Tyfoon.—On Tuesday afternoon the Clipper *Ardaseer*, which left this port for China on the 2d ult. returned into the roads under jury-masts, having on the 16th November experienced a severe tyfoon in the China seas, in latitude 14° 36′ North and longitude 14° 40′ East; during which she was compelled, as a last resort, to cut away all her masts. At 2 in the morning, the Barometer gave indications of the approaching tempest by falling from 30 to 29 inches, when thus forewarned, the hatches were battened down and every preparation made to meet the gale. In a few hours more, it was blowing a perfect hurricane, with the sea rising in pyramids in every direction, and making a clean breach over the vessel; which was now nearly on her beam ends, with both of her quarter boats carried away. They now attempted to heave over the guns, but could only succeed in getting one of them overboard, while they had to beat out the lee port to give a passage to the heavy body of water on the decks, tried to put the vessel before the wind, but she refused to answer her helm. At about half past 8 A. M., an awful gust accompanied by a tremendous sea threw the ship on her beam ends, the sea coming up to the coats of the masts, and the lee bulwarks, and part of the forecastle being

under water. The dead lights were beaten in, partly by the violence of the sea, so that the deck and cabins were covered with water, and she seemed to be going bodily down. With the utmost difficulty, owing to the fury of the blast, and the frightful sea that was breaking over her, the masts were at last cut away, and it appeared that nothing but their fortunately all going nearly at the same time could in so critical a moment have saved the vessel. Being now clear of her masts she gradually righted, and fortunately for all on board, kept quite tight during the strength of the gale. Captain McIntyre having rigged jury-masts, now endeavoured to make Manilla as the nearest port, continuing in that direction until the 23d November, when finding it impracticable to make head against the monsoon in the state to which the ship's rigging had been reduced, he bore up for this port.—*Free Press, Dec.* 9.

It appears from these documents that the *Ariel* was bringing with her a heavy monsoon gale, or it may have been ran into the outskirts of the *Ardaseer's* tyfoon, since her position at noon on the 17th was about 330 miles N. E.b.N. of that of the *Ardaseer on the* 16*th*, and in the 24 hours, the storm might have easily travelled a great part of this distance, though it seems to have been spent, or that the *Ariel.* ran so rapidly to the South, making $2\frac{1}{2}$ degrees of Southing, between the 17th and 18th, that she escaped it altogether. I am, however, more inclined to think, it was not the storm which she felt, for she would in that case have had the wind more Easterly of North if it passed to the South, and more Westerly of North if it passed to the North of her. Could we have obtained any intermediate logs, we might perhaps have found here some evidence of one of these storms, confounding itself with the regular monsoon.

With respect to the track of the *Ardaseer's* tyfoon, we cannot even make a conjectural one from these accounts. All that we can be sure of, is, that its centre must have been very near to her when she had drifted into, say latitude 14° 20′ or 14° 10′, which in this longitude is not far from our Track No. XI., but here our present knowledge of this storm, which was experienced by at least three, if not four, vessels belonging to the port of Calcutta, ceases.

The iron steamer *Medusa* on the 13th and 14th November, encountered a severe gale from the N. E. off the Grand Ladrone, which drove

her down to Hainan North Bay, but this does not appear to have been any thing more than a monsoon gale. Her consort, the *Ariadne*, was compelled to bear up when near Manilla for want of fuel, and I believe experienced some bad weather, but her log has not reached me. The following is also a notice of a storm from the Singapore Free Press.

SINGAPORE.

On the evening of Sunday last, the signal was hoisted for a Steamer to the Eastward, and from the direction indicated, and the accounts that had been previously received of them, it was supposed to be one of the iron Steamers, either the *Ariadne* or *Medusa*, that started from this together for China on the 22d of last October. This conjecture proved correct, the steamer turning out to be the *Medusa*, Captain Hewett, which had been compelled to put back to this port from want of fuel; and the following are the particulars that have been communicated to us of the voyage. On the 2d November, when about 120 miles from Manilla, the *Ariadne* signalised that they had burnt out all their fuel, upon which Captain Hewett, who was the senior officer, hung out the signal for her to return to Singapore; and his own vessel having still sufficient fuel to carry him on to Manilla, he continued his course for that port, which he reached on the 3d Nov., but with scarce an ounce of fuel remaining. Having taken in here about 30 tons of wretched coal, and as much wood as she could stow away, even to filling the cabins with it, the *Medusa* got under steam again on the 9th, and on the 13th, was off the *Great Ladrone*, when they encountered a gale from the North East, and having again burnt out all their fuel, they were compelled to bear away on the following day. Here their compasses shifted two points to the Westward, and at daylight they found themselves in Hainan North Bay, in the midst of breakers and seas running mountains high; to escape from this dangerous situation they had recourse to breaking up the ship's bulwarks and every piece of available timber on board, and thus provided a sufficiency of fuel for two hours steaming, by which they escaped the perils that surrounded them, after they had nearly given

up all hopes. For five days they had no observation, but managed to run down into *Camaraigne Bay*, where they procured wood and water, but the former too green to burn. In a day or two afterwards they got amplitudes, and were enabled to rectify the error in the compasses, when they prosecuted the remainder of their voyage here in safety.

Captain Hewett of course expected to find that his consort had reached this port long before his own vessel—but she having neither arrived here, nor been otherwise heard of, apprehensions begin to be entertained of her ultimate safety.

The *Medusa* is now under orders to proceed to Maulmain, for which she will set out in the course of a few days.—*Ibid.*

The foregoing are all the records which I have hitherto obtained. I now proceed to offer a few deductions, practical and speculative, from them; the practical ones not as rules, but rather as hints for forming a judgment, and both as suggestions for those who may desire to aid in future researches in this important branch of science.

I commence with a tabular view of the tracks laid down in the Chart.

Tabular View of the Storm Tracks, laid down in the Chart.

No. of Track.	Dates.	Names.	Track of Storm.	Remarks.
I	1780 17th July, ..	H. C. S. London, ...	From N. 68 E. to S. 68 W.	Tyfoon.
II	1797 19th June, ..	H. C. S. Buccleugh,.. ..	——East to West, ...	Tyfoon.
III	1803 20th 23d Sept.	H. C. S. Coutts, Camden, &c.	——S.S.E. and E. to W.	Tyfoon, curved track, rate about 7 miles per hour.
IV	1803 20th 23d Sept.	H.C.S. Royal Geo. Warley, &c.	——N. 77 E. to S. 77 W.	Tyfoon, about 7 miles per hour.
V	1809 28th 29th Sept.	H. C. S. True Briton & Fleet,	——N. 60 E. to S. 60 W.	Tyfoon. True Briton founder-
VI	1810 29th 30th Sept.	H. C. S. Elphinstone & Fleet,	——N. 78 E. to S. 78 W.	Tyfoon. [ed.
VII	1812 8th & 9th Sept.	H. M. S. Theban and Fleet,	——S. 84 E. to N. 84 W.	Tyfoon.
VIII	1819 28th 29th Oct.	H. C. S. Minerva, ...	——S. 79 E. to N. 79 W.	Tyfoon.
IX	1820 29th Nov. ..	H. C. S. Lord Castlereagh,..	——East to West, ..	Tyfoon.
X	1821 18th 19th Oct.	H. C. S. General Kydd and General Harris,..	——N. 74 E. to S. 74 W.	Tyfoon.
XI	1822 14th 15th Sept.	H. C. S. Macqueen, ...	——S. 57 E. to N. 57 W.	Tyfoon.
XII	1826 25th 27th Sept.	H. C. S. Castle Huntley, ..	——S. 77 E. to N. 77 W.	Tyfoon, $7\frac{1}{2}$ miles per hour.
XIII	1829 9th Aug. ..	H. C. S. Bridgewater,.. ..	——East to West.	Tyfoon.
XIV	1829 8th & 9th Aug.	H. C. S. Charles Grant, Lady Melville, &c. ..	——S. 78 E. to N. 78 W.	Tyfoon.
XV	1831 23d Sept. ..	At Canton.	——N. 68 E. to S. 68 W.	Tyfoon.
XVI	1831 23d Oct. ..	At Manilla and the Panama's first storm, ..	——S. 68 E. N. 68 W...	Tyfoon.

No. of Track.	Dates.	Names.	Track of Storm.	Remarks.
XVII	1831 24th 25th Oct.	Panama's second storm, ..	From S. 45 E. N. 45 W.	
XVIII	1831 25th 26th Oct.	Fort William, ...	——N. 74 E. S. 74 W...	Perhaps Monsoon.
XIX	1832 3d August, ..	At Canton and Macao, ..	——East to West	Tyfoon.
XX	1832 22d 25th Oct.	Moffatt, ...	——N. 45 E. to S. 45 W.	Perhaps Monsoon.
XXI	1833 28th August, ..	Brigs Virginia and Bee, ..	——S. 40 E. to N. 40 W.	Tyfoon.
XXII	1833 12th October,	H. C. S. Lowther Castle, ..	——N. 12 E. to S. 12 W.	
XXIII	1835 3rd July, ..	Barque Troughton, ...	——S. 34 E. to N. 34 W.	
XXIV	1835 4th August, ..	H. M. S. Raleigh, ...	——S. 72 E. to N. 72 W.	
XXV	1837 16th 22d Nov.	Ariel and Vansittart, ...	——{S. E. and curving to S. W. .. }	Tyfoon and Monsoon.
XXVI } XXVII }	1839 22nd 24th Sept.	{Calcutta Thetis, London} {Thetis and Golconda,.. }	——S. 10 E. to N. 10 W. ——S. 78 E. to N. 78 W.	} Golconda foundered.
XXVIII	1840 29th 30th Nov.	{French Frigate Magicienne and St. Paul, ... }	——S. 75 E. to N. 75 W.	{Tyfoon, perhaps 24 miles per hour.
XXIX	1841 21st July, ..	Hong Kong Fleet, ...	——N. 45 E. to S. 45 W.	Tyfoon.
XXX	1841 26th July ..	Hong Kong Fleet, ...	——S. 56 E. to N. 56 W.	Tyfoon.

It appears from this table that—

1. If we class the storms according to the monsoons in which they occur, we shall find first as to the *times* of their occurrence.

N. E. Monsoon October to May. } Tyfoons seem to occur in October and November* only.

S. W. Monsoon May to October. } Tyfoons occur in all the months from June to October.

There is thus, we may say, but little chance of a violent storm from December to the end of May, *as far as our present knowledge extends,* and the disturbing force of the S. W. Monsoon against the regular N. E. trade seems to be a great cause, if not *the* cause, of these tempests. It is true that the N. E. Monsoon, (which is really the trade wind,) is considered to be fully established in November, at the surface of the earth, but we may suppose that there may be still some disturbing forces from the remains of the influences of the S. W. Monsoon acting in the higher regions. This sort of *vibrating* of some of the November storms, (*Vansittart's* and others,) to which I have alluded, may be noticed as affording some countenance to this view of the subject.

Considering these tables as to the probable tracks of the storms in the different months, we have the following results:—

			Average of Tracks.
June. ...	No. XI.	From East to West.	From East.
July. ...	„ I.	—— N. 68° E. to S. 68° W.	From between N. E. and S.E.bE.
	„ XXIII.	—— S. 34° E. to N. 34° W.	
	„ XXIX.	—— N. 45° E. to S. 45° W.	
	„ XXX.	—— S. 56° E. to N. 56° W.	
August.	No. XIII.	—— East to West.	From between East and S. 40° E.
	„ XIV.	—— S. 78° E. to N. 78° W.	
	„ XIX.	—— East to West.	
	„ XXI.	—— S. 40° E. to N. 40° W.	
	„ XXIX.	—— S. 78° E. to N. 72° W.	
Sept.	No. III.	—— S. S. E. and E. to W.	From between N. 60° E. and S. 10° E.
	„ IV.	—— N. 77° E. to S. 77° W.	
	„ V.	—— N. 60° E. to S. 60° W.	

* At Manilla they are *said* never to occur after the 30th November, the feast of St. Andrew, the patron saint of that city, which is celebrated with much pomp.

		Average of Tracks.
Sept.	„ VI. From N. 78° E. to S. 78° W.	From between N. 60° E. and S. 10° E.
	„ VII. —— S. 84° E. to N. 84° W.	
	„ XI. —— S. 57° E. to N. 57° W.	
	„ XII. —— S. 77° E. to N. 77° W.	
	„ XV. —— N. 68° E. to S. 68° W.	
	„ XXVI. —— S. 10° E. to N. 10° W.	
	„ XXVII. —— S. 78° E. to N. 78° W.	
October.	No. VIII. —— S. 79° E. to N. 79° W.	From between N. 12° E. and S. 45° E.
	„ X. —— N. 74° E. to S. 74° W.	
	„ XVI. —— S. 68° E. to N. 68° W.	
	„ XVII. —— S. 45° E. to N. 45° W.	
	„ XVIII. —— N. 74° E. to S. 74° W.	
	„ XX. —— N. 45° E. to S. 45° W.	
	„ XXII. —— N. 12° E. to S. 12° W.	
Nov.	No. IX. —— East to West.	From between N. E. and S. E.
	„ XXV. —— S. E. & to N. E. & S. W.	
	„ XXVIII. —— S. 75° E. to N. 75° W.	

We must recollect in considering this, and all the other results which this Memoir offers, that we are very far from possessing all the data for the period of time over which it extends; as, up to the opening of the trade with China and the establishment of opium-clippers from Calcutta and Bombay to that country, the China Sea was in certain months rarely navigated by English ships, and of those few (Indian country ships, Americans and others,) which did navigate at those times, we have not a single record; all this should be duly borne in mind, and that the most we can expect are approximate results only from imperfect data. Another consideration also should not be overlooked, which is, that the tracks of the storms *seem* to be influenced by the quarter in which they arise, and that a ship off the Coast of Luconia, or in the S. E. part of the China Sea, in the angle formed by the Philippines and Palawan, may have more chances of a storm coming up from the Southward of East, than one between the Macclesfield Shoal and the Grand Ladrone. This consideration also should not be forgotten.

In my introductory notice I have remarked, that when we cannot prove the theory wholly by the evidence deduced from one storm, we may prove it in parts by the careful analysis of separate storms. I

now proceed to shew how far we have, as it appears to me, done this.

I should state here, that I have as carefully looked for contradictions as for confirmations of the usual law, and for tracks of storms from the Westward as well as from the Eastward; but in no instance have I been able to find data which would admit of this supposition, while all are, as it seems to me, easily and simply accounted for by assuming the rotation from left to right in the Northern hemisphere and tracks from some point to the Eastward of the meridian. Of the progression again, though we have not in the confined space and track which the China Sea affords, such direct evidence of it as we have in the Bay of Bengal, yet we have some, as in the case of the *Magicienne* and *St. Paul*, and the *Raleigh* which are direct enough, and we have again and again, which is perhaps of more importance, the increasing strength, varying direction, sudden changes, contrary shifts, and decreasing violence of the storms, which are exactly what *should* occur with a progressive whirlwind. The *Raleigh's* storm, so ably analysed by Mr. Redfield, and the Manilla and *Panama's* first storm are clear instances of well-ascertained progression, and the use of the hurricane card will shew that in every instance in which the direct evidence of ships in different positions is wanting, the indirect evidence which this demonstration furnishes, is almost equal to it, for it can be accounted for in no other way.

A third kind of proof may be deduced from those cases, (as that of the *Elphinstone*,) in which vessels, by bearing up, have evidently *chased* and ran into the more violent parts of their storms again, while others by lying to a little longer, have allowed it to leave them.

A fourth kind of proof is also worthy of notice. It will be seen by the log of the *Glatton*, p. 644, which ship was on the southern verge of H. M. S. *Theban's* Storm Track, No. VII., and was standing on, so as to cross the wake of it a few hours after the *Theban* and other vessels had been dismasted, that she crossed the "confused sea" which the passage of the vortex had left. This is always described as creating the awful "pyramidal" sea, a state of the elements of which no man who has not witnessed it can form any conception, and no doubt this confused sea is the remains of it. The same occurred, and most remarkably, to the London *Thetis*, as described in Captain Cass' very

able report in my Fourth Memoir.* This ship hove to very carefully on the southern verge of her storm, which was beyond question a rotatory one, and when it had passed her she bore up, and in crossing the track of the centre, she had the sea *heavier* than during the gale! Those who have remarked the effect of a whirlwind crossing a river or a lake, or that of a water spout passing near a ship, will recognise the value of this kind of proof. See also Col. Reid's Work, 2d edition, pp. 474 and 475.

Of the rates at which the storms travel we have very little evidence. In all the instances in which there appears to be any ground for a fair inference I have given it. From 7 to 24 miles per hour, appear to be at present the limits.

As to the circular, or nearly circular form of the vortices, we have I think, abundant evidence. I have again and again, from the logs, projected with every allowance the courses and drifts of the ships, and nothing but the circular theory would account for the winds. Where shifts of wind have taken place, as also where ships have been at a distance, or on opposite sides of a storm, the same rule holds good.

The law for the rotation in one direction, will also I think, be found always to have held good, and that the supposition of the rotation in a contrary course would wholly contradict our data.

One or two other peculiarities remain to be noticed, and the first of these is the occurrence of what may be called double storms, or two storms at the same time travelling on tracks converging towards each other. The *Golconda's* (two *Thetis'* Storm Tracks, No. XXVI. and XXVII.) are a remakable instance of this, and it is a contingency which should not be forgotten by the careful mariner in forming his judgment.

The next is the remarkable abatement in the violence of the weather which appears often to take place a few hours after the storm has commenced, but without any change of the wind or rise of the barometer, and only lasting an hour or two, when it comes on to blow again from the same quarter harder than ever. Old seamen are usually aware of this treacherous peculiarity, but it is one which may sometimes deceive, and thus deserves to be noticed.

* See also the Table at p. 694, 23d September, at midnight.

A third phænomenon is the very remarkable and dangerous one of a terrific tempest like that of the *Ariel*, without any corresponding depression of the Barometer or Simpiesometer. It is possible, however, that if this last instrument was not very carefully watched, it might have been *oscillating*, though not upon the whole falling, before the storm came on. Still the possibility of such a circumstance should warn the seaman to neglect no precaution.

My last practical remark refers to the highly serious danger arising from the current, or "storm wave," which seems to prevail in some of these tempests as far South as the Paracels, setting generally, it would appear, to the Westward, though in the case of the *General Harris* and *General Kyd* to the N. E. The logs of the *London*, p. 607, *Warley*, p. 612, *Scaleby Castle*, p. 628 and 632, and *Castle Huntley*, p. 651, afford ample proofs of this dangerous current; and I may mention in corroboration, that I have, in original documents and replies to a number of circulars addressed by me to the gentlemen of the H. C. Pilot service, at the mouth of the Hooghly, indubitable proof, that a current of the same kind running from two to five knots an hour, sets over the tails of the reefs to the Westward, in the Easterly and North-easterly hurricanes, at the head of the Bay of Bengal;* besides much evidence to shew, that the devastating inundations which occur along the Coast from the Megna to Coringa, are often caused by a true storm-wave breaking in suddenly, and sweeping every thing before it.

From the imperfect accounts which reach us from China, we may also I think gather, that something of the same kind occurs there.

Before I conclude, I must allude, as a question for research only, to another remarkable feature in these tracks, and indeed all the storm tracks we have yet traced out; which is this: If we look at the chart, we shall see that almost the whole of the storms seem to come in groups from certain quarters, and these quarters are those in which active or half-extinct volcanoes are situated.

Considering our chart in this view of the subject, we shall observe that, to commence from the Northward, six tracks, Nos. XXIX to XX appear to come from the North-eastward, or from the direction of the

* These will be published as soon as I can complete my Memoir on the Storms of the Sand Heads, and that on the (old) Storms of the Bay of Bengal.

great volcanic centre of the Japanese Archipelago. Between these we have two tracks, Nos. II and XIX, which may be supposed, if they originated at so great a distance, to have come from the active volcanoes at the North extremity of the Marianas, as may also Nos. XVIII and X.

We have then two groups from Nos. VIII to XXVII, which all pass over, if they do not arise from, active or half-extinct volcanoes ; the North extremity of Luzon having the volcano of Camiguin and another yet active, and a chain of active or half-extinct ones extend through the almost unknown centre of that island.

We have next a group of three storms, No. XVI to XXI, which appear to issue from the Straits of Mindoro, the Eastern extremity of which has the great volcano of Albay, and to the South of it the half-extinct or active ones of Samar, Leyte and Mindanao ; and lastly, we have a group of three tracks which originate at, or cross, the Island of Palawan, which having itself active volcanoes, has also to the South-eastward of it Mindanao and the Siao and Sangir chain of active volcanos.

It may be objected here that since the storms all come from between N. N. E. and S. S. E., and the whole sea is bounded to the Eastward by a volcanic chain at different distances, the storms must necessarily come from some part of it. Allowing all due weight to this objection, the coincidences I have shewn between the quarters or centres from which the storms seem to proceed, or at which they seem to originate, is worthy of attention, and I am not writing now to *prove* any thing, but to suggest points of enquiry for future observers.

I have already, p. 664 alluded to the well known fact at Manilla, that no hurricane* occurs without some volcanic action more or less violent being observed, and as the whole of the chain of the Philippines, from Mindanao to the Northern extreme is full of active, or partially active centres, far more so even than Java, there seems good ground for supposing some connection ; but whether the volcanoes be the cause, or they are agitated by the effect of the atmospheric disturbance, we are as yet ignorant.

In the Bay of Bengal if the tracks of most of our storms be prolong-

* The Hurricanes are there distinguished from the monsoon gales by the term *Bagio*, an Indian (Tagaloc) word, signifying a turning gale, as hurricane does in the West Indies.

Chart
To the Sixth Memoir
on the
LAW OF STORMS
IN INDIA
being
Storms of the China Seas
from 1780 to 1860
by
Henry Piddington

References
Tracks well ascertained
do probable
do conjectural

CHINA
Canton
Macao
Hainan
Pracels
Cochin China
Luzon
Manilla
Mindoro
Palawan
Tayamas

ed to the S. E., they will all be seen as it were to start from near the yet active volcanic centre of Barren Island! and some of the old storms which I have traced, certainly do the same. Again, if we look at Mr. Redfield's chart of the West India hurricanes, we shall find them also mostly beginning about the volcanic Leeward Islands. The neighbourhood of Bourbon and Mauritius, and the Timor Sea, where hurricanes seem very prevalent, are all instances of this sort of relation, whatever it may be, if it really exists.

CONCLUSION.

Authors are not allowed to speak of the merits of their works, but I know of no rule which prevents them from pointing out their faults. I would notice here then, that one fault at least of this Memoir is *incompleteness* of information. For this I am not responsible, * for I have assuredly spared no pains to render it as complete as possible; but the seaman and the man of science, and every friend to humanity, will I hope not fail to see and to point out, from what has been here accomplished with imperfect data, how much more might be done by more accurate and detailed accounts, and the continued publication of them. It cannot be too often repeated, and therefore I again repeat it here, that we are yet in the infancy of our researches; that valuable as are the practical uses to which they have been turned, we know not yet to what greater results they may lead us; and that, moreover, no one can know *what* the value of any apparently insignificant instance or fact relative to storms may be, which he may have it in his power to communicate.

* To cite one instance (for those acquainted with the Hydrographical History of the China Seas, must think it strange that I have not referred more frequently to the logs of the H. C. Survey Vessels, which for at least ten or twelve years were employed there.) I must state that though three or four applications were made to a party who must be in possession of the logs of one of these vessels, not even a reply was ever received!

Observations on the Herat Astrolabe, described in No. 118, *of the Journal. By the Rev.* J. S. Pratt, *Chaplain to the Right Rev. the Lord Bishop of Calcutta.*

I feel ashamed that I should have kept the brass Astrolabe you lent me so long, without having more to say upon it than I have. But, I am sorry to tell you, that incessant occupation has prevented my giving any time to its examination since the first day that I brought it home. On that day I measured some of the arcs, and tried to discover the use of the curves drawn upon the smooth face, but could not ascertain their use. In fact, it would require a long and close examination and measurement of these instruments, and an intimate acquaintance with the Hindoo and Arabic methods of calculation and observation, which I have no time to acquire, I regret to say—to lead one to indulge any hope of discovering the use and method of handling these Astrolabes. The difficulties that stand in the way of discovering the method of using these instruments, and the object for which they were constructed, seem to be the following :—

1. An ignorance, an entire ignorance of the object in view; though it seems most probable, that the object was to calculate the dates of festivals.

2. The want of a complete knowledge of the *principles* upon which the instruments were constructed.

3. An ignorance of the extent to which the numerical constants used in the application of their principles were erroneous.

4. The imperfection of workmanship in the instrument itself.

Perhaps I may presume to say, that the author of the communication to the Asiatic Society's Journal, No. CXVIII, entitled "A description of a Persian Astrolabe," meaning, I believe, the one I now return to you, does not attempt to give an explanation of the use of the curve lines, which intersect the circular arcs concentric with the instrument itself. Indeed, these lines are wrongly drawn in the diagram. It seems most probable, that they serve some important office in the calculations and observations for which the instrument was designed; and

should therefore be carefully examined, and their law of position discovered, to serve as a clue to their use.

Perhaps I may be allowed to say, that from what I have seen or read of the Astronomy of the Hindoos, and also of the Arabs, my own mind has been brought to the conviction, that their knowledge has been very much over-rated. Their knowledge appears to have shewn itself chiefly in the calculation of eclipses; and the phenomena of eclipses being striking and capable of observation by persons of all descriptions, the powers of calculation which have led to their prediction, have excited admiration, and raised the fame of the calculators. But the calculation of eclipses is not so very profound a branch of Astronomy, at least when carried only to the degree of accuracy shewn in Hindoo calculations, as to entitle the Hindoo astronomers to any great fame, except as being attentive observers and moderate geometers. But as to any physical laws, they seem to have been profoundly ignorant, and therefore could not have been *mathematical* or "physical" astronomers. Ancient observations are of great value in Physical Astronomy; for instance, the mere fact of an eclipse having been seen by the Chaldeans on a certain day, and at a certain hour in the year B. C. 720, has led modern astronomers to the demonstrable conclusion, that the length of the mean day has not changed by a hundred and fifteenth part of a second of time within the last twenty-five centuries. This physical fact, of great importance in all theories regarding terrestrial heat, and therefore in the researches of Physical Geology, could not have been demonstrated without the *observed* fact of the Chaldean astronomers. But this observation, (though important in its historical consequences,) does not argue any great power and knowledge in the observers. All *facts* of observation are in a similar way valuable, but do not necessarily prove that the observers are profound philosophers. In this way, by confounding the *value* of *observations* with the *powers necessary* for conducting and recording them, it occurs to me, that the Hindoo and Arabian astronomers have received, in general estimation, far too high a name.

Bishop's Palace, Calcutta, August 11th, 1842.

P. S.—I might as well add, that the object of my making these remarks on the degree of importance *to be* attached to Arabic and Hindoo astronomy is to shew, that researches in this branch of science will be interesting to the astronomical historian or antiquary, rather than to the astronomer.

JOURNAL

OF THE

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A Description of the Coal Field of the Damoodah Valley, and the adjacent Countries of Beerbhoom and Poorooleah, as applicable to the present date 1842. *By* J. Homfray, Esq.

The coal field of the Damoodah valley, and its adjacent river the Adji, commences at about the parallel of latitude 23° 16′, and continues uninterruptedly upwards to nearly the whole length of the Damoodah river, until near to its source, which lies in the hills near Ramghur. Along both of its banks lies the mineral coal field, commencing near to the junction of the Singharun Nullah, which falls into the Damoodah river near to the Serampore Indigo Factory. This point at which, however, none of the mineral is found, is the lowest end of a line stretching (nearly direct) across the country to the Adji river, at a place called Seedpoora Ghaut, where also is the extreme limit of the field at the lowest end on that river. This then forms the boundary on the south side, its northern is stated as above; the western limits are the igneous and granitic hills *with their subdivisions*, which lie at a distance, generally of four or six miles from the right, or western bank of the Damoodah, and continue their course to the high lands in the Ramghur district, and crossing through a portion of Chota Nagpore which abuts against the Damoodah and the Barracar rivers, the eastern limits. The North-east, are the range of high hills flanking the Damoodah and the Barracar rivers. Descending this last river to near to Dabystan, it crosses that river, next to where the

schistose formation of hills commences, and which run across to Monghyr and the Gurruckpore districts. Bending round with these hills, it crosses over to the Adji river, and thence skirting the fóot of the igneous hills, which continue towards Rajmahal, the mineral *decreases* as the distance increases, or as it recedes beyond the Adji river, a small portion, however, alone of this country, east of the Adji, can be called a continuous coal field, and where it descends to a village called Kosta, on the east bank of the Adji, it ceases; and the mineral and its concomitant sand-stone are lost. Eruptions of granite, gness and basalt distinctly mark its limit, until it reaches the very extraordinary mass of gness rocks at the town of Debrazpore, beyond which easterly, there are occasional traces of sand-stones and bituminous shales; and in more than one or two localities immediately beneath the hills, and within the dense forests, traces of very inferior coal are found; and at one locality on the Bermany Nullah, which lies east of Soory or Beerbhoom, about 24 miles, coal is found in quantity, but of a quality so nearly approaching to bituminous shale, as to be unfit for steam purposes. Other localities there are, but the quality of coal remains to be tested; but they are all of them of the same worthless nature as that at Bermany Nullah. I mention this, just to draw attention to a parcel of trashy nonsense, put forth in some publication; something which would induce people to believe, that the Sylhet and Burdwan coal field, (as it is there called) have some, or had some connexion, which by a marvellous occurrence has been disjoined, and that Sylhet and Chirra Poonjee are now journeying towards the moon. There is no more similarity between the coal and its concomitant rocks in the Damoodah and that of the Sylhet and Garrows, than between chalk and cheese. None but the most profoundly ignorant of the matter, would entertain a doubt of it. The whole is a mere literary phantasmagoria, got up *ad captandum*, and put forth in a manner calculated to mislead the unwary. I may be told, that our operations are as yet in their infancy; but I cannot see a trace which long and great experience in such matters would warrant me, or even any unpractised miner, although not educated in the school of modern mineralogists, of snail-hunters and saxo-florists, to arrive at any other conclusion, but that the two great deposits are wholly different. The Damoodah and Adji country is, throughout that portion where

the mineral districts lie, one continued line of country which has been subjected to the greatest convulsions of nature, and the immense chains of hills of igneous origin, which are visible throughout, are corroborative of it. The connexion between these hills at distant points, crossing the coal field, is proved by the line of the great basaltic dykes, which protruding through the sandstone up to the surface of the ground, are traceable from one point to another; whilst we have proofs of the changes, which have been wrought upon the materials by these mighty protrusions. It is not very often that the occurrences of the intersection of basaltic dykes is observed. There are, however, within this field, a vast number of these dykes which cross one another, and of course they must have occurred at different ages, as will be seen hereafter, and doubtless the changes in the subterranean minerals have been affected by it. The most remarkable one which causes these changes in the coal field is, one called the Salmah dyke, and one nearly parallel to it at Bharah. These are distinctly traceable for about 30 miles, and have produced a thorough change in the minerals which are deposited on either side of it. The upheave is evidently to the N. E., but to what exact amount I cannot say; but I conjecture from many circumstances which when examined closely into, leads me to think that the dislocation is of some hundreds of feet. The quality of the coal is also changed, and that portion of the coal field hitherto opened upon, and whose mineral has been largely consumed, lead me to believe, that the coal on the south-western, or *lower* side of this dyke, is much superior to that on the North-eastern. There are other large dykes and faults of magnitude which are already discovered, and from which there are many alterations discernible, independent of lesser faults and interruptions such as impede the progress of the miner. At some distance up the Damoodah river on the South-west bank, is the great hill of Pachete, from which innumerable dykes issue; and all around its base, and between it and the river, a space of about four miles, the country although abounding in coal, is full of these dislocations. It is nearly opposite to the centre of this hill, which is about seven miles in length, that the Barracar river unites with the Damoodah. The Baracar rises in the same range of hills as the Damoodah, and continues its course through the hill for some miles, until it is turned by the mighty Parsonath hill

towards a more easterly direction, and then thrown towards the schistose hills of the Monghyr range, continuing a rocky stream until it bursts through the schistose rocks near to the Panraw hill, and between it and Dabystan, where it enters the coal field, and continues onward until it abuts against the base of the Pachete hill. The Barracar river has on its northern bank innumerable faults, and all running parallel with it, and as I said before, they are traceable from the Pachete hill and *run* towards the Panraw hill. To the North-west of these dykes, which lie generally at a distance of about one to two miles from the Barracar river, no coal is discovered. The eruption of *greenstone dykes*, which I have not only discovered on the surface of the ground, but by sinking pits I have come down upon them at considerable depths, and found them dipping at a sharp angle, completely cutting off all the minerals, and a change in the nature of the rocks which accompany it, takes place. Within the space of country, between the rivers Barracar, Adji and Damoodah, and a line of country generally four to six miles in breadth, to the South and West of this last river, is the coal field; and glancing at a map, it will be seen it is of great extent, and with little exception, may be taken to be full of coal and iron-stone. The veins, however, are not all of them of such thickness, or of such a quality as will warrant any profitable operations for working the mineral. In some situations the best veins lie at great depths, whilst at others, they are comparatively shallow, and are found to a great extent upon the crop of the vein. Much of the coal hitherto worked and brought to Calcutta, is from such openings, and it is well known, that it is necessary to ensure obtaining good coal that the vein be found and worked from beneath some superstratum; and if that be of sand-stone or shale, so much more likely is the mineral to prove of good quality, and less liable to perish with the weather; wasting its tar as well as crumbling and mouldering to dust, and turning grey coloured so soon as the natural tar has been evaporated.

I shall first place an account of the works now opened, and at which coal is obtained and despatched for sale to Calcutta, commencing at the lowest end, where the Benares new road having passed over the alluvial plain near Burdwan, commences a slight ascent nearer to the jungle of Furreedpore. This jungle, which is of some extent, is upon a red konkary soil, and reaching the dawk bungalow of Kyrasole, which

is near to the centre of this jungle; there a reddish sand-stone conglomerate is perceived; thence commences a gradual descent until we reach the Singharun Nullah, before alluded to. This is the first point of the coal field on the south limit. The distance from this point on the Benares road to the junction of the Singharun with the Damoodah is about five miles, and to cross the country northward to the Adji at Seedparah Ghaut is about seven miles, so that the breadth of land between the two rivers of Damoodah and Barracar may be taken on an average of twelve miles. The streams are nearly parallel until the point where the Barracar enters the Damoodah; probably the same causes which were exerted to turn that river to the east have operated to do the same by the Adji, which similarly bends easterly at nearly the same parallel of latitude. Into the Damoodah, or southern river, we trace the following minor streams, proceeding upwards and commencing with the Singharun, which small nullah drains the lands all the way up to Hidgelgurreah hill, situated about three miles from the Adji. In this nullah coal is found to crop out at a distance from the Benares road about one and a half mile, and the basset edge of coal veins are traceable along its bank for about three to four miles. Advantage has been taken of that circumstance to open collieries upon it, and to drain the mine-water into this nullah. There have been workings upon this vein of coal, which varies from seven to nine feet in thickness, ever since 1832, but success has not attended the operations, as the object of despatching the coal by the way of the Adji river down to the river Hooghly has proved both dangerous and expensive, and the coal obtained therefrom, probably owing to its proximity to the surface, has been of inferior quality. Late openings have been made with a view of conveying it to the Damoodah, which is five miles distant, to which it has to be carted at considerable cost; whilst to the Adji, that distance is from the nearest of those openings six miles, and others seven miles. The line in which this vein of coal is found, continues from the first opening alluded to across the country and to the Hidgelgurreah hill, and thence across the river Adji into the Beerbhoom district. Although even near to the Adji, it is not discovered of so great a thickness, the vein having evidently "thinned out" towards the village of Beercoltee. The first opening or lowest down the stream is that by Messrs. Erskine, being the one now whose coal is conveyed by carts to the

Damoodah. A mile and a half higher up, are the openings of Mr. Rogers and Mr. Blake. This last gentleman commenced in 1832, with a view of conveying its produce down the Adji; but hitherto the greatest extent has not exceeded a few thousand maunds, such is the ungovernable nature of that stream and the shallowness of water, and dangerous rocky bottom, that all efforts to overget it prove unavailing. There is but one way of turning the Adji to any account, which is by conveying the coal in carts lower down the river, about 25 to 30 miles, and where the river navigation is less dangerous, although even from that point it is much inferior to its equally ungovernable brother the Damoodah. The vein of coal is but one along this line, and when one reaches to the Hidgelgurreah hill, and between it and the Adji, the iron-stone measures are found cropping out; these I shall hereafter notice. The next nullah above the Singharun, and on the same bank, is the Nooneah. This is the most considerable of all those minor streams at its confluence with the Damoodah, where are situated the collieries of Messrs. Carr, Tagore, and Co.; and Messrs. Gilmore and Homfray, both of which adjoin each other, and are at a distance of only a few hundred yards from the main river. The popular name of Raneegunge, is derived from the proprietary rights of one of them having been vested in the late Ranee of Burdwan, and which also gave rise to the equally fallacious term of Burdwan coal. These collieries have their pits sunk down to the main vein of coal, generally to a depth of ninety feet, the vein varying from seven and a half to eight and half feet in thickness; the covering immediately over the vein is dark shale, and over which is a soft friable sand-stone, and which enables the vein to be excavated in openings of generally four yards in width; the working underground being conducted on the pillar and stall system, and with so excellent a roof over the coal it allows full three-quarters of vein to be excavated, the principal loss or waste of coal being attributable to its nature, being a free burning or non-binding coal. The small, or dust, which is produced in its working being of no value, is left in the hollows of the work. Fortunately, there is no appearance of fire-damp in this vein of coal, and the whole system of working has enabled them hitherto to be kept extremely well ventilated. This vein of coal is perceptible for seven or eight miles up this nullah, and is found cropping out in very

many places in that distance, until it is found where the Benares road crosses this stream, and within two miles of the Assensole dawk bungalow.

Although there are no great impediments to the present works by faults, still they exist around and within these collieries to some extent, and it is evident from the view any scientific person would take of it, that but for such dykes, this noble vein would discover itself in many other places; but no where between these collieries, and those of Singharun is there any visible traces, though beyond a doubt the vein lies beneath the whole extent of ground between these nullahs. Higher up this nullah about one mile, and near to the village of Damooleah, the coal is also worked; it was originally opened and worked by Mr. Jessop and its produce carted to the Damoodah; its proprietary right is now vested in, and exercised by, Messrs. Carr, Tagore and Co. Higher up the nullah, and near to the Benares road, there is another opening by the same proprietors, called Moishla or Damarah, the produce of which is carted about two and a half miles to the Damoodah. Between this locality and the Damoodah near to Cheluad, a pit has been sunk 100 feet, and has passed through two small veins of coal similar to those found on the opposite, or south-western bank of the river at Salmah, where a pit was commenced to be sunk by me in 1831, and after a cessation of two years, has been continued until the present time, June 1842. It has reached a depth of above 210 feet, and has passed through seven different veins of coal, and one of iron-stone. None of these veins, however, are of a description that would warrant mining operations thereon, varying in thickness from 16 inches to three feet only, and are of an inferior quality. I am still sinking, with a view to attain a vein of about seven feet thickness, and of excellent known quality. The strata which have been passed through in this pit, are the usual ones of sand-stone and shale, but differing from any others that I have met with in this country, and approaching closely to those in the English coal fields. The grain of the rock assimilates, and the characters which usually distinguish fruitful mineralogical strata are all present, whilst those met with in the sand-stone of the other collieries, are very unlike the usual ones accompanying coal in England, although the shales are similar, and contain the usual floriform and herbaceous impressions of vegetables; these are also here found both in the shales and in the

sand-stones. This pit is within a hundred yards of the great Salmah basaltic dyke, and at a distance of 600 yards lower down the river is the accompanying dyke at Bharah. They run to the south-westward nearly, but not quite parallel. One of these is traceable to the neighbourhood of Telindah, where is an abrupt conical hill, an offshoot of those hills which constitute the western boundary of the coal field all the way up to Pachete and towards Ramghur. The other dyke is traceable to the same range of hills near to the village of Rampore. The distance from Salmah and Bharah is about six miles.

Near to my pit, these dykes, which are each of them about twelve yards in breadth, cross the Damoodah river diagonally, and after continuing their course nearly a mile along its bank, they gradually tend towards each other, and the Bhara dyke intersects and crosses that of Salmah, at a place called Juggernat Ghaut. The Salmah one continues in full breadth across the country, through the village of Damarah, and several others towards the Adji, and is traceable for the distance of very many miles. The Bharah dyke, where a point intersects that of Salmah, continues its course through the country, but in a different direction, running towards Herahpore, and near to which it also meets another basaltic dyke of lesser magnitude, which I trace from Majeet, and they seem to have united, for I lose all trace of it thereafter. The dyke then turns a little more eastward, and continuing onwards, crosses the Benares road between Gopalpore and Neamutpore, and continues on towards Dabystan and to the schistose hills in that neighbourhood. It is these two main dykes which have caused the alteration in the strata, since the veins which are found on one side have not found corresponding ones on the other. Proceeding up the Damoodah on the south-west bank near to Berooee, there is a nullah called Tentooleah which falls into it, and which takes its rise in the igneous hills at the back or western side of the Pachete hill. This nullah skirts the base of the Beharrynauth hill; it is extremely rapid and rocky. Within this nullah the various small veins of coal met with in the pit at Salmah are here visible, and when close to the base of the Beharrynauth hill, a fault throws up the strata, bringing to view a vein of coal of about seven feet thickness and excellent quality. There are I believe not less than nine different veins which lie above this, and two rich veins of iron-stone. To attain this

vein of coal, my pit at Salmah is sinking. The proximity of the hill is such, that the strata around these are in much confusion, and at its base at the upthrow fault, the whole of the coal measures and their concomitant sand-stone are cut off at once; the country becomes immediately changed from a barren rocky surface to that of a fair cultivatable soil. A line tolerably direct from Beharrynauth hill towards that of Pachete defines the limits of the mineral field on the south-west, about six miles higher up the Damoodah.

Another similar nullah, sometimes called Alroosah, and sometimes Soonaree, runs much in the same direction towards Morelliah village, and in this nullah the same veins are discovered as in the Tentooleah; and are cut off by a similar upthrow fault, probably a continuation of that at Beharrynauth, bringing the same seven feet vein of coal within sight. About two miles above this, and upon the north-eastern bank, is a small nullah called Salinchy; here the strata are seen to be much troubled, and rising at a great angle. Here is situated the Chinacoory colliery, a vein of seven feet, which to me appears to be the same as that above alluded to, and is largely worked by Messrs. Carr, Tagore and Co.; this undertaking was originally begun by Mr. Betts. The vein of coal lies beneath a hard sand-stone rock, and admits of being worked similarly to the other collieries by the manner of stall and pillar, admitting thereby of a large produce being obtained. Around this place of Chinacoory, the strata are extremely deranged, and openings made in different places shew satisfactorily, that the dislocations extend to a depth sufficient to embarrass regular and continuous workings, without the aid of different pits to suit the different distortions. To the westward of this colliery, the vein is thrown up, and lost for a great distance. There is also here a basalt dyke, which runs thence towards the Adji. There is coal also discovered and worked as outposts, or detached workings by the same firm in several places, nearly opposite to Chinacoory on the western bank. Proceeding about three miles higher, and on the same side as Chinacoory, a small vein of coal is found at a place called Dheesherghur, and worked by Messrs. Carr, Tagore and Co. The land hence to the union of the Barracar river, seems to contain this vein near its surface. I cannot determine whether it be the same as Chinacoory, as the numerous faults and dislocations hereabouts have materially alter-

ed the strata, as is frequently the case from such causes, and reduced its thickness to about three feet. There is no information to be derived from the difference of the strata of rocks which accompany it, and usually serve to guide us and assist our judgment in such difficulties. We are now arrived opposite to the great Pachete Hill, and find ourselves in the country of dislocations and troublous faults and dykes. Here on the south-east bank of the Damoodah, as I before have stated, dislocations occur in every direction beneath that great hill, and between it and the river. Coal, which in my present state of survey I take to consist of two veins, is discovered all the way up to Gautcole, the open vein of it is seen in numerous places, and it is all of good quality. At Gautcole, the river navigation ceases for boats; it is impeded by rapids, and of such fierceness, as to preclude a hope of effecting any passage for boats higher up this river. It is convenient, therefore, to confine my description of the minerals to those which are discovered below this place, although the same continuous field of coal, though much more contracted in breadth, extending but a short distance to either side of the Damoodah, continues all the way to Ramghur, and to the hills separating it from Palamow, and it seems probable, that the coal fields in that district are coeval with the one of the Damoodah valley; but it is remarkable that the quality of the coal, as it approaches to the hills of evident igneous origin in that country, has been subjected to a change for the worse, and upon which I formerly reported in my survey of that country for coal by order of Government. The Damoodah, as I have before stated, has a range of conical hills running parallel with it at a distance generally of four or five miles from its south-western bank all the way to Beharrynauth hill, thence they keep at a greater distance, and stretch by the picturesque village of Baroo, which is the residence of numerous priests with temples raised, some on and some cut from the sides of these conical hills, which stretch away hence to near Rogonatpore. On the south-west of these hills, which I take it are protrusions through the sand-stone formation, and further towards Chota Nagpore, the coal formation is again met with, and it has been a matter of some doubt to me, whether it is not connected with that of the Coyle river and the Palamow coal field; and that the great disjunction of the three coal fields of Damoodah, Coyle, and Palamow is clearly defined by the range of hills before described,

running parallel with the river up to Ramghur. Coal is found in many situations in Chota Nagpore, though the veins are deficient in thickness. It remains to be seen, if others of more encouraging quality and sufficiently thick to be worked will be discovered in that wild country. I think it possible, that a previous connection has existed between the coal field of Palamow, Damoodah, and those countries beyond Chota Nagpore, towards the northern part of Cuttack to the sites described by Captain Kittoe, and which are traceable through a great extent of country thence towards the Coyle, and also through Chota Nagpore. The concomitant rocks and shales found in all these countries are extremely similar; nor is there wanting some peculiar veins of iron stone and fire clay, which point towards common and probably coeval formation. The country is so extensive, that years must elapse ere these conjectures can possibly be supported by unerring proofs. But it seems to me indisputable it is not a matter of very much interest as regards Chota Nagpore, as its distance, and the impracticable nature of the country, precludes a hope of finding any demand for its produce of coal.

Returning to Gautcole, and on the north-east bank of the river, we find continuous dislocations, the dykes now appearing to be of greenstone, and the country becomes covered with loose gravelly quartz pebbles and conglomerates. Coming downwards to the rocky island at the junction of the Barracar river, we enter it. This being a subdivision of the Agency of the South-west Frontier, or Chota Nagpore, is subject to the jurisdiction of the Poorooleah Agency. Soon after entering the Barracar, great dislocations are visible, and by the agency of some one of them, a fine vein of coal is brought to the surface of the ground, and upon which I have now two collieries at work. Similar dislocations have again thrown down the vein, and its extreme limit is but a few hundred biggahs. The nature of the mineral differs from any that is found in that part of the country, or within the Damoodah. The coal is of that description called *bending*, though not very strongly so; still it produces an excellent coke, such as is not obtainable from the coals found lower down the Damoodah. It has been found to be the very best description of coal used for steam engines, and far exceeding in value for that purpose any other of the country coals now brought to Calcutta. About four miles up the

Barracar on the west bank, and a little above the Benares road ferry, another vein of coal, about nine feet in thickness, is thrown up, and is now worked; but its quality is extremely low in the scale of fuel; and at about eight miles further from Barracar, and on the western bank, the sandstone formation is abruptly superseded by the schistose rocks and hills about Panraw, where the Benares road crosses the Barracar at the ferry of Bagooneah; and all around there, the ironstone measures rise out of the river, and are seen basseting out for some miles; the veins of iron are three, of a thickness two to three inches, and very poor in metal. These ironstone measures lie *over the vein of coal,* which is found on the opposite bank at Bermoory, as well as at a place called Ramnaghur, about three miles higher up, and it is traceable all the way across the country to the Adji river, thence across it towards the Beerbhoom hills, and down that river at various places near Jamalpore, Cherooleah, and Hedgelgureah, until the formation is wholly lost near Seedparah Ghaut. Nearly in a line from Begooneah, at which ferry are the great Jeyne temples towards Cherooleah, and at a distance from Mamutpore, on the Benares road of about four miles, is situated the village of Hattoreah Aytoorah. At this place the vein of coal crops out, as also does in many other smaller veins, and here was undoubtedly situated the first colliery ever opened in India by the agency of European superintendence. The remains of old crop workings are still visible near to the village, which were carried on by Mr. Heatly in 1774, or thereabouts, and it was from this place the coals denominated in those days Ramghur coals, were obtained; the whole of this country being at that time subjected to the rule of the Rajah of Ramghur; and it is an historical fact, that Mr. Heatly, at that time being politically employed by Government, captured the Rajah, and probably obtained a knowledge of the existence of coal through some attendant circumstances, and for working which, he was said to have obtained Government permission. It seems the coal was twice or thrice worked, and consumed in the arsenal of Fort William; the records of Government attest the fact, and the reasons assigned for discontinuance of operations were, that the coal did not answer the purposes for which it was required, the work was abandoned, and seems to have lain idle ever since. The line of one of the great dykes passes close

to this place, and to its agency probably the out-burst of the vein may be attributed.

From the description of this great coal field it will be seen, that there is no want of the mineral to be apprehended, and that the present collieries are fully capable of producing therefrom any quantity of coal that can be required; but it is not the difficulty of raising, and the production of coal that impedes supply. First, the necessary charge for European superintendence, which is required to conduct money operations, adds an extraordinary heavy charge upon the cost of production. Then comes the capability of river transport, and the difficulty of obtaining such a ghaut on the river as will admit boats to lie ready laden to start off with the mountain torrents. The rivers Barracar, Damoodah, and Adji, all rising in the hills, are navigable only for boats to descend for about ten weeks, and then only at such times as the rain in the hills affords sufficient water to produce a flood in the river; the rapid descent of the river beds seldom allowing a flood sufficient to float a laden boat to remain three days, but more usually two days, for unless a boat starts with the first or beginning of the torrent, it will be difficult for it to reach its destination at Omptah, where the coal depots are situated, before the water shall have fallen to a depth insufficient to bear the laden boat; but empty boats can proceed up the river at all times during the ten weeks. It is therefore necessary for a colliery to have on the river's margin such a ghaut, as where a pond of deep water is situated, and where laden boats can remain till the torrents admit of their departure. Such ghauts are extremely rare, and within the whole distance described on the Damoodah, there are not more than four or five such, where thirty laden boats can remain. It is with the greatest difficulty that the present collieries can manage to keep their extensive number of boats ready laden. This will be easily conceived, when it is recollected, that from the Nooneah Khal, where the collieries of Messrs. Carr, Tagore and Co. and those of myself are situated, if a flood succeeds after a period of ten days' absence of it, that a line of coal boats then departing extends frequently six miles in length, and is perhaps one of the prettiest sights that a stranger can witness. The channel of the river wherein alone the boats pass down, is extremely tortuous, very narrow, and constantly changing from the effects of the sudden rise and violence

of the torrent. Very many boats of the finest description in Bengal are lost by falling foul of each other; and once upset, these boats are usually dashed to pieces on the rocky sides of the river, or else sink with their load to an irrecoverable depth in the quicksands.

In order to be able to load these boats with rapidity, it is next of consequence to have the coals ready at the ghaut; this imposes the necessity of keeping the colliery at work throughout the year; the coals therefore are seldom sufficiently fresh when they are sent to Calcutta, for it is only those worked during the ten weeks' time that can be strictly so called. The consequence is, that the coal being subject to exposure for so many months to the heat of a tropical sun, has its innate tar and coal-oil greatly evaporated. This is the cause of its apparent inferiority to that imported from England, which is usually put on board ship within a day or two of its exit from the coal pit, and arrives at Calcutta without ever having been subjected to exposure. The coal of the district when fresh, will bear a favourable comparison with the average of coals imported from England, and that from Barracar is a very little superior to it ever imported. The great drawback to a cheaper supply of coals to the Calcutta market is attributable mainly to the two great causes of loss in weight by this exposure to the weather, for it is not only the nine and half months at the river ghaut, but there must afterwards be a twelve months stock at Calcutta to supply the market with, until the river again becomes navigable. These two periods will be found to be an average of *twenty months* to be subject to exposure; and the next is, that there is an interest of money on the outlay for the same period of time. I doubt much if any remedy at the present rate of demand for coals can be applied. Neither rail-roads nor canals with the present annual demand for a quantity of about 40,000 tons, (although the present collieries could treble their produce directly,) could compete with the comparatively cheap transport by the ungovernable river navigation, which bad as it is, still permits the coals to be conveyed to Calcutta at an average charge of seven shillings per ton. Although the general price for first class Steam coals is now rated at six annas per maund, or about twenty shillings per ton, whilst there arises a great deal of breakage into small and dust, which abstracts from its quality their price about one-fifth, so that the first class Steam coal may net to the

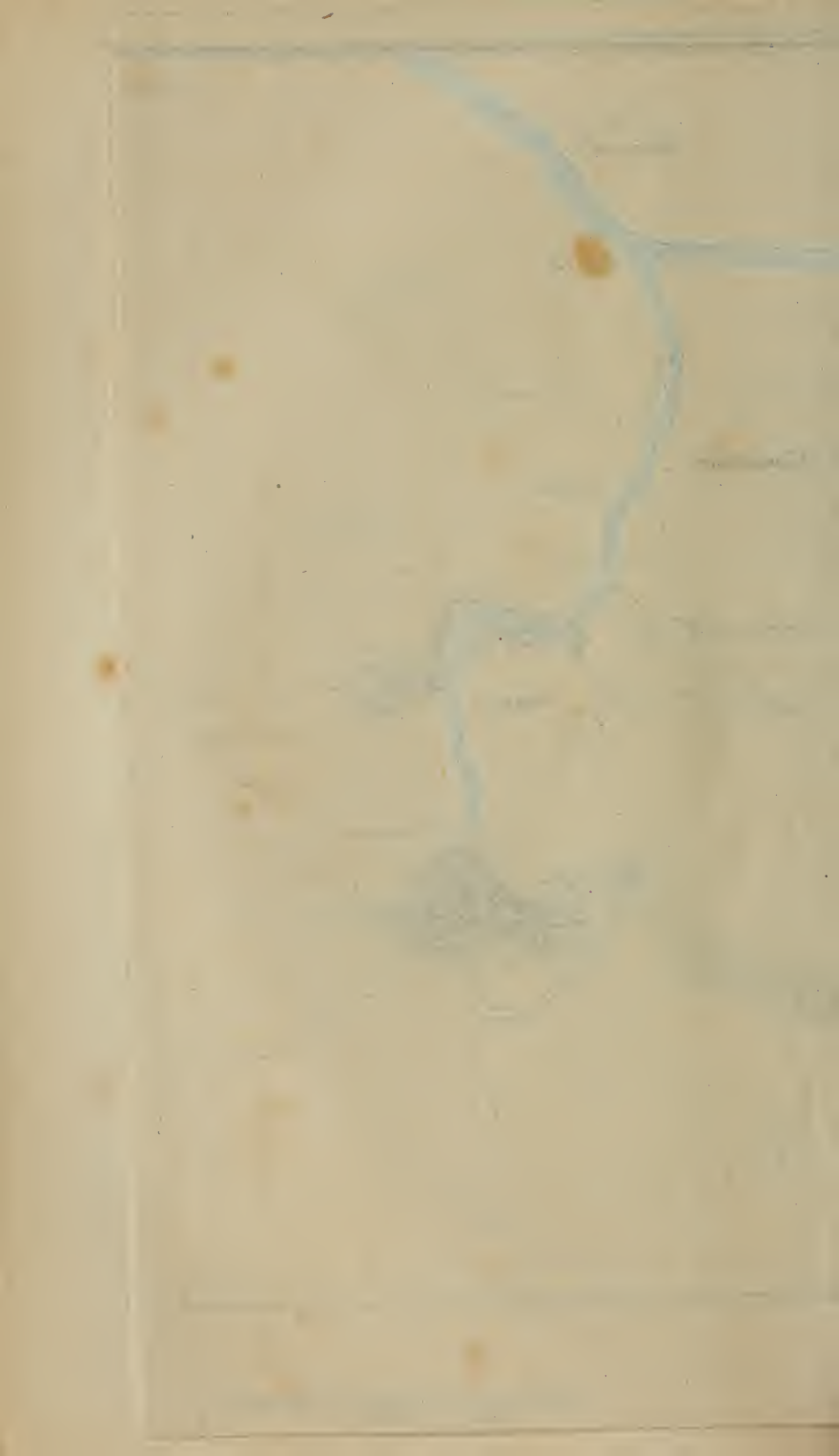
vendor twenty shillings per ton, still the average will not exceed sixteen, and although he has a heavy delivery charge to sustain, the miner at this price is supposed to be amply paid for his undertaking. Again, supposing the plan of a rail-road or a canal to be entertained, to what place should it direct its highest point, so that branches may be formed to the various collieries now open, and others which would doubtless follow? The most expensive part of the undertaking would lie within the line of the mineral field wherein the collieries are now working, which we may take at twenty miles in length. Any undertaking of this nature must be conducted to the extreme point, those most favoured at the lowest point would otherwise possess a virtual monopoly of supply. It is a just source of complaint, that at the present day the right of passage, or way-leave, to the river can be so exercised as to prevent the minerals from reaching the line of navigation of the river, which is an open, free, and untaxed road to the market of Calcutta; but any petty landholder possessing a biggah of ghaut land on the river's margin, may prevent the interior of the country for miles from pouring its resources to the capital, by what seems to me impolitic, withholding of a regulation to open these ghauts to public use. There is scarcely a canal or rail-road act in England but has some clause to oblige persons possessing lands applicable to such purposes, to accept a compensation for its use, settled usually by a jury of assessors. Why should not the rule for what is required for public purposes in that country, be applied to this? The present demand for about 50,000 tons by the removal of such obstacles as these, and many others of a similar nature, may be extended to double or treble that quantity in a year's time, if there was a demand for it, as the costs of the coal at the present day is much enhanced by these sorts of demand, which tell grievously in the accounts of a small concern. These observations apply to the whole of the river-ghauts.

The iron worked within this mineral field is generally the produce of the thin veins which crop out on the surface of the ground, and is smelted now in but a very few locations; but the whole country has in different places been subjected to the workers of iron. Scarcely a spot of five miles square within this field but the scoriæ of iron are found in great quantities; and it would seem, that as the country

became subject to the cultivator, the iron smelter retreated further into the hills and forests. At present, the only place where iron smelting is carried on within this field is near to Gautcole, and beneath that range of hills, and towards Soosnah on the south-west side, and beneath the Beerbhoom Hills on the north-east; but no where east of the Barracar, and between the Damoodah and Adji.

Having thus described the country, I may mention, that in the Damoodah coal field, not a trace of limestone has ever been found, nor in either that of Chota Nagpore or Cuttack; and its absence throughout this and the neighbouring coal field of Palamow will convince any one, how different are the formations of this field from that in Sylhet, the Garrows, and Assam, where the noble limestone rock is found to accompany the coal throughout the whole of those countries. I cannot claim any honour, as others have done in the publication alluded to, for a discovery of coal as it is called, ten miles within the delta of the alluvial formation, and in the midst of the paddy fields; but I hope that what I have above stated, may prove instructive to such as think it worth while to inquire into the resources of the country. There is an account in the "Gleanings of Science," of the coal and colliery of Raneegunge, by Mr. Jones, and I should not have mentioned it, but it is erroneous in the extreme; and at the time he wrote it, I am certain it was based on very limited survey. It cannot be relied on at all, not even the section of the vein at Raneegunge, which is there made out to be seventeen feet, instead of half that thickness from the surface of the ground. We procure lime konkar, and this is the only calcareous production known hereabouts. Limestone, in the way of profit, would be far more coveted than coal; but we have it not. Fire clay of fair quality is found beneath the coal of some veins, but not universally. When properly selected, I have seen excellent fire bricks made therefrom, and have seen them used successfully in Messrs. Jessop's foundery. A porcelain clay is also found extensively near to the hills on the south-west of the Damoodah, but the admixture of foreign matter unsuits it for fine ware. I had some coarse pottery made from it in England, but they failed to produce fine ware. It is evidently decomposed rocks, and I take it, assimilates to that of China. In its native state, and by careful ablution, it might get rid of the impurities, but it is unadapted for pottery.


The Damoodah Valley. and COAL FIELD
Beerbhoom
Burdwan
South West Frontier
Jungle Mehals
Damooda R.
Burdwan
Dikes
Roads
Scale of Miles



Singna Section of the Armanath Coal Field

Palamow Section

Chuta Coory Section
Pit and Boring

Narain Coory Section
Engine Pit

Barra Gunar Section
N° 12 Pit

The hills around the south-west extremity, and near to the Subanreeka, contain a very poor description of copper, which is stealthily worked by the natives. The ore is very poor in metal, so also in the Beerbhoom district, and not very distant from where the coal is found in the Braning ruin. At a place called Doomka, there is lead found in several places, but that is also poor in metal. It probably is an outlier of the same plumbose formations as is found near to Deoghur, although twenty-five to thirty miles distant.

Talc is found in many places in the neighbouring hills, but the plates are not very large.

One might suppose, that where sandstone is found throughout this country, that some good paving stones might be obtained, but with the exception of two places, I have never met with any sandstone which separates in beds. At Cherooleah, on the Adji, large quantities were formerly raised, but were principally hewn from large boulders of sandstone and loose outlying rocks; the grain is very coarse, and the stone soft. It however answers well for common purposes, but is unfit to be applied to fine work.

Note.—Aytura, Chinacoory, and Damoully, (Mr. Homfray's Damooleah) were three of the six mines opened by Mr. Heatly in 1774. The scattered position of these over the country, shew that the field had been explored with some attention at that early period, and its most capable spots determined with judgment. Chirooleah also lies within the limits applied for and granted to Mr. H. So little appears to have been done since, as far as regards the examination of the great coal field of these districts, that though the early discoverers speak uniformly of Beerbhoom coal, and Pachete coal, and even Mr. Jones, "saw nothing to indicate the existence of coal in the Burdwan district," the publications of the Coal Committee invariably term this the Burdwan field, an error that might lure some sanguine capitalist into speculations like those of the Bexhill Colliery on the Hastings' Sand, chronicled by Sir John Herschel, (Disc. Nat. Phil. p. 45). The silence of the same authorities has compelled me to support a narrative of the early history of coal, (placed in Mr. Torrens' hands) by rather tedious quotations from public papers, as its authenticity might otherwise be called into question, since the Committee having easy access to Government records, and this being their special province, appear to be unacquainted with the facts.

S. G. T. H.

A Monograph of the species of Lynx. *By* EDWARD BLYTH, *Curator to the Asiatic Society.*

As the Lynxes are a group of Cats pre-eminently attached to frigid and mountainous regions, it is remarkable that none has hitherto been observed on the Himalaya, where the widely diffused *Felis Chaus* of Guldenstadt (vel *F. Kutas*, Pearson, *F. affinis*, Gray, and *Lynchus erythrotis*, Hodgson,) appears to be their only representative, this being rather a Lynx-like Cat than a true Lynx, though one of an unbroken series of gradations passing from the domestic Cat group into the present form, and which series is finally connected by *F. Caracal* with the typical or northern Lynxes—the Caracal according with the latter in wanting the small foremost upper false molar-tooth which exists in all other known Cats, while it is deficient in the facial ruff and mouchetures so characteristic of the animals under consideration.

That more than one species of this minor group inhabits the wooded Elboorz chain stretching eastward from the southern extremity of the Caspian, there is every reason to consider probable; and "the Lynx"* is included by Capt. Thos. Hutton in his enumeration of some of the mammalia of Afghanistan, *(Calc. Journ. Nat. Hist.* I, 558,) in which country "a large wild Cat, with a tendency to the Lyncean tuft on the ears," (most probably the *Chaus)*, is noticed by Dr. Griffith to be met with about Olipore (*Journ. As. Soc.* X, 978). Mr. Hodgson has obtained a species in Tibet (*Ibid.* XI, 276), which, from the dimensions ascribed to one of his specimens, would seem to be *F. cervaria*;† an animal chiefly found to the eastward of the Ural range, and rarely on the Caucasus, but which is known in Persia (according to M. Menetries) by the appellation *Vaarchach.* As I have had good opportunities of making myself acquainted with the various species of this group, and it appears to me that descriptions of them in this Journal will be of utility in enabling observers to discriminate any they may meet with, I shall pro-

* *In orig.* "three Lynx," a typographical error which, from the context, I read as above.

† Since writing the above, having seen Mr. Hodgson's coloured drawing of the animal in question, I can pronounce it to be *F. cervaria.*

ceed to offer an account of each of them, drawn up from personal examination of specimens in every instance.

The Lynxes may be characterised as merely short-tailed Cats, of middle size, with a tuft of lengthened hair at the tip of each ear, and wherein the small foremost upper false molar-tooth, which appears to be constantly present throughout the rest of the genus, is regularly deficient in the adult, if not in the young also. The Caracal excepted, they have a ruff of lengthened fur bordering the sides of the visage, beneath which is a pointed tuft pendent on each side of the throat, denominated their *mouchetures*. In general, they are light-made animals, with contracted flanks, and rather high on the limbs, and the fur of most of them is in winter long and very dense, having deciduary whitish tips, which more or less conceal the under-colour, but are gradually shed at the approach of summer, when the ground-tint has always a rufous cast (more or less bright, according to the species), and is variously spotted with black, the markings inclining to form oblique streaks on the flanks: the pendent mouchetures are white, with a black line near their outer border, beyond which the edge is of the hue of the body; the ears have the usual dark marks at the base and tip (common to most of the genus), and which shew very conspicuously in winter, from contrasting with the nearly uniform hoariness of the fur generally,—as does also a black tip to the short tail, which latter is more or less ringed above this, and has a very truncate appearance.

These typical Lynxes are solitary in habit, and frequent mountain-forests, where, however, they seek their prey chiefly on the ground; but climb trees with facility, to which they usually resort on apprehension of danger. They are timorous animals, but very destructive to lambs and calves, fawns, and specially to feathered game and hares; but they seldom attack larger animals, and only, perhaps, when urged and rendered desperate by famine. They commonly reside in some rocky cavern or burrow of their own excavation; where the female produces two or three kittens in the spring. Their voice much resembles that of the domestic Cat, only uttered in a fuller and deeper tone: and it may be remarked that the talons of these animals, though slender, are highly formidable, being adapted rather for prehension, or seizing their prey, than for tearing away the skin of it, which latter seems to be the chief purpose to which the Lion and Tiger apply these weapons,

after disabling their victim by a single blow of the tremendous paw, with the talons not exserted.*

As many as four species occur in Europe.

The Great Lynx (*F. cervaria*, Lin.; *F. borealis*, Thunberg, but not of Temminck). This is by much the largest and most powerful of the group, with teeth—the canines at least—fully equal to those of a Leopard, and a comparatively robust frame, appearing more so from the length and fulness of its beautiful fur, which is highly valued by the dealers in peltry. Its length approaches to three feet and a half, and height of the back upwards of two feet: the ears are rather small, only one inch and three-quarters long, and but slightly tufted; and the facial ruff is very conspicuous, the mouchetures hardly appearing below it, though nearly three inches in length. The upper canines are exserted an inch and a half from the gums, and are very stout in proportion. Fur excessively soft and dense, most delicately fine in texture, and two inches long, in winter, upon the back; of a lively rufo-fulvous, or bright rust-colour, underneath (or in summer), and tipped with glistening ashy-white in winter, imparting a fine lustre, besides which is a slight tinge of carneous more or less perceptible: it is marked with distantly placed irregular black spots, sometimes rather large, and more or less lengthened obliquely on the sides; three rows of these appear conspicuously along the croup; and the limbs have smaller spots, and are but little marked on their inner surface. The most esteemed skins have the spots small, and a lustrous greyish-white surface, with a distinct blush. The young, according to M. Temminck, are covered with brown spots in addition to the black ones.

This species is the *Siberian Lynx* of the furriers, and would appear to be principally found in Northern Asia, from whence the skins are mostly

* So far as I have observed, a Lynx's claw is always keenly pointed, whereas in wild-shot specimens of the other great *Feles* alluded to, the talons are often very much split and broken away at the extremity, evidencing the roughest usage, but may be peeled away underneath with facility till they become sharp enough for any purpose. The fact is, they continue growing, but, like a rodent's tusk, are of much softer substance behind or underneath than in front; and as soon as the point is broken away, a horizontal split commences, and the under lamina soon shreds off: the point, being harder, is apt to grow inconveniently long; and hence a common practice of all the genus, which the house Cat is too fond of performing upon the legs of chairs and other furniture, the Jaguar always resorting to a particular individual tree of the forest for the same purpose, and the Puma (as noticed by Mr. Darwin) making deep scores in the bare hard soil of Patagonia.

brought to Moscow. On the Caucasus, it seems to be rare :* and it doubtless extends northward along the forests of the Ural, being likewise found, though as a rarity, in Scandinavia, where it is designated *Kat-lo* (or Cat Lynx). I suspect it to be the Tibetan species of Mr. Hodgson.† Pontoppidan, in his 'Natural History of Norway,' by some inadvertence, asserts that this *Kat-goupe* "is scarcely half the size of the next, or *Warg-goupe*." Of its particular habits I have met with no information.

The Red Lynx (*F. Lynx*, Temminck, but not of Linnæus and Nilsson; *F. virgata*, Nilsson). This is the ordinary European species, which alone is found in the central parts, though now very sparingly, extending from Scandinavia to Naples, and to the Pyrenees, whence it may be suspected to have wandered into Spain, though it is not known to have occurred in that country. It is a long limbed animal, appearing so more particularly in summer, when its coat is short; the pupils of its eyes close vertically; and the facial ruff is moderately full, with the mouchetures appearing conspicuously below it. A fine living male stood nearly two feet high at the croup, with a length of about three feet to the tail, the latter about six inches more; ears fully three inches, with tufts an inch and a half, and the mouchetures an inch and three quarters. The fur is short in summer, but in winter is much longer, with pure white tips almost concealing the bright rufous under-colour: the latter is darker along the middle of the back, paler on the sides, and the under-parts and inside of the limbs are white; the body-markings are obscure, and in some individuals not a little resemble, when sufficiently brought out, those of the Ocelot (*F. pardalis*); forming dusky spots on the limbs only, and faint ocellated streaks descending obliquely backwards on the sides, the inferior border of which ocellations is much more strongly marked (as in various other species), and in some specimens almost solely discernible. The tail is rufous above, whitish underneath, and rather largely tipped with black: the borders of the eyes are white, with a black line proceeding obliquely backward and downward from their

* It is, however, the only species that was noticed on the Caucasus by M. Menetries, who obtained the spoils of one at Bakan, which he was positively assured was killed in that country.

† See Note to p. 18.

outer corner; the upper lip is spotted, and the under one margined, with black; and the facial markings resemble those of the other streaked species of *Felis:* irides greenish-hazel. The young resemble the adults.

This Lynx is the commonest species of the forests of Scandinavia, and the only one which is occasionally met with in the southern parts of that country during severe winter weather. It is there termed *Warg-lo* (or "Wolf Lynx"); that is, in Sweden, being the *Warg-goupe* of Norway. In former times it appears to have been very generally diffused over Central Europe, and it is still sparingly found in the wilder mountain forests of Germany, Poland, Hungary, Switzerland, (where M. Schinz mentions that it is extremely rare), and according to M. Temminck in Italy as far as Naples, and very accidentally France. Baron Cuvier notices its occurrence on the Pyrenees. In Russia it is more numerous; and M. Guldenstadt states that it is common upon the Caucasus,* whence it probably spreads eastward and northward into Central Asia. An interesting notice of this animal occurs in Major Lloyd's 'Field Sports of the North of Europe' (II. 139, *et seq*). This author does not appear to have been acquainted with more than this one species, observed both in summer and winter dress, which he rightly refers to the same animal; and concerning it, he mentions that "they are to be found in some abundance in all the more deeply wooded districts of Scandinavia. They are usually to be met with singly, or at most in pairs, unless it be, perhaps, that the mother is followed by her cubs. They generally confine themselves to the wildest recesses of the forests, and are rarely to be seen in the vicinity of inhabited places.

"The period of gestation with these animals is from eight to nine weeks, and the female brings forth about the beginning of May: this is either in the cavity of a rock, or in other sheltered situations. It is said that the mother [like the rest of the genus] gives her whelps living animals, the better to initiate them in the art of killing their victims.

* I follow Temminck in referring Guldenstadt's *F. Lynx* to this species, although the evidence is not very conclusive. Guldenstadt defines it as "capite et corpore albidô rufô maculatô, caudâ obsoletè annulatâ, apice nigrô;" which applies almost as well to *F. cervaria*. It is probable, however, that the present species is intended.

"The Lynx is a most destructive beast. He kills the young of Elk, Deer, Roe-buck, Hares, &c., and also the Capercaili, Black-cock, and other birds common to the northern forests. He likewise destroys the smaller domestic animals, such as Sheep, Goats, Calves, &c. When he gets among a flock of Sheep or Goats, it is said that, if he be unmolested, he slaughters the whole of them. He has been known to attack and kill even a Horse.* The Lynx, it is asserted, never touches carrion or putrid flesh," nor, indeed, do any of the genus, unless very severely pressed by hunger, when even a Tiger has been seen to make a meal off a putrid carcass.

"The Lynx is little dangerous to the human race. I never heard of his attacking a person, unless molested in the first instance. If he be wounded, he will sometimes turn upon his antagonist [much smaller species, as the British Wild Cat, will do the same]; indeed, more than one instance has come to my knowledge, when, thus circumstanced, he has severely lacerated his assailant. It is not difficult to kill him with a good Dog, for, if closely pursued, the animal usually takes refuge in a tree, which he ascends with the agility of a Cat. In that situation, it is, of course, easy for the sportsman to destroy him. If the Dogs take the Lynx by surprise, and he is unable to shelter himself either in a tree, or in the cleft of a rock, it is said that he throws himself on his back, and defends himself desperately with his claws. He is, however, as much afraid of a bite in the foot as a Lion."

It must be to this species, also, that Pontoppidan's notice mainly refers, when speaking of the Scandinavian Lynxes, he writes — "These animals go out like the Wolf, except that they do not appear so publicly in the open flat country, but keep more to the woods, and lurk in holes of the earth, which they dig for themselves deep and winding; but they are driven out with fire and smoke. In the day-time they lie hid, and steal upon their prey, which they watch for, crouched up like Cats, at the entrance of their holes. They are very nice in their food, and of a Sheep or Goat do not eat more than the head or udder; by which circumstance one knows what animal has been there. Though they always kill, they eat little in the increasing moon [?], but in the decrease are more ravenous, and will hide or bury the carcasses like a

* This was probably *F. cervaria;* but it will be remembered that the Norwegian Horses are remarkably diminutive.—E. B.

Bear. The wild Cat is their worst enemy, for its almost constant employment is to look out for them in their holes, and steal their prey from them. They are very cunning in undoing a sheep-fold, where they help themselves very nobly. When attacked by a Dog, they throw themselves immediately on the back, in the manner of a Cat, and turn up the fore legs, to be the better able to defend themselves; the Dog on this lays hold, but the Lynx *(Goupe)* then makes use of his sharp claws so effectually, that he flays his enemy alive."*

The specimens of the *Red Lynx* which I have seen, in captivity, have all been more or less tame, especially a fine male which was living in the Zoological Society's Garden at the time I left London; this was perfectly gentle and familiar, as much so as any domestic Cat; it courted notice in the same manner as that animal, by purring and arching up the back, and raising its short tail, which at other times was ordinarily carried closely appressed, as in the Caracal: the latter animal I have also repeatedly seen quite tame; but not so the Bay and Pardine Lynxes, which were shy and mistrustful, for ever growling and spitting at persons who approached them, and (the individuals) seem-

* "It happened lately," continues this author, "that a *Goupe* making his way into a sheep-fold, was discovered by a sly old he-Goat, who perceived his subterraneous track, watched him narrowly, and as soon as he had come forth, before the body could be got out, butted him, and gave him such home-pushes, that he laid him dead in the grave of his own making."—*Nat. Hist. of Norway*, II. 21.

Here it may be remarked, that the existence of the European Wild Cat in Scandinavia has been denied by later authorities, though Pontopiddan further states, (at p. 8,) that "we have Cats both tame and wild; the latter are very large, and their skins bear a good price; they live by watching birds upon the trees, and then seizing them with a sudden spring." This is quite the habit of the British Wild Cat, which usually lies dozing or watching for prey upon a low pine-branch of its own colour, where it cannot easily be discerned. M. Nilsson (as cited by Major Lloyd) states, however, that the true Wild Cat does not inhabit Scandinavia, though a stray domestic Cat may now and then be met with in the forest. The *F. Catus* of Linnæus is clearly the domestic species; and the Faunas of Bilberg and Retzius throw no distinct light upon the subject, failing to distinguish the two species apart; which is also the case in Müller's *Prodromus*, where reference is, however, made to Von Aphelin's Work, (II. 299,) which I have had no opportunity of consulting. M. Ménétries notices that the European Wild Cat is not rare in the Cisalpine forests of Caucasus, where the Russians style it *Kowka*, or Wild Cat; a name which, according to Pallas [following Guldenstadt], is bestowed on *F. Chaus*. It descends in winter to the Steppes. Temminck asserts that, in Hungary, Russia, and the Asiatic countries, this animal attains a larger size, and yields a more esteemed fur, than in Western Europe; though I incline to doubt whether the largest British specimens are anywhere surpassed.

ingly altogether untameable; so likewise are a couple of kittens of *F. Chaus* which are now more than half grown, and which I have possessed from the time they could scarcely crawl, and have uniformly tried to subdue their savage disposition, but wholly without success. They will allow me to touch them, but never suddenly or abruptly, nor do they ever fail to greet me with a spiteful hiss, and when I venture to smooth their fur, they throw back their ears as if frightened, and resume their growling and spitting the moment I take my hand off; and so it has been with them from the very first, when they could not have had their eyes open many days. Lieut. Tickell tells me, that he also has found the *Chaus* thus utterly untameable.

The Pardine Lynx (*F. Pardina*, Oken and Temminck). If the preceding species does not extend its range into the Spanish peninsula, its place is there supplied by another, remarkable for the beauty of its spotting, and the length of its pendent mouchetures, which is not known to occur out of that country. The Pardine Lynx is inferior in size to the ordinary Red species, but measures upwards of two feet and a half to the tail, the latter six inches more; and height of the back about a foot and a half, or rather more. The ears are two inches and a half long, or with their tufts three inches and three-quarters; and mouchetures two inches and a quarter. The fur is short and soft, three-quarters of an inch long upon the back, and of a vinous-fulvous colour, paler on the under-parts, and very handsomely spotted with black; the markings inclining to form linked ocellations on the sides, which are of a deeper colour within than the general ground-tint, as usual in all ocellated markings. On the limbs are round spots, which become smaller and tend to group into ocellations above them. The tip of the lower and margin of the upper lip are black, above which the latter is spotted; and the back of the ear is grey in the centre, broadly surrounded with black; the margins of the eyes being white as usual. The mouchetures, also, are conspicuously white, finely set off by the black line near their outside; but there is no other white except on the throat. I doubt whether the fur is ever much tipped with whitish in winter, though there is probably some appearance of it. The ground colour of the young is paler, with the spots less intense.

To the continental furriers, this species is known, according to M. Temminck, as the Lynx of Portugal. Col. Sykes obtained two

skins (of an adult and young) at Seville, where they cost him thirty reals, about six shillings and three pence. "In Andalusia, whence the specimens came, the animal is called *Gato Clavo* (*Clavo* meaning the pupil of the eye), illustrative of the spotted character of the fur. Some peasants in Andalusia make short jackets of the skins. The animal inhabits the Sierra Morena."* M. Temminck suspected that it might also be found in Sardinia, and perhaps Sicily; while the Lynx of Italy and Naples is known to be the Red one. He further conjectured that it may inhabit Turkey and the Levantine countries. No notice of it occurs, however, in Sr. Cetti's work on the quadrupeds of Sardinia, where the only wild Feline appears to be a feral race of the Domestic Cat, with generally black fur, as noticed by Azuni, and which is numerous in all the wooded districts of that island. The specimen here described is a fully adult male, received when young by the Zoological Society from some part of Spain, and which lived till it attained complete maturity in their establishment. The anterior false molar proved to be wanting in its upper jaw, as in all the allied species here described.

The Arctic Lynx (*F. Borealis*, Temminck, but not of Thunberg; *F. Lynx*, Linnæus and Nilsson; *F. Canadensis*, Geoffroy). This fourth European Lynx appears to be common to the wooded districts of the extreme north of both continents. It is readily distinguished by the indistinctness of its markings generally, including those of the limbs, though on the belly there are spots which, in some individuals, are tolerably distinct; and particularly by the shagginess of its paws, the fur covering which is remarkably long and dense, recalling to mind the feet of some of the Arctic birds, as the great Snowy Owl and certain Ptarmigan. This animal bears even a further resemblance to the Owls, in the manner in which the hair of its face meets to form a mesial ridge between the eyes, which is very strongly marked; whereas in other Cats, although some trace of this may generally be found, it certainly requires to be looked for, to be observed. Its length is about two feet and three-quarters from nose to base of tail, the tail with hair only four inches more; height of the back

* *Proc. Zool. Soc.*, 1838, p. 113. From the same mountain range, a Mungoose (*Herpestes Widdringtonii*, Gray), allied to the Egyptian *H. Ichneumon*, has recently been described by Mr. Gray, in the 'Annals and Magazine of Natural History' for March 1842, p. 50, certainly a very unexpected addition to the Mammalia of Europe.

somewhat exceeding a foot and a half. The ears are two inches long, with copious tufts that sometimes attain to two inches, and the ruff and mouchetures are considerably developed, the latter measuring three inches in length. The coat generally of this species is in winter long and very dense, measuring, at that season, an inch and three-quarters upon the back: in summer it is of a yellowish-buff colour, greyish, or mixed with white, having black tips along the middle of the back; and in winter, (or when in season, as the furriers style it,) it is silvered over with hoary tips, the black extremity of its very short and particularly truncate tail, and the black tips and long pencil-tufts of the ears, contrasting in a striking manner with the almost uniform hoariness of the fur generally; its paws have a wide spread, and look immense; their aspect being quite different from that of any of the others. The facial markings of this species are scarcely, even when at all, perceptible, and of numerous heaps of the skins which I have examined, it was very seldom that any trace of spots could be discerned, even upon the limbs: the fur of the under-parts, however, which is longer, has some distantly placed rather large black spots upon a white ground, resembling those of the next species, and which are more or less brought out in different individuals.

This Arctic species, according to M. Nilsson, is the *F. Lynx* of Linnæus, as indeed was indicated by the words "manus amplissimæ," though the expression "corpore rufescente maculatâ" certainly applies much better to the *F. Lynx* of Temminck, which, as being now generally known by that appellation, I prefer still to style so, perceiving no advantage in altering the established denominations with M. Nilsson. M. Temminck united the Scandinavian and Hudson's Bay animals, after comparison of a vast number of skins; and M. Nilsson's coloured figure of a Swedish specimen might pass equally for that of an American one: it may, nevertheless, surprise, that this species is not generally included in the catalogues of observed mammalia, which are appended to the narratives of the different Polar expeditions; but the reason appears to be, that it is everywhere rare near the sea-coast, keeping to the wooded districts of the interior; Captain Back being the only navigator who notices it.

The Arctic Lynx is confined to the northernmost forests of Scandinavia, where it is known as the *Rislo*, or *Raf-lo* ("Fox Lynx");

and it appears to extend throughout the corresponding latitudes of the whole eastern continent, spreading perhaps to the southward in Siberia, and along the forests of the Ural. It is doubtless the species common in Kamtschatka, and it takes a wide range on the western coast of North America, as the Zoological Society possess a specimen from California. In the United States, it appears to be only known as a very rare straggler; and the only recorded instance which I know of its occurrence within the northern territory of the Union is published in Silliman's 'Journal' for 1837, p. 194, where a specimen is mentioned to have been tracked and shot, at Southington, Connecticut. Its weight was thirty-two lbs. and length nearly three feet; the tail about four inches. "Though not entirely agreeing with Dr. Richardson's description", remarks the writer, "it was probably *F. borealis*". There is no other known species which it could have been. Hearne remarks, that "it is very rare to the North of Churchill [on the *barren-grounds?*], but is there exactly the same as those found to the South-west. They never approach near the settlement of Hudson's Bay, and are very destructive to Rabbits [small American Hares], seldom leaving a place which is frequented by them till they have killed nearly all."—"It is the only species of the genus," remarks Dr. Richardson, "which extends north of the Great Lakes, and eastward of the Rocky Mountains. It is rare on the sea-coast, and does not frequent the barren-grounds, but it is not uncommon in the wooded districts of the interior, since from 7,000 to 9,000 skins are annually procured by the Hudson's Bay Company. It is found on the Mackenzie River, as far north as latitude 66°. The early French writers on Canada, who ascribed to it the habit of dropping from trees on the backs of Deer [which Brickell and Catesby likewise assert of the Bay Lynx, being further rendered probable by the known sanguivorous propensity of the ordinary European species,] gave it the name of *Loup Cervier;* but the French Canadians now term it indifferently *le Chat* or *le Pechoo*".

Dr. Richardson further relates, combining the descriptions of Hearne and Dr. Godman with his personal observation, that this Lynx "is a timid creature, incapable of attacking any of the larger quadrupeds, but well armed for the capture of the American Hare, on which it chiefly preys. Its large paws, slender loins, and long but thick hind legs, give it an awkward clumsy appearance. It makes a poor fight

when it is surprised by a hunter in a tree, for though it spits like a Cat, and sets its hair up, it is easily destroyed by a blow on the back with a slender stick, and it never attacks a man. Its gait is by bounds, with the back a little arched, and lighting on all the feet at once. It swims well, and will cross the arm of a lake two miles wide; but it is not swift on land. It breeds once in the year, and has two young at a litter. The natives eat its flesh, which is white and tender, but rather flavourless, much resembling that of the American Hare." The latter accords with the statement of Dr. Shaw respecting the flesh of the Lion, which this author compares to veal; and it is borne out by the personal experience of Mr. Darwin, in the instance of the Puma, which is commonly eaten by the Guachos of South America. Buffon, therefore, may have been writing from supposed analogy when he asserted that the flesh of the common European Lynx, "like that of other carnivorous animals," is not good to eat.*

* It is indeed a question, to what extent the excessive repugnance with which the idea of eating the flesh of Carnivora is usually entertained, be not mere educational prejudice, as an immense host of authorities might be cited to testify. Mr. Darwin, as above noticed, in his extremely interesting 'Journal' (p. 135), relates, "At supper, from something that was said, I was suddenly horrified at thinking I was eating one of the favorite dishes of the country, a half-formed calf, long before its proper time of birth. [This reminds one of an esteemed dainty of the ancient Romans; namely, a gravid *uterus suillus!*] It turned out to be Puma; the meat is very white, and remarkably like veal in taste. Dr. Shaw was laughed at for saying that the flesh of the Lion is in great esteem, having no small affinity for veal, whether in colour, taste, or flavour; such, certainly," continues Mr. Darwin, "is the case with Puma. The Guachos differ in opinion, whether the Jaguar is good eating; but are unanimous in saying that Cat is excellent."

Similar testimony in favour of Dog's flesh might be adduced, and not only as regards the meat of such as are reared exclusively on vegetable diet, but of those which take their chance and find their own subsistence as they may. Mr. Townshend (in his recent 'Narrative of a Journey across the Rocky Mountains' of North America) states, that he has often eaten and relished it, and has no other objection to this diet than the sentimental one of repulsiveness, at having so faithful a servitor and friend of man heartlessly butchered to appease his appetite. In Norway, I may remark *en passant*, a breed is reared solely for the sake of their fur, which has evoked a similar remark from De Capel Broke and other tourists in that country. Capt. Lyon mentions, of the Arctic Fox, that "the flesh, which was very fat, had so good an appearance, that many trials were made of it. All were horrified at the idea of eating Foxes, but very many soon got the better of their delicacy. Not being myself very nice, I soon made the experiment; and found the flesh much resembling that of kid, and I afterwards frequently made a supper of it."—*Private Journal*, p. 90.

Of the quality of *Viverridæ* meat, I do not remember to have seen or heard of any remark, nor do I suspect it would be otherwise than rank and unpalatable: but of the *Plantigrada*, or Bears, Raccoons, and their allies, and of the Badger tribe, all of

The Bay Lynx (*F. rufa*, Guldenstadt; *F. maculosa*, Vigors and Horsfield, *Zoological Journal; Mississipi Lynx* of Buffon, and "Wild Cat" of the United States of North America). Size averaging that of the Pardine Lynx, or smaller than the last species, with much shorter fur, and a very full facial ruff, the mouchetures not appearing below it. From nose to base of tail, it measures about two feet and a half, the tail five inches, and height of the back about sixteen inches; ears an inch

which are vegetable-feeders to a considerable extent (as indeed are also most *Viverridæ*), abundance of favourable testimony might be collected. Vide Major Lloyd's 'Field Sports of the North of Europe,' II, 46, and the Hon'ble C. A. Murray's 'Travels in the Western Regions of North America,' II, 59. Even of the fetid Skunk of the latter continent, we are informed, in Carver's Travels (p. 452), that "Europeans who have fed on them, after the receptacles of the odorous fluid had been carefully extracted, have found them very sweet and good." If this animal be seized and lifted by the tail, it cannot squirt its fluid, and, like other creatures with a sensitive nozzle, it is easily killed by a blow on the snout. Formerly it was customary to eat the Otter, on lenten days, *for a fish!*

With regard to Bear's meat, it should, however, be mentioned, that the flesh of the great Polar Bear appears to have sometimes proved decidedly unwholesome; yet in the Appendix to Capt. Parry's 4th Voyage, it is stated to be "free from any disagreeable taste; it proved a valuable and timely addition to our stock of provisions, and served materially to restore the strength of the party." Hence it may be suspected that the effects resulting from the use of this aliment, noticed in the narrative of one of Capt. Ross's Voyages, are attributable to some particular food the animal had been eating, or even, possibly, to some adventitious circumstance affecting the tone of the digestive operations in the men.

Among the *Insectivora*, Cuv., the respectable editor of the 'Literary Gazette' gives his personal testimony that the flesh of the Hedge-hog is excellent; and there is a notice, in the 'Magazine of Natural History', of a Mole-catcher who was in the habit of eating the Moles he caught, and said that "if folks generally knew how good they were, but few would fall to his share." To cite an instance from among the *Edentata*, Cuv., the Armadilloes are exceedingly foul feeders; yet all who have partaken of it agree that one, "roasted in its own shell," is most delicate-eating.

In the feathered class, I remember that M. Audubon declares, that he has never eaten the flesh of Cormorant, nor, so long as he can help it, will he ever do so, or words to that effect; but M. Schomburgk has assured me that he has frequently eaten of the Cormorant of Guiana, which is really very good, after having been (like other water-fowl) skinned previously to dressing: and very lately a gentleman informed me that he had repeatedly partaken of Anhinga (*Plotus*), a genus closely allied to that of the Cormorants. Indeed, some London readers must not be too sure that they have not themselves feasted off a plump Cormorant; for I have been credibly informed of an instance of a man carrying a row of these birds upon a pole through the streets, and seeking to vend them to the Londoners by the familiar cry of "wild Ducks, wild Ducks, oh!" Of the egg of the Cormorant, the same friend has assured me, that he was much surprised to find how good they were; and there is reason to suspect that any eggs of birds described as otherwise, were none of the freshest when tasted.

It is said that a Buzzard, and particularly a Pern, or Honey Buzzard, is esteemed an excellent dish in some parts of France.

and three-quarters long, or, with their tufts, half an inch more; and mouchetures, which barely acuminate below the considerably developed ruff, an inch and three-quarters at most. The fur is seldom more than an inch long upon the back, or at most an inch and one-eighth; and is of a grey-brown colour, more or less tinged with rufous, much as in a rusty tabby Cat, or as in the *Chaus;* and marked all over with small round dark spots, indistinct on the back, and, in some, all over the body, but always well-defined on the limbs, and more or less so above them; enlarging and becoming deeper-coloured downwards,

People should really be more particular than they are in eating fish, lobsters, &c., to be consistent in following out their notion that the flesh of all carnivorous animals is unfit for the table. Many English gourmands would sicken at the idea of a dish of Snails, which in Hungary, more especially, is esteemed a delicate and is a very frequent viand, so much so that not a few of the peasantry even pay their rents with them (vide Mr. Paget's recent 'Travels in Hungary and Transylvania'); but a Hungarian lady would be fully as much horrified at the thought of swallowing an Oyster, and would, at least, have this advantage over the British epicure, that Snails are vegetable-feeders. One can fancy a civic *bon vivant* commiserating the barbarism of the Persian Princes, who not long ago visited the British metropolis, and testified their abhorrence at the custom of eating Turtle! But that we civilized and enlightened *Carnivora* are altogether free from irrational and totally unfounded misapprehension on the subject of eating the flesh of creatures of prey is, the reader will perhaps begin to think, a little questionable, if he do not go so far as to imagine that a hint might be profitably taken on this subject, as on some others, from the philosophically omnivorous Chinese. At all events, those who are disposed to rail at others for their fastidiousness about eating pork, may ponder awhile upon the reasonableness of their own aversion to partake of various other kinds of flesh, and hesitate before condemning as "unclean" and improper food, what they only presume to be such as a mere matter of course, stigmatizing, by the appellation "carrion," what, in truth, they might have eaten with great relish, had the tide of conventional prejudice happened to flow in the opposite, direction.

A-pro-po's to the foregoing remarks, I have just chanced to meet with a notice in Ellis's 'Tour through Hawaii' (p. 349), which is worthy of being here transcribed. It is well known that the Polynesian natives generally, as well as the Chinese, each rear a particular breed of Dogs for the table, though mainly on vegetable diet: and the *canivorous* propensity is retained by the Chinese in this country; at least I lately saw a well-dressed China-man bargaining for a Corsac Fox in one of the Calcutta bazars, and doubt not that he was prompted thereto by his palate. "Numbers of Dogs, of rather a small size, and something like a terrier," writes Mr. Ellis, "are raised every year as an article of food [in Hawaii, olim *Owhyhee*]. They are mostly fed on vegetables; and we have sometimes seen them kept in yards, with small houses to sleep in. A part of the rent of every tenant who occupies land, is paid in Dogs for his landlord's table. Though often invited by the natives to join them in partaking of the baked dog, we were never induced to taste of one. The natives, however, say it is sweeter than the flesh of the pig, and much more palatable than that of goats or kids, which some refuse to touch, and few care to eat."—*Chacun à son goût. De gustibus*, &c. &c.

and often uniting, more or less, to form transverse streaks on the limbs, similar to those visible on their inner aspect. The belly is clad with longer hair, which is white, with rather large black spots; the summit of the back, and across the shoulders, are darker; the facial markings are more or less brought out, different individuals varying a good deal in this respect; the ears have the basal dark mark distinct, which is not generally the case with the last species; and the tail is obscurely ringed to near the end, where there is a distinct black ring, and beyond it a lateral black spot, which joins that on the other side above, leaving the extreme tip white: the under-surface of the paws and tarsus are conspicuously brown-black (as in *F. chaus*), which is also the case, but in a less degree, in *F. pardina;* and the irides are pale bluish, the pupils of the eyes closing circularly (?). The young (as figured by F. Cuvier by the appellation of "Chat à ventre tacheté,") are clouded with much larger spots, of a darker colour than the general ground-tint.

The Bay Lynx appears to be pretty generally diffused in suitable districts throughout the United States, as more especially in the forests of the Alleghanies and other mountain ranges; extending southward into the Floridas and Mexico. It is also found in California, and about the Columbia river, but it does not occur in the parallel of Labrador. Like the rest, it chiefly inhabits the less frequented parts of the forest, where, in the season, it "makes night hideous" with its loud caterwaulings. It is very destructive to the fawns of the Virginian Deer, young Pigs, Hares, &c. and especially to feathered game, including the wild Turkey in the south. Brickell and Catesby assign to it the habit of dropping from trees upon the backs of Deer, and sucking the blood of its victim. When urged by hunger, it has been often known to follow the footsteps of a hunter, who happened to be carrying the bleeding carcass of a Deer, and become at length so excited, by sniffing and licking at the drops of blood on the ground, as to spring up at the dead animal, and sometimes lacerate the bearer with its talons; but the next moment it will be off and up the next tree, and pursue its course along the forest-boughs with such celerity, like a Puma or Leopard, that, if not shot down at once,—and a wound that does not disable it may exasperate the creature to attack with fury,—it has every chance of escape. When angry, it erects the facial ruff, which helps to impart a savage aspect to the animal.

The above are the only described species of Lynx—putting aside the Caracal—in which, I confess, that I have any confidence, though several others have been indicated by M. Raffinesque as inhabitants of North America, which, at most, I suspect, were varieties of the two last.* According to Dr. Richardson, the late Mr. Douglas was of opinion "that there are more than one undescribed animal of this genus inhabiting the countries bordering on the Columbia. The skins procured in that quarter are generally carried to the Chinese market, without passing into the hands of European furriers." The following passage, however, from a paper on the fur trade, published in Silliman's 'American Journal of Science,' (XXV, 311,) will excite surprise and doubt that any animal so conspicuous should still remain unknown to naturalists. "The fur-countries, from the Pacific Coast to the Rocky Mountains, are now occupied, (exclusive of private combinations and individual trappers and traders,) by the Russians, on the north-west, from Behring's Strait to Queen Charlotte's Island, in north latitude 53 degrees, and by the Hudson's Bay Company thence, south of the Columbia River; from which Ashley's Company, and that under Capt. Bonneville, take the remainder of the region to the Coast of California. Indeed the whole compass, from the Mississipi to the Pacific Ocean, is tracked in every direction. The mountains and forests, from the Arctic Sea to the Gulf of Mexico, are threaded, through every maze, by the hunter. Every river and tributary stream, from the Columbia to the Rio del Norte, and from the Mackenzie to the Colorado of the West, from their head springs to their junction, are searched and trapped for Beaver.

"Almost all the American furs, which do not belong to the Hudson's Bay Company, find their way to New York, and are either distributed thence for home consumption, or sent to foreign markets. The Hud-

* It is well known that the morbid eagerness of this eccentric Siculo-American naturalist to distinguish himself as the discriminator of overlooked species of animals and plants amounted, latterly, to decided mania, insomuch that the conductors of different American scientific works to which he sent his papers were compelled, at length, to refrain from giving publication to his frequent and voluminous contributions. Not even the German ornithologist, Brehm, went the length which M. Raffinesque ultimately did in regarding every trivial variation as indicative of specific distinctness. See a biographical memoir of M. Raffinesque in one of the American scientific periodicals (I do not now remember which), appended to the announcement of his demise.—E. B.

son's Bay Company ship their furs from their factory at York Fort, and from Moose River on Hudson's Bay; their collection from Grand River, &c., they ship for Canada; and *the collection from Columbia River goes to London.*" This wholesale destruction of the fur-bearing animals, and alleged destination of their spoils, seem hardly reconcilable with the opinion that any large species could still remain unknown to European naturalists; and if additional species of the present group existed, especially about the Columbia River, there is certainly no accounting for the total absence of their reliques from among the prodigious multitudes of Lynx skins, from nearly all parts of North America westward of the Rocky Mountains, which find their way to London, and have been diligently examined by myself and others in the store-rooms where (together with other kinds of peltry) they are exhibited previously to each half-yearly sale by the Hudson's Bay Company. From what enquiries I have been able to make of persons who have traversed the western territory of North America, the two well-known species already described appear to be generally recognised as the "Wild Cat" and the "Mountain Cat" or "Catamountain"; and to these, I think, most of the notices of authors may be satisfactorily referred, making some allowance for vagueness in descriptions from memory, or which, perhaps, in some instances, have been given at second-hand. In Brickell's 'History of Carolina' (A. D. 1737, p. 107), a rude figure is published of the "Mountain Cat," though, at the same time, the least bad one in the plate, representing a streaked animal, but which cannot be intended for the Bay Lynx, or common American "wild Cat," as this is separately described by him. It is possible, however, that the Arctic or mountain species is intended, having been designed, perhaps, from mere hear-say. Carver, also, in his Travels (p. 445), mentions the "Cat of the mountain," in addition to the "wild Cat," as being "much larger than a [domestic ?] Cat, with similar fur, but differing in colour, this being of a reddish or orange cast, becoming lighter on the belly. The whole skin is beautifully marked with black spots of different figures, of which those on the back are long, and those on the lower parts round. This creature is nearly as fierce as a Leopard, but will seldom attack a man." In this instance, I am of opinion that the term "wild Cat" refers to the Arctic Lynx, and "Cat of the mountain" to the Bay Lynx. Professor Nuttall, in his "Travels in the Arkansas Territory' (p. 118), notices "wild Cats

of two colours, both striped and spotted," but gives no further description; and Messrs. Lewis and Clarke assert, that—"The Tiger-cat inhabits the borders of the plains, and the woody country in the neighbourhood of the Pacific. It is of a size larger than the wild Cat [Bay Lynx] of the United States, and much the same in form, agility, and ferocity; but its hair is long and fine, far exceeding that of the animal mentioned. The colour of the back, neck, and sides, is of a reddish brown, irregularly varied with spots of dark brown, the tail is about two inches long, and nearly white, except the extremity, which is black: it terminates abruptly, as if it had been amputated. The belly is white, beautifully variegated with small black spots. The legs are of the same colour as the sides, and the back is marked transversely [!] with black stripes: the ears are black on the outer side, covered with fine short hair, except at the upper part, which is furnished with a pencil of hairs, fine, straight, and black, three-quarters of an inch long"*. To me this somewhat elaborate description appears very much as if it had been drawn up from recollection only, the tail being represented as but two inches long, and the back as *marked transversely*, which is at variance with every other species of Cat known. The country, too, where the animal is stated to inhabit, has now been pretty well examined, and is known to yield the Arctic species, which I cannot bring myself to doubt was that intended by the travellers. M. Raffinesque, however, who never allowed an opportunity to pass of coining a name, whether or not he had seen a specimen, or so much as a portion of one, or even a drawing that could be depended on, has imposed the name of *fasciata* upon the sole authority of Messrs. Lewis and Clarke's description. The same author has indicated, as the Golden Lynx (*Lynx auratus*, Raffinesque), an animal mentioned by Leray ('Voyage au Missouri,' p. 190), who met with it, according to Dr. Harlan, on the border of the Yellow-stone River, near the 44th degree of north latitude, and 32d of western longitude from the meridian of Washington. The animal is described as "one half larger than the domestic Cat, the tail two inches long, and ears penicillated; colour, a clear brilliant yellow, spotted with black and white". The reputed *Catamount* is M. Raffinesque's *Lynx montanus*, to which Dr. Harlan is disposed to refer the *Mississipi Lynx* of Buffon, which is clearly the Bay Lynx, and some-

* Narrative of Expedition, III, 28.

thing else is noticed by him as *Lynx Floridanus*. I have not been able to consult M. Raffinesque's paper on these animals, which was published in the 'American Monthly Magazine' for 1817, p. 46; and only know it from the references of Dr. Harlan and others. Should there really be any additional species to those admitted here, no doubt M. Audubon's forthcoming work on the Mammals of North America will include them; but I repeat the expression of my strong suspicion, that none of the foregoing indications will ever be confirmed.

With respect to the Lynxes of Scandivania, a notice occurs in Sir Arthur de Capel Broke's 'Travels in Sweden,' &c. (pp. 147 *et seq.*), which in parts is somewhat obscure. "The forests in the province of Drontheim," it is remarked, "abound with different species of wild animals, as Bears, Wolves, Lynxes, Foxes, Martens, Cats,* &c. The Lynx of the north is not rare in this part of Norway. In the Norwegian language it is called *Goupe*, and in the north of Sweden it is generally termed *Wargilue*. From the skins of this animal that were shewn to me in different parts of Norway and Lapland, three of which differed very materially in colour, it seems that there are, at least, as many species or varieties. Of one of these M. Knudtzon had several. The largest measured five feet in length, not including the tail, which did not exceed an inch and a half. The colour of them all was grey, with a yellowish tinge, beautifully marked with dark spots, and the ears were tufted. The general price they brought at Drontheim was about five specie dollars, or one pound sterling. This seems to be peculiar to Norway, as I never observed it during my subsequent travels. [It would appear to be *F. cervaria*, but much stretched, and the tail imperfect.] Of the two others, which I met with in Lapland and Sweden, one that I saw at Urnea measured, from the muzzle to the beginning of the tail, five feet eleven inches [!], and the tail was hardly two inches and a half. The appearance of the skin in every respect so much resembled that of the Leopard, that I should have suspected it to have belonged to that animal, had it not been for its tufted ears, and the length and superior thickness of the fur. [I presume this to have been an excessively stretched skin of *F. cervaria* killed in summer, when the pale tips to the fur had disappeared.] The third species, which I met with in Swedish Lapland,

* Vide Note to p. 24.

differed very materially from the other two, being of an uniform reddish-brown colour [summer aspect of *F. borealis*]. In length it exceeded five feet [!]. This, which I imagine to be the same as the North American Lynx, and the animal most commonly known by the term Lynx, I have seen alive in the collections of this country, though of a much smaller size." Sir Arthur proceeds to remark on the magnitude of the skins noticed; and if my presumed identifications of them are correct, he does not appear to have been acquainted with the ordinary species of the northern forests, or veritable *Warg-lo (Wargilue)* of the Swedes.

The Caracal (*F. Caracal*, Auct). This well-known species appears to bear that affinity to the Domestic Cat, which the preceding do to the European Wild Cat; and like its analogue, is distinguished by having a tapering tail, in addition to its facile capability for domestication: individuals, however, vary in this respect, as observable in all the higher animals. Length about two feet and a half, the tail nine or ten inches additional; ears three inches, or with tufts three-quarters of an inch more; and height of the back sixteen or eighteen inches. General colour bright fulvous-brown, silvered over with whitish tips in winter, and paler on the under-parts, with some spots generally obscure, but sometimes tolerably distinct, on the belly, flanks, and inside of limbs; ears black without, terminating below in a point considerably beyond the ear; no black spot on the border of the upper lip, but one where the moustaches grow, and another above each eye, and there is a line down each side of the nose; extreme tail-tip black.

This animal is common to all Africa, from Barbary to the Cape of Good Hope, where it is not unfrequent; also to a considerable portion of western and even central Asia, being termed *Tsogde* in Little Tibet, and *Ech* in Ladakh, as I was informed by Mr. Vigne, who shewed me an excellent drawing of a trained one he saw in the former country: but if it exist, according to the current statement, in India, it must be only or chiefly in the western parts, not improbably in the same districts as the Lion: for though its range is asserted in the *Dict. Class. d'Hist. Nat.* to extend from Barbary to Bengal, and Mr. Ogilby mentions it as met with in most parts of India,* while various other authorities

* 'Mammalogy of the Himalaya,' p. 10.

might be cited to the same effect, yet it is neither included in Col. Sykes's list of the Mammalia of the Deccan, nor in the elaborate Catalogue of those of the Southern Mahratta country by Mr. Elliot, neither can I learn of any trace of it in Bengal; Mr. Hodgson omits it in his list of Nepâlese Mammalia (*J. A. S.*, X, 908), and, proceeding eastward, Dr. Griffith among those of Assam. It is even likely that, like the Cherrug Falcon, trained individuals may be occasionally brought from beyond the Indus, and that such have erroneously induced the statement that they were indigenous to the provinces where seen. It is said to inhabit Arabia, as well as Persia, and it is not unfrequently designated the *Persian Lynx*, being trained, especially in that country, to creep and spring upon game, in the manner of the Cheetah. This animal is the *Karrah Kulak* of Persia, *Gat el Khalleh* of Barbary, and bears the name of *Seer-gosch* in India. M. Temminck states, that the wild Caracals hunt in packs of several individuals, pursuing and attacking game in the manner of wild Dogs; but this, I should say, much requires confirmation; as does particularly its claim to be considered as indigenous to India.*

There is a *Felis aurata*, Temminck, (not *Lynx auratus* of Raffinesque,) which appears to need further establishment as distinct from the Caracal. It is described as rather smaller than that species, with tail half the length of the body, a brown band along the median line of the tail, but the extreme point black. Ears short, rounded, not penicillated; the coat very short and lustrous. All the upper-parts are very bright rufous-bay and spotless, with indistinct streaks of a somewhat deeper tint on the flanks; lower parts reddish-white, marked with large and small spots of maronne-brown; ears perfectly black without, and reddish within; limbs golden. Length three feet four inches, of which the tail is twelve inches and a quarter. Described from a skin purchased in London, locality unknown.

* Since writing the above, I have been assured of one having been killed near Jubulpore, in central India.—E B.

Selections communicated by the Suddur Board of Revenue at Allahabad, from Correspondence respecting the proposed formation of a Canal for Irrigation to be supplied from the River Jumna, near the Village of Kuttha Putthur, in the Deyra Doon. From Captain P. T. Cautley, *to the Secretary of the Suddur Board of Revenue, North Western Provinces, Dooab Canal Office, Camp Hurdwar, 29th April,* 1841.

Sir,—In the Revenue Survey of the Deyra Doon completed by Captain Brown, that officer notes "that the lands north of the Sutwala Row in general, may be irrigated from the Jumna, by a Canal cut from Domayut, but the excavations would be expensive."

2. During the late cold season, I took the opportunity of examining the country, which would be benefited by such a work as Capt. Brown refers to, and as I was on the spot, this examination naturally led to a further inquiry into the practicability or not of getting water out of the Jumna upon the high land; the results, which for the satisfaction of Government I have put into form, will be found in the sheet of Plans and Sections which accompany this letter, fig. 1, being a map on a scale of four inches to a mile of the ground over which the Canal will take its course; fig. 2, a map on a quarter of the scale, of the country bounded on the north by the hills and forests of Umbarree and Puthipoor; south by the Asun river; east by the Sutwala Row; and west by the Jumna river. The rest of the figures are longitudinal and cross sections, with plans, &c. of works in masonry which will be required to maintain a regular flow of water.

3. In fig. 2, the course of the Canal is indicated by a blue dotted line, and it will be observed, that as the mountain drainage crosses it at right angles at two points, the whole tract to be irrigated is divided into three distinct portions, stretching from the Canal to the Asun river, the slope of country being in every way favourable to the irrigator.

4. The return of village lands which accompanies this letter shews, that about 17,000 acres of cultivable land will be benefited by this Canal; the country is open with little forest, and only requires a Canal to bring it under cultivation. The want of water* at present prevents the

* Captain Cautley in a subsequent letter explains, that he here alludes to *drinking* water; and adds,

establishment of villages at a distance from the Asun and Jumna rivers, and the want of population depending on this circumstance will, I imagine, until a Canal is made, interfere altogether with the improvement of this portion of the Doon.

5. The amount of my estimate (Rs. 90,307 : 0 : 0) which depends entirely on the difficulties of the first three and a half miles of the course of the Canal is high, but the return of water, rent, mills, etc. when the water-course is doing its proper work, would render such an outlay admissible.

Thus :—

	Rs.	*As.*	*Pie.*
17,000 Acres, or 27,200 Puk. Begas, @ 5 annas per Bega, ...	8500	0	0
Mills, corn, sugar, sawing, etc.	1500	0	0
Total,	10,000	0	0
Deduct Repairs and Establishment.	3000	0	0
Balance net profit, ...	7000	0	0

or equal to $7\frac{3}{4}$ per cent.

6. For a detail of the work I must refer you to figs. 1, 4, 5, 6, 7, 8, 9, 10, the latter being the longitudinal section, the capital letters noted on each referring to particular points; the position, elevation, or depression of which will be easily recognized.

7. It was found impracticable to establish a head at Domayut, the steppes into to the river from the high land being not only exceedingly high, but the relative level of the Jumna's water being low, full advantage was not attainable so far down the river; the head which I have established is immediately under the village of Kuttha Puttha, and at the highest point that the mountains would admit of; the head is favorably situated for a supply of water, and as the depth of digging at that

"In a note from the manager of the Hopeton Grant, dated 25th inst. he observes with reference to the land which would be benefited by the Kuthur Puthur Canal, 'the whole of the lands which you noted as to be commanded by his Canal are still lying waste. Some attempts that I made to cultivate in the outskirts are likely to prove abortive, for the Prithipoor well is almost dry, and the people in that neighbourhood have to drive their cattle to the Jumna for water; they cannot stand out against want of water.' This is characteristic of all the tract coming under the influence of the proposed Canal; the Puthipoor well is, I believe, the only one in existence in its neighbourhood. Water therefore is not only necessary for irrigation, but for the common purposes of life, and consequently, for the concentration of people for agricultural purposes."—*Vide his letter of 26th May*, 1842.

point will be thirty-six inches, the expenses necessary for spurs and bunds will be trifling.

8. From the head to a point at a distance of 4,755 feet, the course of the canal is passed by two rows or mountain streams, one of minor importance having a dam with two openings of ten feet each, the other with a dam of ten openings, as represented at fig. 13. The quantity of boulders, or river stone, in this part of the country will render the execution not only easy, but will enable them to be completed at a very moderate expense. These dams will be precisely the same as those in use of the Doab Canal, with sleeper planks, etc. etc.

9. The second division of the work may be considered as that from the letters A to N, or 18,916 feet; on this line the course of the Canal creeps along the slopes and scarps of the high banks, descending to the Jumna; and the level of the Canal bed, which is proposed to be twenty-four inches per mile, strikes out on the surface of the country at the latter figure. Four mountain streams will be passed by aqueducts, two of them having a span of fifty-one, of forty-five, and the other of twenty-five feet. Care and attention is all that is required to surmount the difficulties of excavation on this line; neither the original labor, nor the chance of after-accident is equal to that which I anticipated on the first mile of the Beejapoor water-course. The soil is full of large shingle or boulders, and the excavation which has been estimated for, is ample to render the work fully efficient. Portions of the line where the Canal comes in contact with high banks is proposed to be constructed of masonry, as represented on the section in fig. 15. The masonry channel will lead to and from the masonry aqueducts, as well as from the dam of ten openings, which I have described as constituting part of the work of the first division, and immediately south of this dam, grooves for sleeper planks will be made in the main channel, so as to keep it clear of water during floods. As the breadth of main channel and that of dam-openings correspond, the same sized plank will do for both.

10. The third division, from the letter N to the Seetla or Sutwala Row, or a distance of 21,834 feet, is plain digging. Six lines of drainage are crossed: two by aqueducts of twenty-five feet span each; four by dam or outlet, one of which has ten openings of ten feet each; and three outlets of ten feet each. The slope of the Canal bed is still continued on a descent of twenty-four inches per miles the extra

slope being overcome by four falls in masonry: one of four and half feet, two of eight feet, and one of twelve feet, which latter will deliver the tail-water into the Sutwala Row, and ultimately into the Asun and Jumna rivers.

11. The facility with which boulders will be procured, and the cheapness of the very best lime, ought, I should think, to enable the persons, who superintend the construction of these works, to do them efficiently on the estimate now submitted.

12. I need hardly advert to the power for machinery which is introduced into the Doon by the construction of these masonry falls. On the Beejapoor water-course, there are 115 descents averaging four feet each. On the Kuttha Puttha Canal, the four proposed falls will place on the high lands means for machinery of every description. It may be long before these means are taken advantage of, but with the growing interest taken in this valley, the annual arrival of new settlers, the certainty that a new generation of Europeans is now springing up, who must look to a livelihood from this country, I see in perspective not only a valley rich in its fields and harvests, but one that will be the centre of an active and manufacturing population.

13. The quantity of water required by the Kuttha Puttha Canal is eighty cubic feet a second. When not used for irrigation, the escape ultimately finds its way back to the Jumna, through the course of the Sutwala and Asun rivers.

14. I am prepared for a question that may be put as to the propriety of going to the expense of this work for using, (advantageously though it may be,) eighty cubic feet of water, when the demand for the Delhi and Doab Canals absorbs during years of drought the whole volume of the Jumna river, and when this eighty feet, now proposed to be turned to account in the Doon, at an expense of 90,000 rupees, would be used in the Doab without incurring any expense at all. In the right that Government has very properly assumed over the waters in the Doon, I merely see the intention of regulating the supply and establishing a supervision, so that the water taken from any river may be applied to the greatest advantage. The inhabitants of the Deyra Doon, who on the west side possess the Asun river rising in their own country, and pouring a supply of water into the Jumna, equal to 600 cubic feet a second, may well be permitted to relieve the Jumna of one-eighth of that

amount; their claim to such a small proportion is infinitely greater than that of others, and as the necessity for water not only for irrigation, but even for drinking, is as great on this tract of the Doon as it is on any portion of the districts under the influence of the Delhi and Doab Canals, this claim to a portion of the Jumna may be fairly conceded.

15. In the case of the Beejapoor water-course, which was proposed to be opened by a private individual, a precedent, and a very judicious one, appears to have been established of preventing a work of this nature, which must ultimately be of service to all, from becoming the private property of one person. Government in the case alluded to, proposed being at the expense of the work, so as to admit of the benefits being equally distributed, both amongst the Native and European farmers. The same argument would apply to the Kuttha Púttha Canal; the expenses of outlay on this work, however, are beyond the means of the holders of the land coming under its influence. This fine tract of cultivable land, therefore, must lie waste unless Government gives its aid in the first instance. I believe, that I have shewn that there are no natural obstacles to the undertaking, and should the return for outlay come up to the estimate which I have made of it, the sanction to carrying the work into effect would, in giving fair interest for the capital expended, be the means of fertilizing a large tract of the valley which otherwise must lie waste and uncultivated.

I have the honour to be, &c.

(*Signed*) P. T. Cautley, *Capt.*
Superintendent Doab Canal.

To H. M. Elliott, Esq.
Secretary, Revenue Board, Allahabad.

No. 38.

Estimate for the Kuttha Puttha Canal in the Deyra Doon, for the Irrigation of the tract of Country bounded by the Jumna, Asun, and Seetla Rivers, Doab Canal Office, 14th April, 1841.

Description,	Measurement. L.	B.	D.	No.	Cc. ft.	Total Cc. ft.
Kuttha Puttha Dam No. 1.						
Floorings, ...	29	area	114	× 1	= 3306	
Piers, centre and side, ..	3	area	66	× 3	= 594	
Tail Wing Walls, ...	25	× 3	× 5	× 2	= 750	
Front ditto, ...	7 ×	area	48	× 2	= 672	
Total Cubic feet,..	..	..	..	..	..	5322
Domayut Row Drainage No. 2.						
Floorings, ...	147	area	114	× 1	= 16758	
Piers, centre and side, ..	3	×	66	×11	= 2178	
Tail Wings, ...	25	× 3	× 5	× 2	= 750	
Front ditto, ...	7	area	48	× 2	= 672	
Total Cubic feet,..	..	..	..	..	..	20358
Aqueduct No. 3 *Nulla.*						
Piers, ...	16	× 10	× 17	× 2	= 5440	
Arch, ...	16	× 60	× $3\frac{1}{2}$	× 1	= 3360	
Wing Walls, ...	40	× 3	× 10	× 4	= 4800	
Flooring, ...	150	× 3	× 16	× 1	= 7200	
Parapets, ...	150	× 3	× 4	× 2	= 3600	
Cordon, ...	150	× $1\frac{1}{4}$	× 1	× 2	= 375	
Abutments to Piers, ...	10	× 1	× 30	× 4	= 1200	
Total Cubic feet,..	..	..	..	..	..	25975
Aqueduct No. 4.						
Nulla same as above,	..	..	..	..	..	25975
Aqueduct No. 5 *Nulla.*						
Piers, ...	16	× 8	× 13	× 2	= 3328	
Arch, ...	16	× 52	× 3	× 1	= 2496	
Wing Walls, ...	35	× 3	× 10	× 4	= 4200	
Flooring, ...	130	× 3	× 16	× 1	= 6240	
Parapets, ...	130	× 3	× 4	× 2	= 2120	
Cordon, ...	130	× $1\frac{1}{4}$	× 1	× 2	= 325	
Abutments to Piers, ...	8	× 1	× 24	× 4	= 768	
Total Cubic feet,..	..	..	..	..	..	20477
Carried over Total Cubic. feet.	..	..	..	..	.. ..	98107

Description.	Measurement. L.	B.	D.	No.	Cc. ft.	Total Cc. ft.
Brought over Cubic feet..	..	..	..	..	..	98107
Aqueduct No. 6 Nulla.						
Piers, ...	16	× 6	× 13	× 2	= 2496	
Arch, ...	16	× 30	× 3	× 1	= 1440	
Wing Walls, ...	22	× 3	× 6	× 4	= 1584	
Floorings, ...	80	× 3	× 16	× 1	= 3840	
Parapets, ...	80	× 3	× 4	× 2	= 1920	
Cordon, ...	80	× $1\frac{1}{4}$	× 1	× 2	= 200	
Abutments, ...	6	× 1	× 24	× 4	= 576	
Total Cubic feet, ..	..	..	..	..	..	12056
Aqueduct No. 7, same as above,	..	..	..	..	..	122219
Outlet No. 8 Drainage.						
Floorings, ...	16	area	114	× 1	= 1824	
Piers, ...	3	area	66	× 2	= 396	
Tail Wing Walls, ...	25	× 3	× 5	× 2	= 750	
Front ditto, ...	7	area	48	× 2	= 672	
Total Cubic feet,..	..	..	..	..	..	3642
Outlet No. 9 Drainage, same as above, ...	..	..	..	..	..	3642
Aqueduct No. 10, same as at No. 4, ...	..	..	..	..	..	12056
Dam No. 11, same as Domayut Row Drainage, .	..	..	..	..	..	20358
Outlet No. 12 Drainage, same as No. 6, ...	..	..	..	..	..	3642
Masonry Water Channel Area Section 26 × 10560	..	..	..	..	..	274560
Total Cubic feet of Masonry,		..	..	..	..	440119

Earth Work.

On the first 23,671 feet in length the Canal either crosses the Steppes or traverses the Bank, dipping into the valley of the Jumna. The superficial soil is clay and sand, that under it shingle; where the Canal traverses the Banks, the excavation will be done without Cooli labor, by throwing the shingle and earth over the sides.

1st Portion,	7431	×	15	×	20	.. ..	2229300
2d Portion,	16240	×	25	×	20	.. ..	8120000
3d Portion,	21834	×	20	×	6	.. ..	2620080
					Total Excavation, ..		12969380

Masonry 440119 *Cubic feet.*

Of which	40,119 Cubic feet, @ 16 Rs. per 100, ..	6419	0	7
,,	100,000 ditto, @ 12 Rs. per 100, ..	12000	0	0
,,	300,000 ditto, @ 8 Rs. per 100, ..	24000	0	0

Earth Work 12969380 *Cubic feet.*

Of which	10,349,300 Cubic feet, @ 3 Rs. per 1000, ..	31047	14	5
,,	2,620,080 ditto, @ $2\frac{1}{2}$ Rs. per 1000, ..	6550	3	2
4 Falls with Bridges attached, 150 Rs. each, ...		600	0	0
2 Bridges Villages, @ 60 Rs. each, ...		180	0	0
2 Mills, @ 500 Rs. each, ...		1000	0	0
100 Planks for Dams $10\frac{1}{2}$ feet × 1 feet × $2\frac{1}{2}$ inch with iron straps, &c. complete, @ 3 Rs. each, ...		300	0	0
	Total Co's. Rs. ..	82097	2	2
Add for Contingencies, ...		2809	13	10
	Grand Total, Co's. Rs. ..	90307	0	0

Assignment required on the Saharunpoor Treasury.

(*Signed*) P. T. Cautley,
Superintendent, Doab Canal.

Kutta Putthur Canal
Deyra Dhoon

No. 33.

To G. F. Franco, Esq.

Commissioner, Division of Meerut.

Sir,—I have the honour to acknowledge the receipt of your letter, No. 35, dated 12th July 1841, with its enclosure, and map as per margin,* relative to a Canal proposed to be cut from the river Jumna at Kutta puther, for the purpose of supplying water for drinking and irrigation to a portion of the Dhoon, where it is indispensibly required to secure the settlement of villages, increase of population, and cultivation of some of the finest and richest lands in the western division of the Dhoon, and calling on me for a report on the same.

* Capt. Cautley's letter No. 1883, dated Doab Canal Office, Camp Hurdwar, 29th April 1841.
Estimate No. 38 dated the same office, 14th April 1841.
Return of Village Lands, extracted from Capt. Brown's Survey, dated the same date.

The delay which has occurred in sending my reply, was caused by the uncertainty which existed regarding the quantity of water which would be contracted for by Grantees and Mookuddums falling under its influence, in consequence of the principal grant being in progress of transfer; this arrangement having been brought to a satisfactory conclusion, and the present holders having the means at command of carrying into full effect the intentions of Government in opening the Canal, I have much pleasure in reporting, that I have consulted the wishes of all those whose lands come under the influence of the Canal under consideration, and the desire to have it completed, as soon as possible, is universal, and all are ready to engage for as much water as will irrigate all the lands falling under its influence, which after examination and comparing with Captain Brown's survey, does not appear to be overestimated by Captain Cautley when he reports it to comprise 10,700 acres. A great portion of this land is now waste, overgrown with fine grass, and uninhabited, principally from want of water; these obstacles being removed, there is not a doubt, but villages will spring up and the population will increase.

The full amount of the receipts calculated on by Captain Cautley, may not be realized the first or second year, but they will increase, and lands at present waste will soon become productive, and ultimately yield a considerable revenue to Government, which has not

been taken into consideration in Captain Cautley's estimate. Under this impression, I cannot too strongly urge my recommendation of the undertaking being commenced on as soon as circumstances will permit. I have detained the documents stated in the margin, for the purpose of taking a copy of them for registry in my office; when that has been effected, I shall have the honour of returning them.

I have the honor, &c.

(Signed) F. Young, *Lieut. Col.*
Political Agent.

Deyrah Dhoon,
Political Agent's Office,
the 30th October, 1841.

The Commissioner of the Meerut Division, in submitting the Political Agent's report, with his letter No. 433 of the 24th December 1841, observes, Par. 2: "I consider that one lac of Rupees would "be well laid out in the construction of this work, and that it would "yield a sure and early return. The grantees in the Doon are en- "terprising, and will avail themselves immediately of the means of "irrigation afforded, by bringing under tillage the arable land now "lying waste for want of water. Colonel Young's reference to those "who would benefit by the proposed Canal is very satisfactory, and "I know that the grantees are most desirous that the work should be "undertaken."

No. 118.

Canal Office, West of the Jumna, Kurnaul, July 7, 1841.

To H. M. Elliott, Esq.
Secretary, Sudder Board of Revenue,
Allahabad.

Sir,—I have the honor to acknowledge the receipt of your letter No. 63 of the 22nd ultimo, enclosing copy of Captain Cautley's report on a proposed water-course from the Jumna in the Deyra Dhoon, on which you do me the favor to ask my opinion.

2. The simplicity of the work proposed, and the known skill and experience of Captain Cautley, leaving no doubt as to the correctness of the estimates, the practicability of the work, or its exact suitable-

ness to the purposes for which it is intended, I suppose that my opinion is merely required on the question mooted in the 14th paragraph of Captain Cautley's report, regarding the expediency of diverting any part of the Jumna water from the supply of the existing Canals.

3. The supply of water in the Dehli Canal has during some months of three several years; (viz. 1836-37, 1837-38, and 1840-41,) fallen considerably short of the demand, and many villages situated near the ends of the Canal branches in the Dehli, Rohtuk, and Hansie districts, have, from this cause, and from the greater consumption of water by those above them, been temporarily deprived of the full means of irrigation they once possessed, nor has the loss been confined to the villages so situated, as it has necessitated vexatious restrictions on the irrigation throughout the whole line of Canals.

4. Under these circumstances, I consider it my duty (both to Government, whose revenue settlements have been made with reference to present means of irrigation, and to the Zemindars, whom I have induced and assisted to dig water-courses,) to deprecate any avoidable diminution of the Jumna water.

5. I am willing to admit that the Doon may probably benefit more from the Kutha Puttur Canal, than the Dehli territory would lose by the abstraction of eighty cubic feet of water per second, and that the whole of the eighty feet so abstracted might not be a dead loss, as some surplus might return via the Satwala and Asun to the Jumna, and a proportion even of that used in irrigation, might, by percolation of the soil, find its way into the natural drains of the country, and eventually return to the parent stream. A deduction may also be claimed for waste by absorption and evaporation, during the transit of the said eighty feet from the Dhoon to the irrigating districts of the Dehli territory. But with respect to the first concession, I submit that the Dehli territory has a prescriptive right to as much of its present means of irrigation as can be maintained, and though I cannot exactly estimate the effects of the latter, I believe that they would be found inconsiderable, and at all events, it is undeniable that some loss would occur, and whether that loss be small or great, the principle remains unaltered.

6. It may be argued, that the loss of the Dehli territory merely results in that of Government, who have the power of compensation by re-

mission of revenue, and that the real question, therefore is, whether the moral and political advantages anticipated from the colonization of the Dhoon are likely to overbalance the partial deterioration of the Dehli territory as a source of revenue, and the proportionate loss of the original outlay on the Dehli Canal. But I consider that the discussion of such questions will not be expected from me, who am merely called upon to state *(ex parte)* in what degree the contemplated measure would affect the particular interests intrusted to me by Government.

7. In conclusion, I beg to acknowledge the courtesy of the Sudder Board of Revenue, in having allowed me an opportunity of bringing forward the above statement.

And have the honor, &c.

(Signed) W. E. Baker,

Superintendent of Canals, West of India.

Extract Pars. 2 to 4 of letter No. 2603, dated 8th February 1842, from Captain F. Abbott, Officiating Superintending Engineer, North-west Provinces.

2. "I much regret that I did not receive the plans of the Kutha Puther water-course, as I could not in consequence, examine the proposed site. I have, however, been over portion of the ground to be watered by this project, and have visited the Jumna, near the proposed head.

3. "Captain P. T. Cautley proposes, I believe, to draw off seventy-five cubic feet per second from the Jumna, for the supply of the Kutha Puther water-course. Of this a portion would return to the Jumna in the shape of tail-water, and a small portion by percolation. I am therefore of opinion, that the diminution of the river's volume, at the heads of the Doab and Dehli Canals, would be imperceptible. It must, however, be noticed, that the whole loss, instead of being divided between the two, would fall exclusively upon the latter, as the Doab Canal has the command of head.

4. "It would appear adviseable, on general principles, to make this small sacrifice upon the Dehli Canals, with the view of fertilizing so large a portion of valuable land as that contemplated by the Kutha Puther project, amounting I believe to 26,000 Beeghas, were measures

taken to ensure the use of its waters; and I think this might be effected by the adoption of the assessment or contract system. But some agreement should, I think, be entered into with the landed proprietors previous to commencing upon the work, to save the State from chance of loss."

No. 160.

To R. N. C. Hamilton, Esq.

Secretary to Government, N. W. Provinces, Agra.

Sir,—In submitting for the consideration and orders of Government, the accompanying correspondence respecting the opening of a new Canal near the village of Kutha Puther, in the Dehra Doon, the Sudder Board of Revenue, N. W. P. observe, that Captain Cautley estimates the expense of the proposed water-course to be, 90,307, and that it will yield 7,000 Rs. per annum, or about $7\frac{3}{4}$ per cent. the capital sunk.

2d. At the same time it will divert from the channel of the Jumna 75 cubic feet of water per second, of which one-half, it is calculated, will be entirely lost to the volume of the stream at the Doab Canal head. The whole of this water will be abstracted from the Dehli and not from the Doab Canal, the head of the former lying below that of the latter, and the loss will be felt during that portion of the year, when the whole body of the river is used for irrigation through the Canals.

3d. Half the water then which will yield rent through the Kutha Puthur water-course, after an outlay of 90,000 Rupees, would at present yield a higher rate through the Dehli Canal, without any outlay at all.

4th. Hence it seems very questionable whether, viewing the question as a mere profit on the consumption of a certain quantity of water, it would be desirable for the Government to engage in this undertaking.

5th. There are, however, many other questions which might influence the decision, and on these the Board have not the means of decidedly expressing an opinion at present. The Dhoon may perhaps become a most valuable portion of British territory, from the peculiar adaptation of its soil to the more valuable products, and from the fitness of its locality and climate for the enterprize of British capitalists.

Without artificial irrigation of this nature, large tracts of it, and amongst them that which would come under the influence of the Kutha Puthur Canal, cannot be brought under cultivation. Wells cannot be dug, and the difficulty of procuring water even for domestic purposes, renders them uninhabitable. The water in such cases possesses a double value, being used for the support of life, as well as for irrigation, whilst the rapid fall of its course gives it a still further value as the motive power of machinery.

6. It is therefore far from improbable, that other circumstances besides those of a mere profitable return for the water may render the execution of the proposed work deserving the attention of Government, or become an object for private enterprize.

7. Agricultural operations in the Dhoon are still too much in their infancy to enable the Board to speak with confidence on these points, whilst they are also unprovided with results from the experience of the lately opened Beejapore water-course, and the now constructing Rajpore water-course, on which to build any certain calculations of the effects of such works in the peculiar climate and soil of the Dhoon.

8th. The present time is also probably one in which the Government would be reluctant to engage in an expensive undertaking of problematical utility.

9th. These considerations restrain the Board from recommending the work for immediate execution. But they think it of great importance that the scheme should be generally made known, in order that its merits may be fully discussed. They therefore propose, with the sanction of the Government, to print the Plans, and so much of the Correspondence as may tend to throw light on the project, and hope on some future opportunity to be able to bring the subject again forward on better grounds than they at present possess.

I have the honor, &c.

(*Signed*) H. M. Elliott, *Secretary.*

Sudder Board of Revenue,

N. W. P. Allahabad, the 1*st April,* 1842.

(True Copies.)

H. M. Elliott, *Secretary.*

Comparison of the Areas of Plane and Spherical Triangles. *By Captain* SHORTREDE, *1st Assistant, Grand Trigonometrical Survey.*

[N. B.—The first part of the following investigation is taken from Young's Trigonometry, but the formula there deduced $\cot \frac{1}{2} E = \left\{ \frac{\cot \frac{1}{2} a \cot \frac{1}{2} b}{\cos C} + 1 \right\} \cot C$, being inconvenient in all cases, and utterly unworkable when $C = 90°$, I have transformed it as follows.]

E being the spherical excess

$$\tan \tfrac{1}{2} E = \tan \tfrac{1}{2} (A + B + C - 180°) = - \cot \tfrac{1}{2} (A + B + C)$$
$$= \frac{\tan \frac{1}{2} C - \cot \frac{1}{2} (A + B)}{1 + \tan \frac{1}{2} C \cot \frac{1}{2} (A + B)}$$

By Napier's analogies, $\cot \frac{1}{2} (A + B) = \frac{\cos \frac{1}{2} (a + b)}{\cos \frac{1}{2} (a - b)} \tan \frac{1}{2} C$ which substituted gives

$$\tan \tfrac{1}{2} E = \frac{\tan \frac{1}{2} C - \frac{\cos \frac{1}{2} (a + b)}{\cos \frac{1}{2} a - b} \tan \frac{1}{2} C}{1 + \frac{\cos \frac{1}{2} (a + b)}{\cos \frac{1}{2} a - b} \tan^2 \frac{1}{2} C}$$
$$= \frac{\left\{ \cos \frac{1}{2} (a - b) - \cos \frac{1}{2} (a + b) \right\} \tan \frac{1}{2} C}{\cos \frac{1}{2} (a - b) + \cos \frac{1}{2} (a + b) \tan^2 \frac{1}{2} C}$$
$$= \frac{\cos \frac{1}{2} (a - b) - \cos \frac{1}{2} (a + b)}{\cos \frac{1}{2} (a - b) \cot \frac{1}{2} C + \cos \frac{1}{2} (a + b) \tan \frac{1}{2} C}$$

Multiplying the numerator by sin C, and the denominator by its equal $2 \sin \frac{1}{2} C \cos \frac{1}{2} C$, we have

$$\tan \tfrac{1}{2} E = \frac{\cos \frac{1}{2} \left\{ \cos \frac{1}{2} (a - b) - \cos \frac{1}{2} (a + b) \right\} \sin C}{2 \cos \frac{1}{2} (a - b) \cos^2 \frac{1}{2} C + 2 \cos \frac{1}{2} (a + b) \sin^2 \frac{1}{2} C}$$

and substituting for $\cos \frac{1}{2} (a - b)$ and $\cos \frac{1}{2} (a + b)$, it becomes

$$\tan \tfrac{1}{2} E = \frac{\sin \frac{1}{2} a \sin \frac{1}{2} b \sin C}{\cos \frac{1}{2} a \cos \frac{1}{2} b + \sin \frac{1}{2} a \sin \frac{1}{2} b (\cos^2 \frac{1}{2} C - \sin^2 \frac{1}{2} C)}$$

and, because $\cos^2 \frac{1}{2} C - \sin^2 \frac{1}{2} = \cos C$,

$$\tan \tfrac{1}{2} E = \frac{\tan \frac{1}{2} a \tan \frac{1}{2} b \sin C}{1 + \tan \frac{1}{2} a \tan \frac{1}{2} b \cos C}.$$

This expression has some analogy to that for the area of a plane triangle, but here, unlike the case of the plane triangle, it is not a matter of indifference whether the contained angle be acute or obtuse. The second term in the denominator is + or — according as C $<$ 90 or C $>$ 90. Hence the area and excess also of a spherical triangle whose

sides are given, is greater or less according as the contained angle is greater or less than 90.

When C = 90 the equation becomes simply

$$\tan \tfrac{1}{2} E = \tan \tfrac{1}{2} a \tan \tfrac{1}{2} b ;$$

and as every spherical triangle by letting fall a perpendicular becomes the sum or difference of two right angled triangles, this expression may be extensively used.

When the second term in the denominator becomes $= 1$, $\tan \frac{1}{2} E = \infty$, whence $\frac{1}{2} E = 90°$ and $E = 180°$.

When the second term exceeds unity, the whole expression becomes —, hence $\frac{1}{2} E$ is in the second quadrant, and the excess exceeds 180°.

In order to apply the expression above found to the comparison of the area of the spherical with that of a plane triangle, it may be otherwise written

$$\tan \tfrac{1}{2} E = \tan \tfrac{1}{2} a \tan \tfrac{1}{2} b \sin C \left(\frac{1}{\tan \frac{1}{2} a \tan \frac{1}{2} b \cos C} \right)$$

when the denominator of the term within the parenthesis may be expanded in the usual way.

For $\tan \frac{1}{2} a$ and $\tan \frac{1}{2} b$ substitute their values in arc to radius 1 by the formula

$$\tan \chi = \chi + \tfrac{1}{3} \chi^3 \frac{2}{15} \chi^5 + \frac{17}{315} \chi^7 + \&c.$$

and we have $\tan \frac{1}{2} a \tan \frac{1}{2} b =$

$$\left(\frac{a}{2} + \frac{a^3}{24} + \frac{a^5}{240} + \frac{17\, a^7}{39720} + \&c. \right) \left(\frac{b}{2} + \frac{b^3}{3} + \frac{b^5}{240} + \frac{17\, b^7}{39720} \right)$$

which by actual multiplication becomes

$$\frac{ab}{4} \left\{ 1 + \frac{a^2 + b^2}{12} + \frac{6\, a^4 + 5\, a^2\, b^2 + 6\, b_4}{720} + \right.$$
$$\left. \frac{136\, a^6 + 63\, a^4\, b^2 + 63\, a^2\, b^4 + 136\, b^6}{40320} + \&c. \right\}$$

This expression and its powers being substituted in the expansion of the original equations gives

$$\tan \frac{E}{2} = \frac{ab}{4} \sin C \left\{ 1 + \frac{a^2 + b^2}{12} + \frac{6a^4 + 5a^2\, b^2 + 6b^4}{720} + \&c. \right\}$$
$$\left\{ 1 - \frac{ab}{4} \cos C \left(1 + \frac{a^2 + b^2}{12} + \&c. \right) + \frac{a^2\, b^2}{16} \cos^2 C \left(1 + \frac{a^2 + b^2}{6} + \&c. \right) \right.$$
$$\left. \frac{a^3\, b^3}{64} \cos^3 C \left(1 + \&c. \right) + \&c. \right\}$$

by actual multiplication and reduction of terms with common factors this becomes

$$\tan\frac{E}{2} = \frac{ab}{4}\sin C\left\{1 + \frac{a^2+b^2}{12} - \frac{ab}{4}\cos C + \frac{6a^4+5a^2b^2+6b^4}{720} - \frac{a^3b+ab^3}{24}\cos C + \frac{a^2b^2}{16}\cos^2 C + \&c.\right\}$$

For $\tan\frac{E}{2}$ substitute its value in arc $\frac{E}{2} + \frac{E^3}{24} + \&c.$ and transpose all the terms after the first, then substituting for them their values in powers of the quantity on the right hand side, we shall have

$$\frac{E^3}{24} = \frac{1}{3}\left(\frac{ab}{4}\right)^3 \sin^3 C + \&c. = \frac{ab}{4}\sin C\left(\frac{a^2b^2}{48} - \frac{a^2b^2}{48}\cos^2 C + \&c.\right)$$

incorporating these terms, and multiplying the whole by 2, we have

$$E = \frac{ab}{2}\sin C\left\{1 + \frac{a^2+b^2}{12} - \frac{ab}{4}\cos C + \frac{3a^4-5a^2b^2+3b^4}{360} - \frac{a^3b+ab^3}{24}\cos C + \frac{a^2b^2}{12}\cos^2 C + \&c.\right\}$$

The first term is the same as that for the area of a plane triangle having the same sides and contained angle: the following terms therefore shew the difference between the areas of the two triangles. Of these, we may take account of as many as suits our object; but in ordinary cases it will be needless to regard any beyond the two first. Limiting ourselves to these, the difference between the areas of the plane and spherical triangles corresponds to an excess represented by

$$\frac{ab}{2}\sin C\left(\frac{a^2+b^2}{12} - \frac{ab}{4}\cos C\right) \text{ or by } \frac{ab}{24}\sin C\left(a^2+b^2-3ab\cos C\right)$$

This expression shews that when cos C becomes —, or when C exceeds a right angle, the spherical area must exceed that of the plane triangle. When the two terms within the brackets cancel each other, the two triangles will have equal areas; and when the second term exceeds the first, the spherical area will be less than that of the plane triangle.

The limits are easily assigned.

The sum of a and b being given, $a^2 + b^2$ is a minimum, and $3ab$ is a maximum when $a = b$. In this case the triangles are isosceles, and $a^2 + b^2 = 2a^2$, and $3ab = 3a^2$; hence the terms within the brackets will cancel each other when $\cos C = \frac{2}{3}$ or when $C = 48° 11' 23''$. For equal areas this is the maximum of C. With isosceles triangles, if

C be less than this, the spherical area will be less than that of the plane triangle.

When cos C is a maximum C = O. In this case $a^2 + b^2 = 3\,a\,b$, or $1 + \frac{b^2}{a^2} = 3\,\frac{b}{a}$; which solved as a quadratic gives $\frac{b}{a} = \frac{3 + \sqrt{5}}{2} =$ 2·618 nearly. This is the maximum inequality in the sides, so as to have equal areas.

In like manner, the value of the angle may be found for any given ratio of the containing sides within these limits; or the angle being given, the ratio of the sides may be found. To save the trouble of these calculations, I have constructed the small table in the margin, which shews for given ratios of a and b the value of C with which the spherical and plane triangles have equal areas. If the sides were so large in regard to the radius, that the terms omitted could sensibly affect these results, it would be necessary to take into account those of the next, and perhaps also of higher orders.

$\frac{b}{a}$	Cos C	Log cos C	C
1·0	$\frac{200}{300}$	9·82391	48°·11′
1·1	$\frac{221}{330}$	·82588	47·57
1·2	$\frac{244}{360}$	·83109	47·20
1·3	$\frac{269}{390}$	·83869	46·23
1·4	$\frac{296}{420}$	·84804	45·11
1·5	$\frac{325}{450}$	·85067	43·46
1·6	$\frac{356}{480}$	·87021	42·08
1·7	$\frac{389}{510}$	·88238	40·18
1·8	$\frac{424}{540}$	·89498	31·16
1·9	$\frac{461}{570}$	·90783	36·01
2·0	$\frac{500}{600}$	·92082	33·33
2·1	$\frac{541}{630}$	·93386	30·50
2·2	$\frac{584}{660}$	·94687	27·46
2·3	$\frac{629}{690}$	·95980	24·16
2·4	$\frac{676}{720}$	·97262	20·08
2·5	$\frac{725}{750}$	·98528	14·50
2·6	$\frac{776}{780}$	·99777	5·48

To ascertain the actual difference in the areas of the spherical and plane triangles in an extreme case, suppose an equilateral with sides of $1\frac{1}{2}$ degrees: the direct formula gives the excess = 61″·217; and the difference in the areas of the two triangles will be 0·3951 square miles, corresponding to an excess of 0″·005245: One-third of this would be the error on each angle, and, were it ten times as great, it would still be, in Troughton's phrase, a quantity less than what is visible in the telescope.

It is almost needless to remark that the supposed triangle is larger than any which has yet occurred in practice. The great triangle in the French arc, (long supposed to be the largest in the world), has an

excess of about 39″. I have had one observed by day-light on which the excess was about 40″.5. The least side was 80 and the largest 92 miles. Such a triangle does not often occur, but even this had about $\frac{2}{3}$ only of the area of that on which the difference has been shewn to be utterly insensible.

But as the greatest difference occurs when C exceeds a right angle, we may find the particular angle giving a maximum difference of area by making $\frac{a\,b}{24}\left\{(a^2+b^2)\sin C - 3\,a\,b\sin C\cos C\right\}$ a maximum. By differentiating, we have

$$\frac{a\,b}{24}\left\{(a^2+b^2)\cos C - 3\,a\,b\cos 2\,C\right\}\mathrm{d}\,C = 0$$

whence the maximum corresponds to $\frac{a^2+b^2}{3\,ab} = \frac{\cos 2\,C}{\cos C}$

This hardly admits of being solved directly, but the indirect solution is very easy.

Since C must be greater than a right angle, we may put $C = 90 + \chi$; whence $\frac{\cos 2\,C}{\cos C} = \frac{\cos 2\,\chi}{\sin \chi}$: and since $\frac{a^2+b^2}{3\,ab}$ is always +, it is plain that χ cannot be less than 0 nor exceed 45°. Hence the quantity $\frac{\cos 2\,\chi}{\sin \chi}$ will pass through all its values from o to ∞ in every half quadrant.

C	Log $\frac{a^2+b^2}{3\,ab}$	C	Log $\frac{a^2+b^2}{3\,ab}$	C	Log $\frac{a^2+b^2}{3\,ab}$
90	+ ∞	105	0·52453	120	0·00000
91	1·75788	106	·48808	121	9·95977
92	·45612	107	·45264	122	·91763
93	·27881	108	·41798	123	·87320
94	·15217	109	·38389	124	·82601
95	·05306	110	0·35020	125	9·77546
96	0·97117	111	·31674	126	·72076
97	·90101	112	·28336	127	·66088
98	·83929	113	·24989	128	·59433
99	·78387	114	·21620	129	·51901
100	·73332	115	0·18212	130	9·43160
101	0·68657	116	·14750	131	·32661
102	·64285	117	·11217	132	·19372
103	·60157	118	·07595	133	8·00980
104	·56226	119	·03864	134	7·70105
105	·052453	120	0·00000	135	— ∞

By tabulating this, as in the margin, for every degree of χ, we may readily find, for any given ratio of the sides, the approximate angle giving a maximum difference of areas.

By means of this and the former Table, it will appear, that with equal sides the angle of maximum difference of areas is somewhat greater than 124°, and by a nearer computation the exact value of C will be found 124°· 02′·35″, being the greatest angle, giving a

maximum difference of areas. For any other ratio of sides the angle will be smaller. For the ratio $\frac{3+\sqrt{5}}{2}$ the angle is 120°. When the ratio is $\frac{10}{1}$ the value of $\frac{a^2+b^2}{3\,ab}$ is $\frac{101}{30}$, the log of which 0·52720 corresponds to a value of C somewhat less than 150° or 140°.55′.45″; and so in other cases. When the ratio of the sides becomes indefinitely great, the maximum difference angle approaches indefinitely near to 90°.

In well chosen triangles there is not usually any very great differences in the sides, and hence, practically, the greatest differences of area will usually occur when C is not far from 120°.

If, for example, we suppose a triangle with sides of a degree each, and containing an angle of 120°, by the original formula, the excess is 27″.210; and the difference in area between the spherical and plane triangles is 0·18214 square miles, the excess corresponding to which is 0·0024176. On a triangle with degree sides and the maximum angle 124°.02′.35″, the excess is 26″.035 : the difference of areas is 0·18320 square miles, the excess corresponding to which is 0″.0024318. Such differences, though utterly insensible in the telescope, are still much greater than have ever occurred in practice; for though a single side of more than a degree be nothing very extraordinary, it is but rarely that two such sides can be found forming a triangle with a third side of from 118 to 120 miles.

The difference here treated of is, in similar triangles, proportional to the 4th powers of the homologous sides: Hence, in an equilateral with half degree sides, this difference would be $\frac{1}{81}$ of 0″·005245, or 0·00006475; and on the isosceles with half degree side containing 120°, the difference would be $\frac{1}{16}$ of 0″·0024176, or 0″·00001511. Triangles such as these are not very uncommon, but it is much more common to have triangles with less than half of their area.

It is thus fairly proved that the difference between the excess on a spherical triangle computed rigorously and the excess deduced by reckoning its area as equal to that of a plane triangle with the same sides and contained angle, is a quantity so small that, even in extreme cases, the neglect of it will not induce any sensible error; and that, on triangles such as usually occur in practice, the difference is so utterly insignificant that to go much out of the usual way in order to take account of it, would be a very needless refinement.

A Note on Capt. Shortrede's *Remarks in No. CXXIII. (Page 240) of this Journal. By* S. G. T. Heatly, *Esq.*

The subjects of geometry are not the creatures of arbitrary definition. We strive first to attain such a definite conception of them as enables us to see how their properties follow from their nature: we enunciate this conception as well as we can in words, and call it the *definition*. But we cannot, however, enunciate the process of intuition by which we are conscious of the necessary consequence of any the most rudimentary property. We are compelled therefore to put down this rudimentary property itself; it is termed an *axiom*. Hence the indispensable appearance of axioms in a system of geometry.

On these grounds I agree entirely with the position that, in mathematical definitions, it is necessary to have a clear conception of the idea, and then to use such words as will convey that conception to the mind of another. It did not appear to me that a clear conception of the idea of an angle is generally entertained; and I endeavoured to analyse the language commonly held on the subject, so as to detect the peculiarity which impressed itself on the minds of various authors, and to shew that the idea of an angle involved the conceptions—of surface —of determinate extension in the direction of width—of indeterminate extension in the direction of longitude. These are conceptions which every one, sooner or later, finds floating in his mind clearly or obscurely, and if they enable the student to perceive distinctly what he is about when he is discussing angles, it is our business to place them before him in the simplest and most direct form.

The use made of the word *direction* arose from the habit of always reducing geometrical magnitudes and positions along fixed axes, the two axes being in this case (I need not say) one bisecting the angle, indicating the direction of length—and one perpendicular to it, indicating the direction of width. This appeared to me necessary to embody distinctly the conceptions intended to be impressed.

To the axiom I cannot conceive any objection raised: it is merely an application of the principles of geometrical equality to angular magnitude. The real "pinch and nip" (to use Colonel Thompson's significant expression) lies in the perception of the truth that whatever applies to an angular space, applies to its angle. This is the elemen-

tary property which must be clearly seized: for which purpose we may put it thus: Let the angle and the angular-space be in any ratio, say $a : b$. Then *á dividendo* the angle is to the difference between it and the angular space, a finite rectilineal figure, as $a : a\text{-}b$. But the angle is infinitely greater than the finite rectilineal figure: hence a is infinitely greater than $a—b$, whence the latter is zero, or $a=b$, and the angle = the angular space.

The matter lies in a simple compass: if the angle be not an infinite surface, what is it? If it be, it must be discussed according to its nature. There can be no arbitrary limitations to the province of geometry: if you will adhere to them, you must try to do without angles, for they are interlopers. The Greek confined himself to the geometry of the line and the circle, and did wonders therewith; but the trisection of the angle and the duplication of the cube required him to extend his armory. The Italian (Mascheroni) yet more chivalrous, used only the circle: but his was a tilt-yard exercise. The only oath administered to the candidate for mathematical knighthood is, that he shall seek always for Truth in the realms of Space and Number, and that he will do his devoirs with every lawful weapon of sound logic. The attempt to assign forced and arbitrary limits to things which do not admit of them, has always been productive of mischievous consequences in retarding our onward progress in physics as in legislation, in poetry as in mathematics.

Errata in the Essay on Angular Geometry.

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,,	233	,,	1,14	,, top	,, Thomson	,,	Thompson
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,,	238	,,	15	,, ,,	,, D E D	,,	D E B
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,,	,,	,,	2	,, ,,	,, Fig. 12.	,,	Fig. 11
,,	239	,,	3	,, top	,, C	,,	A
,,	,,	,,	4	,, ,,	,, Fig. 13	,,	Fig. 12
,,	,,	,,	6	,,	This line should run thus: Let A C meeting A B, not meet *its* parallel E D, consequently, &c.		

Descriptive Notice of the Bat described as Taphozous longimanus, by Gen. Hardwicke. *By* Edw. Blyth, *Curator to the Asiatic Society.*

Upon a former occasion (in vol. X. p. 971 *et seq.*,) I described three Indian species of *Taphozous*, doubtfully identifying one of them with the *T. longimanus*, Hardwicke (*Lin. Trans.* XIV. 525); but I have since obtained a species which I cannot doubt is the animal so named by that naturalist, bringing the number of ascertained Indian species of this genus to four, of which the present is the only one previously known to the publication of my former memoir. It remains, therefore, to impose a distinctive appellation upon the species which I then cited doubtfully as *T. longimanus*, and which I now propose to designate *T. Cantori*, in honour of the accomplished naturalist who favored me with the specimen.

The *T. longimanus* deviates in some particulars from the detailed account which I gave as of generic application, the ears of this species not lying flatly outward—as in the *Rhinopomata* and *Dysopodes*, and as in the recent *T. Cantori*, but remaining suberect, as usual in other *Vespertilionidæ :* hence the measurement of nine-tenths of an inch between them, given by Gen. Hardwicke, is intelligible; whereas in *T. Cantori* I could not recognise it, nor well understand where it had been taken : again, the tail when exserted by the collapse of the interfemoral membrane does not curl round upward, as in *T. Cantori*, nor has any tendency that way, but remains out straight, with but slight capability of bending except at its extreme base : the nostrils do not appear capable of closure, which leads me to doubt whether this be truly the case in the other species. I observe, both in the present species and its congeners, two remarkable characters which may be added to the diagnosis of the genus : viz., the double flexure outward of the extremity of the closed wing, which always collapses in this manner, whereas in other Bats the wing does not naturally so fold, but the tip turns inward ; in connexion with which may be mentioned that the first digit in *Taphozous* consists of but one phalanx terminating in a *(quasi)* joint-knob, whilst in most other Bats (*Rhinolophus* appears to be an exception) there is a small second phalanx more or less developed beyond this, and in the Pteropodine group two additional phalanges with a terminal claw (the latter only being absent in *Cephalotes*, Geoff., in which was comprised *Hypodermis*,

Is. Geoff.); secondly, the testes, in *Taphozous* (as in *Megaderma*, and I presume *Rhinolophus*), are situate as in man and the monkey tribe, whereas in the restricted *Vespertilio* group they are placed posterior to the anus, and in the Pteropodine section laterally to the penis; this being a character which may help to indicate the primary divisions of the family: the magnitude of the genitals is a remarkable feature of the Vespertilionine subdivision generally, being in some species quite inordinate; but this is not the case in *Taphozous*, wherein the penis wholly withdraws internally. Finally, it may be remarked that the feet and tail of this genus have always a few scattered long and slender hairs; and that the fore-arm is more than usually curved at the basal third.

The specimen of *T. longimanus* before me (an adult male) measures four inches and one-eighth to tail-tip, the membrane extending five-eighths of an inch beyond; expanse fifteen inches and a half, and length of fore-arm two inches and three-eighths; the tail an inch, capable of being wholly sheathed within the membrane, and of protrusion for five-eighths of an inch: ears, measured internally, from base of lowermost lobe, nine-sixteenths of an inch, and externally half an inch: no upper incisors, as likewise in the examples of the three other species described by me: the throat-sac particularly large, measuring three-eighths of an inch wide, and thickly lined with a hard and fœtid exudation; there is also a small circular second cavity, a quarter of an inch posterior to the first, and yielding a similar secretion; this is also perceptible, but rather less developed, in *T. fulvidus*: the fur is close and velvety, of a dark brown colour, slightly grizzled with a pale hue at the tips, and not white at base as in *T. Cantori* (which species has the throat-sac merely rudimentary); beneath it is scarcely paler than above, but the throat is deeply tinged with rufous: membranes brownish-dusky.

The *T. longimanus* is stated by Gen. Hardwicke to be "common in Calcutta, in dark store-rooms; at night it frequents habitations, attracted by the light of the candles and numerous insects." The present specimen was shot in a rural situation, two or three miles from Calcutta; and, I may remark, rather late in the evening, when I had been waiting some little time for an opportunity to discharge my second barrel, prior to returning from a Bat-shooting excursion;

hence, as its stomach was quite empty, I think it probable that the members of this genus do not leave their retreats so early as the ordinary *Vespertiliones;* indeed I have often wondered that, considering the great number of Bats which I have lately shot, I could never thus meet with any not appertaining to the sub-genera of restricted *Vespertilio*, save only the great *Pteropus Edwardsii* and the *Pachysoma marginatum*, both of which are abundant. The Bats that fly round the dinner-table of an evening are oftentimes a little tantalizing to a zoologist, though it is not often he would succeed in catching them if he made the attempt, since the rooms in this part of the world (as the European naturalist may be reminded) are lofty and spacious, with open doors and windows in all directions. Still I must say I cannot think that the *Taphozoi* are frequent visitors.*—Nov. 22d, 1842.

Proceedings of the Asiatic Society.

(Friday evening, 15th July, 1842.)

The Hon'ble W. W. Bird, in the chair.

The following Books were presented.

Books received for the Meeting of the Asiatic Society, on the 15th July, 1842.

The Oriental Christian Spectator, April 1842, Vol. III. No. 4.

The Calcutta Christian Observer, July 1842. Vol. III. No. 31.

The Calcutta Literary Gleaner, 1842, Vol. 1, Nos. 3 and 5.

Annual Report of the Transactions of the Bombay Chamber of Commerce, 1840-41.

London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, Vol. XX, No. 130.

The Annals and Magazine of Natural History, Vol. VIII. No. 54, and Vol. IX. No. 55.

Journal des Savants, Novembre et Decembre, 1841.

Pemberton's Report on Bootan, Calcutta, 1839, from Government.

Macpherson's Report upon the Khonds of the districts of Ganjam and Cuttack, Calcutta, 1842.

Catalogue of the Physiological series of Comparative Anatomy, contained in the Museum of the Royal College of Surgeons in London, 1840, Vol. V.

Summer; or, the causes, appearances, and effects of the Grand Nuptials of Nature, by R. Mudie, London.

Narrative of an Expedition to the Polar Sea, in the years 1820, 1821, 1822, and 1823, by the Baron Von Wranzell, translated by E. Sabine, London, 1840.

Glossarium Archaiologicum: Authore H. Spelmanno, Londoni, 1687.

* Some annoying typographical errors occur in my former paper on the *Taphozoi*, consequent upon making a slight alteration in the text when correcting the proofs. In vol. x, p. 972, 2nd line, read "*Loret Volant* of Daubenton, styled *Senegalensis* by M. Geoffroy;"—4th line, read—"a fourth is described by M. Geoffroy, as *F. Mauritanus;*"—close of 18th line, read "Raffinesque;"—and at p. 973, line 21, for altitude read "attitude." E. B.

Read letter from J. H. Batten, Esq. Almorah, 27th June 1842, reporting that Mr. Lushington was sending a magnificent collection of Ores, which would do admirably for the Museum of Economic Geology, and that the continuation of Capt. Manson's Journal was just now suspended, because Lieut. Weller, Executive Engineer and Junior Assistant to the Commissioner of Kemaoon had lately visited the Juwahir Pass, and among other things, had with his own eyes seen "*millions upon millions of maunds of Ammonites*" on the hills sloping down from the Pass into the valley of the Sutlej, and that he wished to enrich his side notes with Extracts from the Journal of his Correspondent on his return to Almorah.

Read letter from Lieut. A. Cunningham, of 18th June 1842.

My dear Torrens, *Lucknow, 18th June*, 1842.

I send you a packet of English Coins to be offered to the Asiatic Society for sale; and a small packet of Roman Coins to be presented to the Museum.

I enclose a list of the English Coins, silver and copper, with their prices. They form a small collection; but amongst them, are some rather scaree Coins.

I have a fine Sassanian collection to dispose of, which perhaps the Society might like to take. If so, kindly let me know, and I will make out a list, with the prices of the Coins attached.

Believe me,

Most sincerely yours,

Alex. Cunningham.

LIST OF ENGLISH COINS.

Nos.	*Silver.*	*Denomination.*	*Value.*			
1.	Edward 4th	groat, ...	5	0	0	
1.	Elizabeth, ...	shilling, ...	1	0	0	
1.	Ditto, ...	six pence, ...	2	0	0	
2.	Ditto, ...	pennies, ...	2	0	0	
1.	Ditto, ...	half penny, ...	5	0	0	
1.	James 1st, ...	six pence, ...	1	0	0	
1.	Ditto, ...	penny, ...	1	0	0	
1.	Charles 1st, ...	shilling, ...	5	0	0	
1.	Ditto, ...	six pence, ...	2	0	0	
1.	Ditto, ...	two pence, ...	1	0	0	
1.	Commonwealth, ...	two pence, ...	5	0	0	
2.	Charles 2nd, ...	three pence, ...	1	0	0	
1.	Ditto, ...	three pence, ...	5	0	0	by Simon.
1.	Ditto, ...	two pence, ...	0	8	0	
+ 1.	William 3rd, ...	half crown, ...	2	0	0	
1.	Ditto, ...	four pence, ...	0	8	0	
1.	Ditto, ...	three pence, ...	0	8	0	
1.	Anne, ...	four pence, ...	0	8	0	
4.	George 2nd, ...	six pence, ...	2	0	0	
1.	Ditto, ...	three pence, — ...	0	8	0	
1.	Ditto, ...	two pence, ...	0	8	0	
1.	George 3rd, ...	shilling, ...	4	0	0	
2.	Ditto, ...	six pence, ...	1	0	0	
1.	Ditto, ...	four pence, ...	0	8	0	
3.	Ditto, ...	three pence, ...	1	0	0	
1.	Ditto, ...	penny, ...	0	8	0	
+ 1.	William and Mary, ...	shilling, ...	1	0	0	
1.	Ditto, ...	two pence, ...	1	0	0	
37.			52	0	0	
	Copper.					
	James 1st, ...	small coins, ...	2	0	0	
1.	Charles 2nd, ...	farthing, ...	0	8	0	
1.	Anne, ...	token	1	0	0	
2.	William and Mary, ...	farthings, ...	0	4	0	
2.	George 2nd, ...	farthings, ...	0	4	0	
			4	0	0	

Totl, 52 + 4 = 56 Rupees.

It was ordered, that the English Coins offered, be purchased, and that the thanks of the Society be communicated to Lieut. Cunningham, for his presentation of the Roman Coins.

Read letter from H. M. Elliot, Esq. Secretary Sudder Board of Revenue at Allahabad, dated the 29th June last, forwarding selections from correspondence respecting the proposed formation of a Canal for irrigation to be supplied from the River Jumna, near the village of Kuttha Putthur in the Deyrah Doon.

Referred to the Secretary for publication in his Journal.

Read letter of 30th June last, from R. H. Mytton, Esq. Magistrate 24-Pergunnahs, requesting return of some Coins found by a convict, or their value Co.'s. Rs. 36.

Ordered, that the Coins be purchased for the Society, and their value forwarded to Mr. Mytton.

Read the following Report from the Curator:—

Sir,—In the class of Mammalia, I have nothing of particular interest on which to report. We continue to receive such animals as are entrapped or shot at the Botanic Garden, which are always acceptable for exchange or transmission elsewhere; and I have especially to thank Mr. Jos. De Cruz of that establishment, for his kind attention to my wishes in this respect.

In that of Birds, our acquisitions, since the last meeting, have been very extensive.

1. From B. H. Hodgson, Esq., British Resident at the Court of Nepâl, I have the gratification to announce the arrival, as a donation to the Society, of 270 species of birds, whereof four specimens respectively are sent of the greater number (though it is to be regretted that many are in very imperfect condition); and there are seventy species which are new to the Museum, while above 100 are more or less common in this neighbourhood.

2. Mr. Frith has forwarded to the Society specimens of

Budytes citreola, or, I rather suspect, an allied species which is also met with in this neighbourhood.

Esacus recurvirostris, Lesson (1831): *Pseudops* (olim *Carvanica) grisea*, Hodgson, *J. A. S.* V, 776; *Œdicnemus recurvirostris*, Swainson.

Rhynchops flavirostris.

3. Mr. Mackay has kindly permitted me to select from a very interesting collection of Malayan birds received from Singapore, examples of such species as are wanting to the Museum, for which I have given duplicate specimens in exchange; and Dr. Spry has also favored me with a like permission in the instance of another collection of Malayan birds, for which I have also looked out a somewhat extensive series of duplicates for transmission to the Cornish institution at Truro. Our acquisitions in this manner consist of the following species, of which those new to the Museum are marked with an asterisk.

Palœornis Malaccensis, Vigors: *Psittacus Malaccensis*, Gmelin, but not of Latham, which refers to the next species. A more beautiful specimen than I remember

to have seen before. Middle tail-feathers eleven inches and a half long, and uniform bright purple; the collar between the black moustache and the emerald cap of the finest peach-blossom hue, heightened on the nape (like the crown of *P. Bengalensis)* with a cœrulean bloom; and the rest of the colours exquisitely brought out.

**Psittinus* (Nobis) *Malaccensis: Psittacus Malaccensis*, Latham, but not of Gmelin; *le petit Perruche de Malacca*, Sonnerat. This bird cannot be arranged in *Psittacula* of Kuhl, where generally located, if *P. galgulus* is to be regarded as typical of that division; but, though having a short tail, the rest of its structure places it in immediate proximity with *Palœornis*, while a further token of this affinity exists in the maronne wing-spot, seen also in *Pal. Alexandrinus, schisticeps*, and *Bengalensis*. The allied *Ps. setarius* of Temminck, an inhabitant of Borneo, presents an additional approximation to *Palœornis* in having its two middle tail-feathers much elongated beyond the rest, though remarkable for being partly naked-shafted. I add a description of the specimen before me. Length nearly seven inches, of wing four inches and three quarters, and tail an inch and seven-eighths, the three first primaries being equal and pointed (as in *Palœornis)*, and reaching to the end of the short tail, which latter consists of somewhat narrow feathers resembling those of *Palœornis*, even though not elongated, the outermost being but a quarter of an inch shorter than the middle ones. Beak coloured as in *Palœornis* generally, or having the upper mandible bright coral-red with a white tip, and the under one dusky; its form precisely as in that genus. Crown, rump, and upper tail-coverts, bright purplish smalt-blue, passing on the crown into the greyish-dusky colour of the back; under-parts dull yellowish-olivaceous, the mesial portion tinged with brownish-ruddy: lower tail-coverts yellowish-green tipped with blue; and tibial plumes mingled blue and green: uropygials deep green, and the rest of the tail-feathers yellow, more or less green-edged: wings deep green, margined with yellowish on the coverts, except those of the primaries which are wholly purple: maronne wing-spot before noticed; and the coverts underneath the wing are brilliant crimson, as are also the axillaries, which must shew to advantage as the bird is flying overhead, and induce the expectation that the species is much handsomer than it proves on closer examination.

Ierax cœrulescens, Vigors. I am now acquainted with three species of these very diminutive Falcons, viz. in addition to the present one,—*I. erythrogenys*, Vigors, *P. Z. S.* 1831, 76, (from Canton,)—and a Nepâlese species, rather larger than the others, contained among the specimens sent by Mr. Hodgson, and which is the *Falco Bengalensis* of the old authors, currently but erroneously identified with *I. cœrulescens.**

* A live specimen of *I. cœrulescens* has lately been received by Dr. M'Clelland from Assam; and the aspect of the living bird gives the idea of a larger species than would be supposed from examination of preserved skins, as it puffs up its feathers much, in a manner which can only be successfully imitated when mounting a recent specimen.

It is not generally known that these tiny Falcons are trained for hawking in the Upper Provinces of India, being flown at Quails and other game of corresponding size, as I have been informed by different eye-witnesses of the sport, which is thus described in Capt. Mundy's 'Sketches of a Tour in India,' II, 25. "We had also some amusing sport with another kind of Falcon, a very small bird, perhaps barely so large as a Thrush, and its prey was proportioned to its strength. It is flown at Quails, Sparrows, and others of the feathered tribe, of like calibre. The mode of starting it is different from that used with any other hawk. The falconer holds the little,

**Ceyx tridactyla*, Lacepede; the so called first variety described in Shaw's Zoology,' Vol. VIII, pt. II, 104.

Bucco gularis, Temminck.

Picus mentalis, Temminck, — not of Jerdon, *Madr. Jl.* Vol. XI, 214, which is *P. Nipalensis* of Hardwicke and Gray, badly figured in their 'Illustrations of Indian Zoology.'

**Cuculus (Pseudornis*, Hodgson,*) lugubris*, Horsfield, *Lin. Trans.* XIII, pt I, p. 179, and figured in the 'Zoological Researches in Java' of the same naturalist: *C. albopunctulatus*, Drapiez, *Dict. Class. d'Hist. Nat.*, Art. *Coucou.* A rare species in collections, and nearly allied to the *Pseudornis dicruroides*, Hodgson, *J. A. S.* VIII, 136.

**Rhinortha* (Vigors,—*Anadœnus*, Swainson,) *chlorophœa; Cuculus chlorophœus*, Raffles, *Lin. Trans.* XIII, pt. II, p. 288.

Eurylaimus Sumatranus, Raffles: *Eu. Corydon*, Temminck.

Eu. ochromalus, Raffles: particularly fine.

Calyptomena viridis, Raffles: male and female.

Irena puella, Horsfield: female.

Vanga cristata, Vieillot.

Edolius balicassius verus, adult and young: *E. affinis*, Nobis, Vol. XI, p. 174. I doubt whether this species occurs in India, being replaced here by *E. Fingah*, v. *albirictus*, Hodgson, which is the Indian *balicassius*, Auctorum. I append a Monograph of the Asiatic species of this genus at the close of the present report.

Lanius strigatus, Eyton, *P. Z. S.* 1839, p. 103. Four specimens, all in the obviously immature livery described by Mr. Eyton, and also by myself. (Vol. XI, p. 203).

**Tephrodornis sylvicola*, Jerdon, *Madr. Jl.* No. XXV, 237. This bird appears also to be very common in the Tenasserim provinces.

Muscipeta atriceps, Nobis, Vol. XI, p. 203. The fully mature male of this species has the dorsal region very rich deep ferruginous-bay, with a fine purplish gloss, and all the colours more intense than in the specimen formerly described by me.*

well-drilled savage within the grasp of his hand, the head and tail protruding at either opening, and the plumage carefully smoothed down. When he arrives within twenty or thirty yards of the quarry, the sportsman throws his hawk much as he would a cricket-ball, in the direction of it. The little creature gains his wings in an instant, and strikes his game after the manner of the *Bhause* [Goshawk.]

"There is a queer tribe of gregarious little birds, common in India, which afford very laughable sport with the above mentioned hawk. They are usually found in a chattering fluttering congress of ten or a dozen, at the foot of some baubul tree; where the little busy-bodies are so absorbed in the subject under immediate agitation, that the falconer may approach within six paces of their noisy court of parliament ere they entertain a thought of proroguing it [*Malacocercus* ——— is probably the species meant]. In the heat of debate, down comes the little Hawk (like some Cromwell) into the midst of the astonished assembly, and begins to lay about him right and left; when strange to say, the whole tribe set upon him, *unguibus et rostris*, and with a virulence of tongue as manifestly vituperative, as if it were couched in words. In the dust of the contest, the sportsman runs up, and all the party take wing, except two or three unfortunates, who, having caught a tartar, lie fluttering in the clutches of the feathered tyrant."

* I have now reason to believe that the latter is a female, whilst the specimen formerly described as female is certainly distinct, and may be designated *M. plumosa*. I shall therefore redescribe the two as follow:—

M. atriceps, Nobis. Length seven inches and upwards, of wing three inches and three-eighths, and tail two inches and five-eighths; bill to forehead (through the feathers) three-quarters

**Muscicapa hirundinacea*, Reinwardt, figured in Horsfield's 'Zoological Researches in Java,' and described by the same naturalist as *M. obscura* in *Lin. Trans.* XIII, pt. I. 146; erroneously identified by Mr. Jerdon with *M. picata* of Sykes, (not of Swainson,) from which it is readily distinguished by having no white on the wings, nor on the exterior border of its outermost tail-feathers, while the bill is also fully a third longer. Inhabits also Tenasserim.

**M. latirostris*, Raffles, *Lin. Trans.* XIII, pt. II, 312, and again so termed by Swainson, *Nat. Libr., Flycatchers*, p. 253: distinct from *M. Poonensis* of Sykes, with which it was suspected to be identical by Mr. Jerdon. I presume this to be the species here indicated, as it differs only from Mr. Swainson's description by having the 4th primary above one-eighth of an inch shorter than the 2nd, whereas the latter is stated by that author to be only as long as the 6th; whence it may be that the feather in question was not fully grown in his specimen. The species there also described by the same author as *M. leucura* (so also named in Latham's 'General History,' though described as new by Mr. Swainson,) is extremely common in Bengal during the cool season; but the same specific name was bestowed by Gmelin upon another species, which should retain it, the more especially as the present one, *i. e.* the male of it, becomes, with full maturity, the *Saxicola rubeculoides* of Sykes, *P. Z. S.* 1832, 92, as first suggested to me by Mr. Jerdon.* Lastly, I may remark that the *M. picata*, Swainson, of Western Africa, described by him in the same place, yields precedence to the Indian *M. picata* of Sykes, and must therefore receive another appellation. I add a description of the skin before me of *M. latirostris*. Length four inches and seven-eighths, of wing two inches and three-quarters, and tail an inch and three-quarters; bill to forehead (through the feathers) half an inch, and three-quarters of an inch to gape; tarse half an inch, and slender. The hue of the upper-parts is darker than in *M. grisola*, being also slightly deeper on the crown; wing-coverts and tertiaries margined with dull fulvous: throat, gorget, belly and under tail-coverts, white, with a slight fulvous tinge on the former; the breast and flanks dull ashy

of an inch and upwards, and tarse somewhat exceeding half an inch. Crown and nape, of the (presumed) male, black with a bright steel gloss; the sides of the head, neck, and breast dark ashy passing into slightly glossed blackish on the throat, and into white on the belly and under tail-coverts: the rest of the upper-parts dark rufo-ferruginous, with a purplish gloss on the back, scapularies, and smaller wing-coverts; the rest of the wing dusky, more or less edged with ferruginous, and broadly so on each side of the tertiaries: bill light horn-colour; and feet apparently plumbeous. The (presumed) female has the colours generally weaker, the glossed tips of the coronal and nape feathers less developed, and no rich purplish gloss upon the back, which is of a dingy and much lighter ferruginous: the under-parts scarcely differ from those of the preceding.

M. plumosa, Nobis. Length (of a supposed female) about six inches and three-quarters, of wing three inches and a quarter, and tail two inches and five-eighths; bill to forehead (through the feathers) nearly seven-eighths of an inch, and tarse five-eighths of an inch. Body plumage very much longer and looser in texture than in the preceding, especially the feathers of the rump, which are of remarkable length and puffy. Upper-parts light olive-brown, tinged with greenish-ash on the crown and ear-coverts; throat and breast pale rufescent, still lighter and passing into white on the belly; wings and tail bright rufo-ferruginous, except the smallest coverts of the former which are hidden by the scapularies, and the primaries and their coverts which are edged with the same colour as the back. Bill pale horn-colour; and feet appear to have been greenish.

* This bird falls under the division *Dimorpha* (olim *Siphya*), Hodgson, *Ind. Rev.* I. (1839), p. 651.

brown, as also the front of the neck contiguous to the ear-coverts, where but a narrow mesial line of fulvous-white passes from the throat to the gorget; bend of the wing beneath, and axillaries, pale fulvous brown; a whitish streak from the nostril to the eye; and bill horny-black, with the basal half of the lower mandible yellow; the latter is broad at base, and evenly attenuating; and the feet apparently are lead-coloured.

Pycnonotus (Kuhl) *melanocephalus: Lanius melanocephalus*, Gmelin; *Turdoides atriceps*, Temminck: not *Brachypus melanocephalus* of Hardwicke and Gray, which I followed in so designating—Vol. XI, p. 168, where I identified with it the *Vanga flaviventris*, Tickell, *J. A. S.* II, 573, though it is far enough removed from a typical *Vanga*. The present is clearly enough the species referred to *Turdoides atriceps*, Tem. *Pl. Col.* t. 147, in Griffith's 'Animal Kingdom,' VI, 389, and again in 'Shaw's Zoology,' VII, 330; but as both descriptions are brief and defective, I subjoin the following. Length six inches and a quarter, of wing two inches and seven-eighths, and tail, which is considerably rounded, two inches and a half, its outermost feather being above three-eighths of an inch shorter: bill to forehead (through the feathers) nine-sixteenths of an inch, and to gape three-quarters of an inch: tarse barely half an inch. General colour olive-green, brightening to yellow on the upper and under tail-coverts, belly and flanks: the whole head and throat glossy black: primaries and inner webs of the tertiaries dusky-black, as also the other wing-feathers interiorly; and tail greenish for the basal two-thirds, then dusky-black, and tipped with yellow more developed on its lateral feathers. The irides are in this genus, usually, if not always, crimson. A young specimen is rather smaller in all its dimensions, but scarcely less bright in colouring, except on the head and throat, where the black is merely indicated. In both, the plumage of the rump is black at base, broadly margined with yellow, as in certain allied species.

Ixidia

P. (?) cyaniventris, Nobis. Length six inches and a quarter, of wing three inches and one-eighth, and tail two inches and seven-eighths; bill to forehead (through the feathers) nearly five-eighths of an inch, and to gape eleven-sixteenths of an inch; tarse half an inch. Colour of the upper-parts uniform yellowish olive-green; the head, neck, and under-parts uniform dark bluish ash-colour, bordering on plumbeous, except the lower tail-coverts which are bright yellow, as are also the edges of the wings anteriorly: primaries dusky, together with the inner and terminal portions of the caudal feathers. Bill dusky, and legs lead-coloured. I place this bird provisionally in this genus, though far from satisfied of the propriety of so doing. As compared with the preceding species, the bill is more Thrush-like, though small; the nostrils very different; the gape furnished with much smaller and less conspicuous setæ; the tail even, or all but so; and the claws less minute; the *ensemble*, in a word, is different, though the technical characters sufficiently apply.

**Chloropsis Malabaricus:* adult and young.

**Parus Sumatranus (?); Melanochlora Sumatrana (?)*, Lesson, as quoted by Mr. G. R. Gray ('List of the Genera of Birds, with their Synonymes,' 1st edit., p. 23), who, doubtfully identifying with it the *P. flavocristatus*, Lafr., v. (apud Horsfield) *P. sultaneus*, Hodgson, I think there can be little doubt that the bird now before me is referred to. This only differs from *P. sultaneus* in its inferior size, and in the rounded form of the crest, which does not consist, as in the other,

of pointed feathers. Length seven inches and a quarter, or probably as much as eight inches in the recent specimen; of wing four inches; and tail three inches and a half: bill to forehead (through the feathers) nearly five-eighths of an inch, and to gape three-quarters of an inch; tarse three-quarters of an inch. Colour of the upper-parts, wings, and tail, throat, neck, and breast, deep black, without the green shine of *P. sultaneus:* and top of the head, belly and lower tail-coverts, brilliant yellow, the coronal feathers lengthened but rounded. Bill black, and feet bluish lead colour. Possibly enough, this may yet prove to be the *P. flavocristatus* of M. Lafresnoy, rather than Mr. Hodgson's *P. sultaneus.*

**Timalia pectoralis*, Nobis. Beak nearly resembling that of *T. pileata*, Horsfield, but longer, less laterally compressed, and not quite so deep. Length about six inches and a half, of wing three inches and a quarter, and tail three inches, the latter scarcely rounded, but the outermost feather five-sixteenths of an inch shorter than the next, which again does not quite equal the others; bill to forehead (through the feathers,) three-quarters of an inch, and to gape fifteen-sixteenths of an inch; tarse an inch: colour of the upper-parts, to the rump, olivaceous, the coronal feathers darker along their centres; throat black, and feathers of the fore-neck and breast also black, but each elegantly and conspicuously margined with white: rump, upper tail-coverts, and basal margins of the *rectrices*, bright rufo-ferruginous, the rest of the tail-feathers reddish-brown, tipped and slightly edged with rufous; flanks olivaceous; the lower tail-coverts ruddy: bill dusky-black, the lower mandible whitish underneath; and feet leaden-dusky. A supposed female is rather smaller in all its dimensions, with the breast-markings less developed.

**T. erythronotus*, Nobis. Bill as in last, but rather less elongated. Length six inches to six and three-eighths, of wing two inches and a half to two and three-quarters, and tail two inches and a quarter to two inches and a half; bill to forehead (through the feathers) eleven-sixteenths of an inch, and to gape seven-eighths of an inch; tarse seven eighths of an inch. Colour of the upper-parts deep rufo-ferruginous; the forehead black, with whitish lateral margins to the feathers, imparting a striated appearance; crown and back of the neck dull rufous-brown, passing into the ferruginous of the back and wings; and sides of the neck, with the under-parts from the breast, dark fuscous-ashy; throat and breast black, the bordering feathers of the latter having a subterminal narrow white bar; above the eye also black, and a small white line passing from the eye backward; likewise a white moustachial patch near the base of the lower mandible: tail much graduated, and, with the primaries, dusky edged with rufous; the lower tail-coverts dark faintly rufous brown: bill black, white at base of lower mandible; and feet dusky-leaden.

**T. striata*, Nobis. A small species, with proportionally shorter bill than in the preceding. Length five inches and a half, of wing two inches and a half to two and five-eighths, and tail two inches, the outermost feather three-eighths of an inch shorter; bill to forehead (through the feathers,) nearly five-eighths of an inch, and to gape almost seven-eighths of an inch; tarse three-fourths of an inch. Head and neck above black, or rather brown-black, the feathers of the mesial line white about the shaft, forming a streak of this colour along the middle of the head, besides which are two slight lateral streaks not observable in every specimen, in addition to a superciliary line of the same: on the nape the white centres of the feathers broaden and are

more irregularly disposed, while on the back they become much narrower again, more or less so in different specimens, and wholly disappear on the rump ; the ground-hue of the back and rump is rich fulvous-brown, brightening on the latter, and tending to rufous on the upper tail-coverts : lores conspicuously pale fulvous, and the throat and foreneck fulvous-white, the ear-coverts margined with black ; sides of the breast white, handsomely bordered with black, and a very slight margin of the same to the medial pectoral feathers ; rest of the under-parts white, the flanks bordered with fulvous-brown, which spreads nearly over the whole feather posteriorly ; lower tail-coverts more or less tinged with the same ; wing-feathers dusky interiorly, the coverts having terminal longitudinal white spots ; and tail ruddy-brown, margined with more rufous brown at base : bill black, and legs (in the dry specimen) yellowish-white.

**T. erythroptera,* Nobis. Another small species, with bill very like those of some of the small Soras or Water-crakes. Length five inches and a quarter, of wing two inches and a quarter, and tail two inches, its outermost feathers three-quarters of an inch shorter than the middle ones ; bill to forehead above five-eighths of an inch, and to gape three-quarters of an inch ; tarse a little exceeding three-quarters of an inch. Upper-parts rufous olive-brown, darker on the head, the wings bright rufo-ferruginous ; fore-head, sides of head, throat, fore-neck, and breast, ash-colour, becoming paler towards the belly ; flanks pale fulvous-brown, bill dusky, and legs apparently yellowish.

T. gularis, Horsfield ; figured in the 'Zoological Researches in Java' : *Prinia pileata,* Nobis, Vol. XI, p. 204. The difference in the bill from *T. pileata* is so remarkable, that I hope I may be pardoned for not formerly looking among the described species of *Timalia* for this species, which Dr. Horsfield described from a Sumatran specimen, and I have now seen from the Malay peninsula and Tenasserim. The *T. pileata,* discovered by Dr. Horsfield in Java, was met with by Dr. McClelland in Assam, and the Society's Museum contains a specimen of it from Upper Bengal ; this bird is also included in Major Franklin's Catalogue.

T. chloris* ; *Iora chloris,* Hodgson, *M. S. : probably *Motacilla rubicapilla,* Tickell, *J. A. S.* II. 576, though the description there applies equally to this and the preceding nearly allied species. It differs from *T. gularis* by having the upper-parts pale olive-green instead of brown, the rusty cap much paler and less spread, and the gular streaks are fewer and narrower. Length about five inches, of wing two inches and three-eighths, and tail two inches, its outermost feather but a quarter of an inch shorter, which is less than in *T. gularis ;* bill to forehead five-eighths of an inch, and to gape nearly three-quarters of an inch ; tarse five-eighths of an inch. The yellow tinge to the breast is, in some specimens, scarcely less deep than *T. gularis,* whilst in others it is scarcely discernible : bill and feet pale. Lieut. Tickell writes, of his *M. rubicapilla,*— "Female : five inches, eyes reddish-hazel ; bill and legs pale horn. * * * Found in the thick underwood, hollows, ravines, &c. is lively and agile, with a frequent piping note and occasional chatter." *List of Birds collected in the Jungles of Borabhúm and Dhulbhúm.* I notice this species here for the convenience of describing it along

* Mr. Hodgson has since proposed the subdivisional name *Mixornis* for this bird, and the preceding species ranks with it.

with its congeners. It is comprised among the specimens presented to the Museum by Mr. Hodgson.*

* *Macronous ptilosus*, Jardine and Selby, *Ill. Orn.* pl. CL.: *Timalia trichorrhos*, Temminck, *Pl. Col.* 594, fig. 1, apud G. R. Gray. Length six inches and upwards, of wing two inches and five-eighths, and tail two inches and a half, the latter broad and much graduated, its outermost feathers being an inch shorter than the middle ones: bill to forehead above five-eighths of an inch, and to gape nearly seven-eighths of an inch: tarse seven-eighths of an inch. The extraordinary character of this species consists in the curious form of the feathers of its flanks and rump, which on the latter, in fine specimens, are two inches and a half in length, being very numerous and dense, and consisting of long and flexible flattened stems, conspicuously white, and scantily fringed with fine discomposed and lengthened hair-like barbs, of a dark colour. The crown is bright rufo-ferruginous; throat black; back and breast deep tawny olive-brown, darker on the wings, and more dusky towards the flanks; and the tail is uniform dusky-black: bill black, and legs dusky probably tinged with lead-colour. This bird is barely separable from *Timalia*, but has the bill less laterally compressed.

Trichastoma, Nobis; n. g. Also nearly allied to *Timalia*, but having a moderately stout Warbler's bill, and very long slender setæ at the gape, affording a ready distinguishing character.

* *Tr. rostratum*, Nobis. Length above six inches, of wing two inches and three-quarters, and tail two inches, its outermost feathers three-eighths of an inch shorter than the middle ones; bill to forehead (through the feathers) above three-quarters of an inch, and fifteen-sixteenths of an inch to gape; tarse fifteen-sixteenths of an inch; middle toe and claw seven-eighths of an inch, and hind toe and claw nearly three-quarters of an inch. Colour of the upper parts uniform olive-brown, somewhat darker on the crown, and having a slight ruddy tinge on the rump and tail; whole under-parts pure white, a little sullied on the breast and lower tail-coverts; lores and sides of the head pale fulvescent-brown, and sides of the neck to the breast ashy: upper mandible horny-black, the lower yellowish-white except at its extreme tip; and legs deeply tinged with yellowish-brown.

* *Tr. affine*, Nobis. So like the other in plumage as to cause some doubt, on a first view, whether it be specifically distinct; but the much smaller size, and different

* The same indefatigable naturalist has described *T. Nipalensis* and *T. pellotis*, H., *As. Res.* XIX, 182; neither of which I have seen. There is also a Javanese *T. thoracica*, v. *Pitta thoracica*, Temminck, *Pl. Col.* t. 76, which is referred to the present genus in Griffith's 'Animal Kingdom," VI, 402, being described as "olivaceous brown above; underneath testaceous-grey; narrow white band from base of bill passes over the eye." Several species from the Indian peninsula have also been described by Messrs. Franklin, Sykes, and Jerdon; but the greater number of these constitute the distinct group *Malacocercus*, Swainson. The following must, however, be excepted.—*T. hyperythra*, Franklin, *P. Z. S.* 1831, p. 118, described as follows: — "*T. suprà olivascenti-brunnea; capite in fronte corporeque toto subtùs rufis; caudâ supernè fusco obsolete fasciatâ; rostro pallido. Longitudo* 5." The specimen sent to the Society by Mr. Jerdon for this species is rather larger, and has the throat and upper-part of the fore-neck conspicuously white; the frontal plumes merely rufescent-brown, and very rigid, as are in a less degree those of the crown, which it is evident are usually raised, while those of the forehead would at all times stand up forming a sort of crest, somewhat as in *Pastor cristatellus*. Though referrible in preference to *Timalia*, this species is little else than a miniature of the *Malacocerci*.—*T. hypoleuca*, Franklin, *loc. cit.*

colour, of the legs and feet, and also the much shorter bill, have decided me to adopt the present course with it. Length five inches and three-quarters, of wing two inches and five-eighths, and tail two inches and a half, its outermost feather nearly five-eighths of an inch shorter than the middle ones; bill to forehead (through the feathers,) not five-eighths of an inch, and nearly thirteen-sixteenths of an inch to gape; tarse three-quarters of an inch; middle toe and claw under eleven-sixteenths of an inch, and hind toe and claw rather more than half an inch. General colour rather paler than in the preceding, excepting on the head; the nape much paler; and rump inclining to fulvous more than rufous: tail and its coverts brighter rufous than in the other; and breast crossed with pale fuscous. Bill wholly pale, and legs appear to have been green.*

* *Goldana* (G. R. Gray) *nigrocapitata; Brachypteryx*† *nigrocapitata*, Eyton, *P. Z. S.* 1839, p. 103,—distinct from *Br. atriceps* of Jerdon. Length six inches and a quarter to six and a half, of wing two inches and five-eighths, and tail the same, its outermost feather five-eighths of an inch shorter than the middle ones; bill to forehead (through the feathers) eleven-sixteenths of an inch, and to gape seven-eighths of an inch; tarse an inch and one-eighth. General hue of the upper parts rufous-brown, of the under bright ferruginous: throat white, flanked by a black streak: cap black, bordered by a white superciliary streak and loral feathers; ear-coverts dusky, minutely lineated with white and posteriorly with rufous: sides of the head ashy; bill horny-black above, the lower mandible yellowish-white; and legs brown.

* *Oriolus castanopterus*, Nobis. A typical Oriole of small dimensions. Specimen apparently female, or perhaps young male. Length about eight inches, of wing four inches and a quarter, and tail two inches and one-eighth; bill to forehead seven-eighths of an inch, and to gape an inch; tarse three-quarters of an inch. Plumage ge-

identical with *T. Horsfieldi*, Jardine and Selby, *Ill. Orn.* pl. CXIX: vide *J. A. S.* XI, p. 199. Rather a peculiar species, with not a little of the form and aspect of *Calamophilus*. — *T. platyura*, Jerdon, *Supplement*. "Plumage above dark olive-brown, beneath ochry-yellowish; bill yellow-horny; legs fleshy-yellow; irides yellowish-brown: tail-feathers obsoletely barred, very broad; 1st and 2nd quills graduated, 4th longest, 3rd and 5th equal. Length five inches and a quarter; wing two inches and a half; tail two inches and a half; tarsus nine-tenths; bill at front four-tenths; at gape six-tenths: bill much compressed; plumage very lax. I was at first," continues Mr. Jerdon, "inclined to take this little bird for a *Warbler*, but a review of all its characters has induced me for the present to place it among the *Timaliæ*. I procured a specimen in long reedy grass at Goodaloor at the foot of the Neilghierries. It took short flights and endeavoured to conceal itself among the thick reeds. Its food consisted of insects." Possibly a member of my new genus *Trichastoma* described in the text, as is decidedly Mr. Jerdon's *Timalia poiocephala*, which he has sent me. (Vide *Addendum* introduced at the close of *Appendix*, No. 2, of the present Report.)

* A third species of this group exists in the *Timalia poiocephala* of Mr. Jerdon's *Supplement*, which has a good deal the aspect of a *Curruca*, and likewise considerably resembles the *Hemiparus* (olim *Siva*) *Nipalensis*, Hodgson, *Ind. Rev.*, 1838, p. 89, but is readily distinguished from it by the rufescent hue of its under-parts, the length of the rictorial vibrissæ, and absence of any dark line over and beyond the eye. Length six inches, or nearly so; of wing two inches and five-eighths, and tail two inches and a half; bill to forehead (through the feathers) above half an inch, and three-quarters of an inch to gape; tarse seven-eighths of an inch. Head and neck dull cinereous, the body greenish olive-brown, inclining to tawney on the rump, wings, and tail; beneath light rufescent-brown, the rufous tinge increasing on the belly, and lower tail-coverts dull tawney. Bill dusky above, yellowish at the edges and tip; "legs pale fleshy; and irides white. I procured a single specimen of this bird," writes Mr. Jerdon, "on the Coonoor Ghaut, in high forest jungle. It was alone, flying from branch to branch, and had been feeding on small insects." The *vibrissæ* in this species are less lengthened and thicker than in the others.

† Previously employed in other classes.—G. R. Gray.

nerally similar to that of *O. Galbula*, but the shade of colour darker, especially on the head; beneath throughout yellowish white to the lower tail-coverts which are bright yellow, and lineated with black from the breast; greater wing-coverts conspicuously margined externally with ferruginous, and tertiaries edged with the same towards their tips; primaries slightly edged with whitish; and all the tail-feathers, save the middle pair or uropygials, largely tipped on their inner web with bright yellow, contrasting with deep black: bill pale, and feet greenish lead-colour.*

Anthus Malayensis, Eyton, *P. Z. S.* 1839, 104. This species, which we also possess from Tenasserim, is, I have little doubt, that insufficiently described by the author cited, who should at least have given the length of the wings to help in identifying a member of this difficult genus. It is, he remarks, the *A. pratensis* of Raffles, being nearly allied [in plumage,] to *A. trivialis*, but differing in its larger size. It is also common about Calcutta, and occurs in Southern India upon the Neilghierries, where alone it has fallen under the observation of Mr. Jerdon.

**Coturnix Phillipensis*, Brisson; *Tetrao Chinensis* and *Manillensis*, Gmelin; *C. excalfaloria*, Temminck: male and female.

Ortygis atrogularis.

**Crex fasciatus; Rallus fasciatus*, Raffles, *Lin. Trans.* XIII, pt. II. 328. Nearly allied, it would seem, to *R. fuscus*, Lin. Length eight inches, of wing four and a half to five inches, and tail an inch and a half; bill to forehead seven-eighths of an inch, and tarse an inch and five-eighths; middle toe and claw an inch and seven-eighths. Upper-parts deep rufous-brown, the head, neck, and breast, bright dark ferruginous, paler on the throat; belly, flanks, and under tail-coverts broadly banded white and black, the latter broader in old birds, the former in younger specimens; wings dusky-black banded with white or fulvous-white. "Bill bluish-black, feet red, irides red." (Raffles.) Younger specimens, or perhaps females,

* I have obtained the true *O. Galbula* in this neighbourhood, and the other Indian and Malayan species known to me are as follow:—

O. aureus, Gmelin; to which Mr. Jerdon refers the *O. Galbula* of Sykes's catalogue (*P. Z. S.* 1832, p. 87), and also *O. kundoo*, Sykes, as the young bird. It closely resembles *O. Galbula*, but has shorter wings, and the black facial streak passes beyond the eye: from the nearly allied African *O. auratus* it differs in the greatly diminished quantity of yellow upon its wings. Though very common in peninsular India, I have not yet met with it in this neighbourhood.

O. Chinensis, Gmelin; *O. hippocrepis*, Wagler; *O. acrorhynchus*, Vigors, *P. Z. S.* 1831, p. 97; *O. Maderaspatanus*, Franklin, *P. Z. S.* 1831, 118, apud Jerdon, as (doubtfully) the young. Black-naped Oriole. Not common in India, but much more frequent in the countries to the eastward.

C. Hodsonii (Hodgsonii?), apud Swainson, v. *O. melanocephalus* of India, as distinct from that of Africa styled *Capensis* by Swainson, who has described a second black-headed African species as *O. brachyrhynchus*, while a fourth presenting the same character inhabits the Malay countries, and the *O. Traillii* constitutes a fifth. Very common in Bengal, and hardly less so, it would appear, throughout India from the Himalaya southward; extends eastward to China, but is not included in Dr. Horsfield's catalogue of Javanese birds, whereas *O. Chinensis* is there enumerated. *O. McCoshii*, Tickell, *J. A. S.* II, 577, is the once-moulted male.

O. leucogaster, Reinwardt; *O. xanthonotus*, Horsfield, *Lin. Trans.* XIII, pt. I, p. 152, and figured and further described in the 'Zoologieal Researches in Java.' Malay countries generally.

O. Traillii, Hodgson; *Pastor Traillii*, Vigors and Gould; *Psarophilus Traillii*, Jardine and Selby. Himalaya, and likewise Ava. In all seven oriental species, of which the two peculiar (so far as I am aware) to the Malay countries, — viz. *O. leucogaster* and *O. castanopterus*, — are remarkable for their small size.

have the colours less intense. The immature plumage has no rufous on the head, neck and breast, which are dull grey-brown, and the bars on the under-parts are much less defined; throat whitish.

In the suite of the foregoing Malayan species, I now proceed to describe a magnificent *Podargus*, which appears to be the *Bombycistoma Fullertonii* of Capt. Hay *(J. A. S.* X, 573*)*, though not minutely agreeing in all respects with the description furnished by that gentleman. It is the species mentioned in one of my reports, *ante*, p. 106, and there is reason to suspect that the specimen was obtained in the Malay peninsula.

Podargus Fullertonii (?). Length about sixteen inches, of wing ten inches and a quarter, and tail eight inches, its two outermost feathers successively much shorter; bill to gape two inches and a half, and the same broad at base, its vertical height at base about five-eighths of an inch; tarse seven-eighths of an inch. Colour different shades of fine rich rufous-brown, with a banded whitish half-collar at the nape, and very remarkable elongated white spatulate tips to the wing-coverts, laterally margined with black, each being prolonged beyond the dark portion of the feather, and curling upward so as to rise from the even surface of the wing, with the fine dark ferruginous-brown of which they contrast strongly: quills and tail less deep ferruginous-brown, banded with a still paler tint, which is slightly bordered with blackish; scapularies and tertiaries having each a terminal black spot; interscapularies dark, and but indistinctly mottled: crown brown, with little or no rufous tinge, and a subterminal irregular whitish streak, bordered with black, to each plume: feathers of the nuchal collar lengthened and fulvous-brown, rayed with dusky-black, and having a subterminal broad fulvous-white transverse band, which is also edged with black both above and below: under-parts comparatively dull ferruginous brown, with small whitish spots on the breast, and faint mottling; the belly paler; and lower tail-coverts whitish banded with light brown; ear-coverts rufous-tinged, and a pale streak over the eye becoming more conspicuous beyond it. Bill and feet brown, the former whitish towards the gape.

Capt. Hay's second species is probably the *Podargus stellatus*, Gould, *P. Z. S.* 1837, p. 43, being received from Malacca, whereas Mr. Gould's specimen was obtained from Java. His third species appears to be an *Eurylaimus* with which I am unacquainted.

The *Podargus Javanicus*, Horsfield, already noticed by Mr. Eyton as inhabiting the Malay Peninsula, likewise occurs, as I have been informed by Mr. Jerdon, in Southern India, that gentleman having received "a very accurate description" of the species, drawn up from a specimen killed in Coorg. It is rather an unexpected addition to the Ornithology of India.

The more interesting species which I have lately procured in this neighbourhood are as follow:—

Cuculus micropterus.

C. niger, Latham, v. *C. Bengalensis niger*, Brisson; of which the middle-aged female is *C. tenuirostris* of Hardwicke and Gray, and the adult male is the doubtfully cited *C. flavus* of Mr. Jerdon's list: a mature male.

Cypselus affinis, Gray: very abundant at all seasons. C. *palmarum* is less so, and no other species are met with in this vicinity. Of Swallows *(Hirundo)*, I have never

yet seen a single individual in Bengal, but the Society possesses an example of *H. rustica*, which was shot at no great distance from Calcutta.

Mirafra Assamica: nestling plumage, which helps to affine this genus to the Larks.

**Dicæum erythronotum*: male and female.

Tephrodornis superciliosus, Swainson, v. *Lanius Keroula*, Hardwicke and Gray. The female of this bird appears to present an extraordinary difference from the male. I brought down two at a shot, from a small party on the higher branches of a tall tree, where they were making much the same kind of noise as a family of young Shrikes. One was a young male, retaining most of its nestling feathers, which on the head and body resembled the corresponding garb of *Muscicapa grisola*, while the wing-coverts, tertiaries, and tail, were those of *Lanius*; and this specimen, like the adult male, has the two outermost tail-feathers almost wholly white; the other bird was an adult female, with no white whatever on the tail, which is besides shorter and less rounded; and the superciliary streak and dark colour of the ear-coverts are also wanting: in other respects the two resemble; but the diversity in the tail is so remarkable, that I imagine few would incline to regard them as specifically the same.*

Columba Javanica: interesting as proving the existence of this beautiful species in the neighbourhood, where indeed (in the Botanic Garden,) it is not uncommon.

Numenius arquata.

Tringa subarquata: fine summer plumage.

**Gallinula lugubris;* Horsfield, *Lin. Trans.* XIII, pt. I, p. 195: male.

**Rallus rufescens*, Jerdon, *Madr. Jl.* No. XXIX, 205: female.

A considerable number of skins have likewise been set up.

I am, Sir,

Your's obediently,

Edward Blyth.

Appendix to Report, No. I. —— The Asiatic Drongos (*Edolius*, Cuv.). Upon a former occasion *(ante*, p. 169 *et seq.)*, I was partially successful in my endeavour to elucidate the various Oriental species of this group, which I am now enabled to monograph, I think, satisfactorily: and to aid the student in determining the various species with which I am acquainted, I annex a plate with figures of the beak of each of them, and proceed to offer a conspectus of the series with their synonymes.

Subgenus *Criniger*, Tickell, 1833; *Cometes* (olim *Chibia*), Hodgson, 1837.

1. *Edolius Crishna* (Latham), Gould; —— *splendens*, Tickell; —— *casia*, Hodgson: ante, p. 171. Figs. 1 and 2.

Subgenus *Edolius* (Cuvier), Nobis; *Cometes* (in part), Hodgson.

2. *E. grandis*, Gould; —— *malabaricus*, Shaw and Stephens; —— *malabaroides*, Hodgson: *ante*, p. 170. Figs. 5 and 6.

3. *E. retifer*, Temminck; —— *platurus*, Vieillot; —— *malabaricus* Gould; —— *cristatellus*, Nobis; —— *grandis*, apud Horsfield†: ante, p. 170. Fig. 7.

* I have since shot a female of this species not differing from the male, which leads me to conclude that the female above noticed is distinct.

† Identified as such by Dr. McClelland's drawing of the specimen; and accordingly Dr. Horsfield's remark is explained, that the Assamese specimens of supposed *grandis* "agree with the specific character and description given by Mr. Gould in all points excepting the size, being about one third smaller." The present is also Mr. Jerdon's species.

4. *E. Rangoonensis*, Gould;—probably the *Malabar Shrike* or *Drongo* of Buffon and Sonnerat:* *ante*, p. 172. Figs. 8 and 9.

N. B.—— Either the first or second of these three species (probably the first of them) is the *Cuculus Paradiseus*, Lin., the *Coucou vert huppé de Siam* of Brisson, or *Coucou à longs brins* of Buffon, as founded on a drawing by a M. Poivre, who had figured the feet to be zygodactyle: the same artist had in like manner misrepresented the *Pica (Cyanocorax) erythrorhynchos*, which accordingly has been described as the *Coucou bleu de la Chine, en langue Chinoise, San-hia*, of Brisson and Buffon, and the *Cuculus Sinensis*, Linnæus. This species was observed in Chusan by Dr. Cantor.

Subgenus *Melisseus* (olim *Bhringa*), Hodgson.

5. *E. remifer*, Temminck; —— *tectirostris*, Hodgson; —— *Rangoonensis (?)*, apud Horsfield: *ante*, p. 169. Figs. 3 and 4.

Subgenus *Prepopterus* (olim *Chaptia*), Hodgson.

6. *E. æneus*, Vieillot; —— *muscipetoides*, Hodgson. Figs. 20 and 21. *Butchanga* of the Bengalees.

Subgenus *Dicrurus* (Vieillot), G. R. Gray, olim *Buchanga*, Hodgson.

7. *E. viridescens (?)*, Gould: ante, p. 173. Figs. 10 and 11.

8. *E. balicassius* (Linnæus);—*affinis*, Nobis (*ante*);—Javanese *forficatus (?)*, Horsfield: *ante*, p. 174. Figs. 12 and 13. A fine adult, recently obtained from Singapore, has the wing five inches and three-quarters long, middle tail-feathers four inches and three-eighths, and the outermost above seven-eighths of an inch additional; the tip of the latter curling nearly as much as in *E. Fingah*, from which species this differs in its shorter and much less deeply forked tail, and in the superior size and much greater vertical height of the bill, the upper ridge of which is also considerably more angulated.† In both the abdominal feathers of the once moulted birds are tipped with greyish-white, which totally disappears in the plumage of full maturity. I doubt whether that now under consideration occurs in India, but it seems to be the common species of the Malay countries generally, including the Phillipine Islands (from whence it was originally described by Brisson and Buffon), and it is said to extend even to Australia (apud Vigors, *Lin. Trans.* XV, 211).

9. *E. Fingah*, Shaw (the young),—*Indicus*, Stephens (the adult);—*albirictus*, Hodgson;—*balicassius*, Nobis (*ante*), as also of Jerdon and other writers on the Ornithology of peninsular India. Figs. 14 and 15. Shaw appears to have had no further authority for this species than Edwards's figure of the "Fork-tailed Indian Butcher-bird," which he erroneously refers to *Lanius cœrulescens* of Linnæus; and holding this opinion, he had no right to clog our systems with a superfluous name: quoting, too, the Linnæan definition of *cœrulescens*, and perhaps following Edwards's description, or, it may be, describing from that author's plate, it would seem that the most has been made of the whitish tips to the abdominal feathers of the young of our present species, thus bearing out the mal-identification with *cœrulescens*.

* "Il manque de huppe."—Buffon.

† This bird is the *Corvus balicassius* of Linnæus, and in truth its beak partakes much of the corvine form, so that the species might be styled with propriety the *Crow-billed Drongo*, as the next might be equally well named the *Shrike-billed Drongo*.

His statements, however, that "this species is described and figured by Edwards, from a specimen brought from Bengal, where it is known by the name of *Fingah*," and that "it is said to be a great persecutor of the Crows, which it attacks and obliges to quit its haunts," leave no doubt in my mind that the present is the species intended, inasmuch as though others of this genus likewise drive away the Crows, still this is the common *Fingah* of the Bengalees, familiarly known to every body, and its beating off the Crows and even Kites is here a scene of daily observation. A seemingly constant character of this species is a minute white spot at the rictus, which does not occur in any of the other species, and hence the appropriate name of *albirictus* bestowed by Mr. Hodgson.

10. *E. macrocercus*, Vieillot;—*annectans*, Hodgson, — *Muscicapa biloba*, Lichtenstein, apud Griffith's work;—*Neel Fingah* of the Bengalees: *ante*, p. 173. Figs. 16 and 17.

11. *E. cœrulescens* (Linnæus). Figs. 18 and 19.

12. *E. cineraceus*, Horsfield, *Lin. Trans.* XIII, pt. 1, p. 145;—probably also *D. leucophæus*, Vieillot, *Dict. Class d'Hist. Nat.* V, 621, which, with *D. Ceylonensis*, Stephens, are referred to (and the latter founded on) the *Drongri* of Levaillant. "*E. cineraceus saturatus concolor, remigibus supra ad apicem rectricibusque lateralibus margine exteriore, nigris. Longitudo* 11 *poll.*" Horsfield: who adds that—"Although very similar to *forficatus* [which I suspect to be *balicassius verus*], it must be considered a distinct species; the bill is more robust, and the exterior tail-feathers form a greater curve; it is much less common, and the natives of Java distinguish it by a peculiar name." *Dicrurus leucophæus*, Vieillot, is briefly described as having "*tout le plumage d'un gris plombé avec l'extremité des remiges d'un brun noirâtre; barbes exterieures des rectrices noires; queue longue et fourchue; bec et pieds plombés. Taille, neuf pouces. De Ceylon et de Java.*"

13. *E. leucogaster* (Vieillot), *Dict. Class. d'Hist. Nat.* V, 622 (1824); *D. albiventris*, Stephens, (1825): founded on Levaillant's *Drongo gris à ventre blanc*, and suspected by both Vieillot and Stephens to be merely a variety of the last, or *leucophæus*, Vieillot. "It chiefly differs in having all the under-parts, *from chin to vent*, white," and therefore cannot be identified with *cœrulescens*, to which Mr. Jerdon has assigned *leucogaster* as a synonym.

14. The only remaining species which I can find ascribed to this part of the world is *D. æratus*, Stephens. "Inhabits Bengal. Beak and legs black: general colour of the plumage above black, with a brilliant changeable blue gloss, like bronze, in some lights appearing green: belly, sides, and under tail-coverts, dull black-grey; underparts of the wings and tail black; the last forked: the hairs about the nostrils point forward [as a matter of course], and there is a large oval patch of black beneath the eye." Is much in need of verification.

Explanation of Plate.

Figs.	1 and 2	*Edolius krishna.*	
,,	3 and 4	,,	*remifer.*
,,	5 and 6	,,	*grandis.*
,,	7	,,	*retifer.*
,,	8 and 9	,,	*Rangoonensis.*
,,	10 and 11	,,	*viridescens ?*

Figs. 12 and 13 *Edolius balicassius.*
,, 14 and 15 ,, *Fingah.*
,, 16 and 17 ,, *macrocercus.*
,, 18 and 19 ,, *cœrulescens.*
,, 20 and 21 ,, *æneus.*

Appendix, No. 2.—Genus *Turnix*, Bonn. (1790); *Tridactylus*, Lacepede; *Ortygis*, Illiger; *Hemipodius*, Temminck: the *Three-toed Quails* of sportsmen. On a former occasion (Vol. XI, p. 586), I referred a pair of specimens, male and female, of this genus, to the Malayan *T. atrogularis*, Eyton, *P. Z. S.* 1839, p. 107; to which also I now find that I should have assigned the Malayan female noticed at p. 204, and there wrongly identified with *T. taigoor* of Sykes, which latter is, however, included by Mr. Eyton in his list of a collection of Malayan birds, wherein he has characterized the *T. atrogularis:* but the similitude of some females of these species is so extremely close, that it is almost (if not quite) impossible to discriminate them, even though ordinarily they are distinguishable at a glance; and now that the Singapore collection noticed in the foregoing report has yielded undoubted examples of both sexes of *T. atrogularis*, it appears to me that of the pair first mentioned, the male pertains decidedly to that species, while the female sent with it should perhaps be referred to *T. taigoor*. I have now four continental eastern species before me, of which the males of three would appear to be normally distinguished from the other sex by having the throat and middle of the fore-neck and breast jetty-black; but in *T. atrogularis* this black is very much broader than in *T. pugnax* and *T. taigoor*. Col. Sykes states, indeed, that the last mentioned species is devoid of this colour, which is the case with one specimen marked male in the Society's Museum, but another example before me has fully as much of it as *T. pugnax:* again, of the latter species, remarks Mr. Jerdon, "Col. Sykes and M. Temminck assert the identity of the plumage of both sexes [each having the mark], and though I did not examine them when I shot several in company, they were always clothed alike"; on the other hand, M. Drapiez states (*Dict. Class. d'Hist. Nat.*, Art. *Turnix*),—"La femelle [of *T. Pugnax*] a généralement les couleurs du plumage beaucoup moins vives; la bande longitudinale de la gorge au lieu d'être noire est blanche avec un simple trait noir qui l'encadre; le milieu du ventre est d'un blanc roussatre." Of the *T. Luzoniensis*, v. *H. thoracicus*, Tem., of the Malayan Archipelago, Sir Stamford Raffles observes, that "the throat is black in the males, generally whitish in the females"; and I imagine that the fully adult males of all these exhibit the black mark, while (in various degrees, according to the species,) the young males, and a greater or less number of old in addition to the young females, are devoid of it, some also presenting a mere trace of this marking, as stated by M. Drapiez of the female of his *pugnax:* and it should be borne in mind that this is a genus of which several species are so closely allied together, and withal so numerous in species, that in cases of conflicting testimony there is generally much room for doubt whether precisely the same species be intended by different writers.

I proceed to offer descriptions of all the oriental species which I know of.

1. *T. pugnax*, apud Sykes and Jerdon; perhaps *Tetrao nigricollis* and *Madagascariensis* of the older authors, though it is unlikely that the very same species inhabits Madagascar. Length six inches and a half; of wing three inches and a half; bill to forehead (through the feathers) nearly five-eighths of an inch, and fully a quarter of


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an inch in vertical depth; tarse an inch, and middle toe and claw seven-eighths of an inch. Upper-parts rufous, with transverse black lines on each feather of the back, scapularies, and rump, these having also yellowish-white lateral margins, internally edged with black; sides of the lower part of the neck and breast, together with the more conspicuous feathers of the wings, fulvous-white, with tolerably broad black cross-bars; below the breast light and bright ferruginous; throat and middle of the fore-neck, to the commencement of the breast, deep black; and crown rufous, with a series of black and white feathers, appearing as white spots set off with black, along the mesial line, another and broader series over each eye, a third bordering the black throat, and the sides of the upper-part of the neck covered with the same, appearing as whitish with black edgings to the feathers; quills brownish-dusky, with pale edges. The description of the female by M. Drapiez has already been cited, whilst M. Temminck and Col. Sykes assert that it does not differ from the male. The example here described is from Madras, and the species is understood to inhabit the Indian peninsula where it is tolerably common, Java, and (very doubtfully) Madagascar.

2. *T. taigoor*, Sykes: 'Bengal Sporting Magazine,' Oct. 1836, pl. I, fig. 6; *H. plumbipes*, Hodgson, Ibid. May, 1837, p. 346; 'Bombay Literary Transactions,' II, 271. The species which I conclude to be this, presents scarcely any difference in plumage from the preceding: the upper-parts are merely browner and less rufous, especially the head and nape, and the black cross-bars of the dorsal feathers are commonly broader and incline to be confluent, the markings generally being somewhat less clearly defined; but the size is inferior, and the beak proportionally more slender. Length five inches and three-quarters; of wing three inches and one-eighth, or less; bill to forehead (through the feathers) nine-sixteenths of an inch, and under three-sixteenths in vertical depth; tarse not seven-eighths of an inch, and middle toe and claw three-quarters of an inch. The male specimen before noticed as wanting the black gular streak has also the light ferruginous colour below the throat paler and less developed, the throat being spotless whitish, flanked with dusky specks. This appears to be the species figured in the 'Bombay Literary Transactions,' as above cited, which is stated to be common in Guzerat and in Malwa. "Extent of wings nine inches and a half." In the peninsula, Mr. Jerdon has "only procured it solitary, in long grass in the more open spaces of the Western coast." It is not uncommon in the vicinity of Calcutta, where I have found it breeding, in the Botanic Garden. As occasional females of this and of the next so much resemble, and Mr. Eyton, while enumerating *T. taigoor* in his list of species from the Malay peninsula, describes only the male of his *T. atrogularis*, it is certainly not improbable that he mistook the female of that bird for the present species.

3. *T. atrogularis; H. atrogularis*, Eyton, *P. Z. S.* 1839, p. 107. Intermediate in size to the two preceding species, with as stout a bill as the first (in old males), and seldom much trace of rufous on the upper-parts, the predominant hue of which is a sort of dusky-chocolate, having much black intermixed, the transverse lines mostly confluent and suffusing a considerable portion of the feather; the black bars on the sides of the breast and wings, also, are broad, so as to assume an oval or even round form, and the fulvescent tinge on the belly is not very deep, and mostly extends up the breast; the black of the breast and fore-neck of the male is, as

already noticed, very much broader than in the others, whence this sex may always be readily distinguished, which is not the case with the females in every instance, even by referring to the thickness of the bill, which presents a much less marked distinctive character than in the male. Length about six inches, of wing three inches and three-eighths, or generally under three inches and a quarter in the female; bill to forehead (through the feathers) five-eighths; and tarse an inch, middle toe and claw seven-eighths of an inch. It is evidently very common in the neighbourhood of Singapore, and occurs in the Tenasserim provinces.

4. *T. Dussumieri*, 'Bengal Sporting Magazine,' October, 1836, pl. I, fig. 5; *Hemipodius variabilis*, Hodgson, Ibid. May 1837, p. 345; *Button Quail* of sportsmen. This is the most abundant species of India generally, including Bengal, and it extends northward into Nepâl, where it is also numerous; but I have not yet seen it from the eastern side of the Bay. Its length is five inches and a half, with wing two inches and three-quarters; bill slender, and half an inch to forehead through the feathers; tarse three-quarters of an inch, and middle toe and claw five-eighths of an inch. Throat whitish in both sexes, flanked with a few transverse dusky specks; and middle of the breast of the same fulvescent hue as the belly of the others, more or less deep: the colour of the upper-parts most nearly resembles that of *T. pugnax*, but the black is rather more predominant, especially on the rump which is chiefly of this hue; the belly is whitish; and the wings marked differently from those of the three preceding species, having a whitish ground-tint, upon which each feather shews a large rufous spot, containing a smaller black one externally; and these spots being longitudinal instead of transverse.

The following oriental species have also been described, and it will aid the student to give detailed notices of them.

5. *T. nigrifrons; H. nigrifrons*, Tem. "Six inches in length, having the forehead ornamented with three broad bands; the first of which is formed of small white feathers, arising from the base of the beak to the nostrils; the second, which is twice as broad as the first, is deep black; and the third, which extends beyond the eyes, pure white: the top of the head is of a fine red, with delicate black stripes in the middle of the feathers; the nape is slightly tinged with bright olive; the back, rump, and upper tail-coverts are of a reddish-yellow, tinged with black and fawn-colour; the lesser and middle wing-coverts are yellowish, each feather having a small black spot towards its tip; the secondaries and greater quills are grey; the throat bright reddish-yellow; neck and breast the same, having all the feathers sprinkled with semicircular black spots; belly and thighs pure white: bill red; and feet reddish, the claws black. Said to be a native of India, and described by Temminck from a single specimen in the Paris Museum." Stephens, in Shaw's Zoology.

6. *T. maculosus; H. maculosus*, Tem. This is an Australian species, but is stated in Griffith's work also to inhabit India, upon the authority of Gen. Hardwicke; and I make no doubt that the Indian bird here referred to is the same as that figured, together with another little known species, as two different *Bustard Quails* of sportsmen (both of them differing also from the preceding species of this genus), in the 'Bengal Sporting Magazine' for March, 1838, the present being represented as fig. 2 of the plate. The following is Stephens's description of the *O. maculosus* of Australia, in the Appendix to Shaw's 'Zoology.' "Distinguished by its very short

tail, which scarcely exceeds the tips of the wings when closed; its length is five inches: the top of the head is varied with black spots, and the whole of the feathers are tipped with greyish-red; a white band extends over the crown; the eyebrows, sides of the neck, and nape, are bright red; the throat and cheeks reddish-white; the fore-part of the neck, breast, belly, sides, and thighs, are red, and (with the exception of the feathers of the sides and those of the edge of the breast, which are varied with stripes of black and reddish-white,) they are spotless; the feathers of the top of the back and the scapularies are black in the centre, bordered with white, and tipped with red; those of the middle of the back and the long ones which hide the tail, are deep black, varied with rufous undulations, and slightly edged with yellowish; the scapularies are a little spotted with grey-blue; the wing-coverts are reddish-yellow; the whole of the feathers with a black spot near the tip, and the longer ones with the inner webs red, spotted with black; primaries and secondaries bright grey, edged with reddish-white; the bill and feet fine yellow." Capt. Brown's figure of the Indian bird before referred to accords tolerably well, upon the whole, with this description, differing chiefly a little about the head.

7. The other *Bustard Quail* is identified by that gentleman with the *Dubkee Quail* of Latham, *Gen. Hist.* VIII, 340, and which is thus described by that author. "Length under five inches. Bill pale. Head mottled whitish and ash-colour; all round the neck and sides ferruginous; down the middle from the chin, paler ferruginous; the rest of the upper-parts fine pale ash-colour, varied with paler spots, inclining to rufous; under-parts cinereous clay-colour, marked on the sides of the breast with round black spots of several sizes; greater wing-coverts and second quills pale clay-colour, spotted with black, some of the spots kidney-shaped; greater quills and tail plain dusky; legs yellow, and three toes only. Inhabits India, where it is called *Dubkee*." Sir J. Anstruther.

"*A.* Bill and legs yellow: plumage in general pale grey, crossed with fine black lines; lower part of the neck behind, inclining to rufous; breast the same; outer part of the wing and breast marked with small, distinct spots of black. Inhabits India and China, called *Looah*," -- a name commonly bestowed on the tiny Bush Partridge, classed as *Coturnix Argoondah* by Col. Sykes.

Capt. Brown's figure of this species represents the back as handsomely ornamented with round white spots, margined with black.

8. Dr. Latham also describes a *Balen Quail*, which is very probably the *taigoor*, notwithstanding certain discrepancies. "Size uncertain. Bill black. Top of the head, even with the eyes, marked brown; down the middle of the crown a pale clay-coloured streak, and another over each eye, almost to the back; the chin, sides under the eyes, and throat, white; sides of the neck and breast clay-colour; down the middle, from the throat to the breast, a broad black streak; the rest of the under-parts pale clay-colour, each feather marked down the middle with a long black streak, rounded at the bottom; back and wings pale mottled brown, as the head, marked with a series of pale yellow streaks down the middle and two others of the same on each side, besides some fine similar lines from the shaft of each feather; legs pale red, three toes only.

"Inhabits India, called *Balen*. Sir J. Anstruther."

"One supposed to be a female, is marked much the same about the head, but with-

out the black down the breast, or the transverse curved marks on the throat: sides of the body dirty-white, with fewer black spots."

"With the above, another of the first. The plumage much the same, but darker in colour, and the under parts flesh-colour instead of pale rufous, or clay-colour. This is called *Gassur*, and is probably a young bird; the specimen differs however, in having on one leg a rudiment of a hind-claw."

"*A.* Length five inches. Bill pale blue; above, the body is pale mottled ash-colour, with a series of yellowish streaks; also some large spots of blackish before, and marbled behind; the wings pale brownish rose-colour, chequered with white, and in the interstices a spot of black; greater quills dusky; along the middle of the crown a slender yellow streak; the rest of the crown marbled; sides of the head paler; round the eye nearly white; beneath the bird is wholly buff-colour; sides of the breast spotted with black; tail blotched with brown; legs flesh-colour, no hind-toe."

"Inhabits India. Gen. Hardwicke. Taken in Cawnpore in May."

9. *T. Luzoniensis; Tetrao Luzs.* Gmelin: *H. thoracicus*, Tem.; *Turnix maculatus*, Vieillot. Common in the Eastern Archipelago. "About seven inches in length: the top of the head, cheeks, and nape, covered with black and white spots, more numerous on the former; the feathers of the throat are white, tipped with black; the under-part of the neck and breast are fine bright red; the belly, sides, and thighs, bright yellowish; back, rump, and feathers covering the tail, grey-brown, marked with delicate zig-zag black lines; the greater and lesser wing-coverts whitish-yellow, varied with black spots, having a bright red transverse line above each of the latter; the greater feathers of the wing are grey-brown, and spotless." Stephens.

Sir Stamford Raffles remarks, that "The colours vary much in different specimens. The head, back, and wings are varied with black, brown, and fawn-colour, of which sometimes the one, sometimes the other, predominates. In full-grown birds the head is generally black, spotted with white, particularly at the sides, while the back is more of a red-brown, and the wings are black, banded with white. The breast also varies, being sometimes ferruginous, but at a later period becoming marked with transverse bars of black and white. The abdomen is always of a ferruginous colour. The throat is black in the males, generally whitish in the females. Bill rather long, yellowish, which is also the colour of the legs. Irides white.

"These Quails are frequently kept tame, and the females are trained to fight with each other by the natives. The superior courage of the females has given rise to a common Malay proverb, in which a hen-pecked husband is compared to a *Puyu*. This species is always seen in pairs, never in flocks like the *Pikau (Coturnix Phillipensis)*.

"I am at loss to discover," continues Sir Stamford Raffles, "what species of Quail is intended by the *Tetrao suscitator*, or Indian Quail of Bontius. The *Pikau* and *Puyu* are the two generally known throughout the Eastern Islands. The latter is the most frequently domesticated, and becomes as tame as the common fowl. It is the only one trained for fighting, and they will often combat with such fury as to kill each other. It is not however noisy, and in the wild state is only seen in pairs. The *Pikau*, on the contrary, has a loud clear note, is seen in flocks, will not become so tame as the other, and is not valued for fighting. It would seem as if the man-

ners of both were confounded in the account given of *T. suscitator*. *Lin. Trans.* XIII. pt. II, p. 324.

T. Luzoniensis is also the only species included in Dr. Horsfield's Catalogue of the Birds of Java; but it may be that the *H. pugnax* of Temminck is regarded by Sir Stamford Raffles merely as a particular state of plumage of his *Luzoniensis*, for M. Temminck informs us that *H. pugnax* inhabits Java, where it is greatly prized on account of its pugnacious disposition, the inhabitants amusing themselves by setting the males (?) to fight in the manner of game-cocks. [Col. Sykes, it may here be mentioned, takes upon himself to assert of his *H. pugnax* that "its pugnacious qualities are quite unknown in Dukhun, and even in Java."] I should not be surprised if *T. atrogularis* should prove to be identical with the Javanese *pugnax*, while it is quite distinct from a Madras specimen of Col. Sykes's Indian *pugnax*, this being the only one I have to compare with several specimens of Mr. Eyton's *atrogularis* received chiefly from Singapore. Of *T. Luzoniensis*, I have no specimen to refer to, but there is a rude figure of this bird in Sonnerat's *Voyage à la Nouvelle Guinée*, upon which its specific name was founded. *La petite Caille de l'Isle de Luzon* of this author, represents the female of *Coturnix Phillipensis*.

10. *T. fasciatus; H. fasciatus*, Tem. Inhabits the Phillipines. "Rather above five inches in length. The whole of the fore-part of the neck, the sides of the head and of the breast, transversely striped with black and white; belly spotless red; top of the head black; the region of the eyes striped alternately with white and black; nape bright red; back and rump brown, varied with black and red; wing-coverts transversely striped with black and white; the feathers nearest the body having their outer webs black, tipped with grey: the feet and beak are yellowish." Stephens.

11. *T. rufus*, Vieillot. "*O. corpore suprà cinereo, punctis nigris; jugulo nigro alboque vario; corpore subtùs, remigibus primariis, rectricibusque lateralibus fusco-rufis; rostro corneo, basi nigricante, pedibus rubescentibus.*" Inhabits China.

Various other species of this genus occur in Australia, the whole of Africa, even Spain, and probably other parts of Southern Europe, and doubtless Western Asia; but there is none in America. The Society's Museum contains two from the Cape colony, of which one appears to be the *Spotted-necked Quail* of Latham, and the other (a pretty, small, red-breasted species,) I cannot find described; but then I have not Dr. A. Smith's 'South African Zoology' to refer to. I have brought together all the notices I could find of eastern species, though I do not expect that so many will eventually be verified as distinct; but the data here collected will be useful in assisting the investigations of such as may now bestow attention on the group, and certainly may be presumed to intimate that the latter is richer in Indian species than has hitherto been currently supposed.

The other small *Gallinaceæ* classed with the preceding as *Quails* by Anglo-Indian sportsmen are as follow,—all having a fourth or hind toe.

True Quails (genus *Coturnix*), having the first quill longest, the tarsi having no trace of spurs, &c. Habits migratory.

1. *C. dactylisonans:* the Common Quail. An inhabitant of Europe, Asia, and Africa, to the Cape of Good Hope. It is very abundant in the Upper Provinces of India during the cool months, less so in the peninsula, and is the most frequent species of *Coturnix* in the vicinity of Calcutta. Is rarely known to breed in this country.

2. *C. textilis*, Tem.; *Perdix Coromandelica*, Latham: the *Rain Quail* of sportsmen. Distinguished from the last by its smaller size, the plainness of its primaries, and especially by the black breast of the male. Is very numerous in the cultivated parts of the Indian peninsula, where many breed; but great numbers arrive in the N. E. provinces of the Bengal Presidency early in the rains, and, after breeding, depart thence (save a few stragglers, which are observed at all seasons,) in September. It is not common about Calcutta; and in Nepâl its migrations resemble those of the common species.

3. *C. flavipes*, Nobis. A remarkably diminutive species, which I understand is not rare in Bengal during the cool season. I procured a fine male alive, which I kept some time, but it unluckily made its escape. Afterwards I obtained a female, in bad condition, both of them having been brought with Larks, &c., by the bazar shikarees, and this, when it died, was ruined as a specimen by the Ants. However, its dimensions were—Length five inches and a half, by nine inches and a half in extent, the wing two inches and seven-eighths, and tarse seven-eighths of an inch. Legs bright yellow. The plumage does not differ much from that of the common Quail, and the sexes are similarly distinguished. This bird has a remarkably soft, piping note.

4. *C. Phillipensis*, Brisson; *Tetrao Chinensis* and *Manillensis*, Gmelin; *Coturnix excalfatoria*, Temminck. "There is an accurate description of this species of Quail," writes Mr. Jerdon, "in Mr. Elliot's notes, taken from a single specimen shot by a gentleman near Belgaum, in the southern Mahratta country." The Society has also received Nepâlese specimens from Mr. Hodgson: and Mr. Frith assures me that he has found it tolerably common in different parts of Bengal, as near Islampore, where he resides. In the Malay countries generally, it appears to be very abundant. Some notice of its habits, as the *Pikau* of Raffles, has been already cited. It is remarkable for the great dissimilarity of the sexes, and the male is perhaps the most beautiful bird of its genus.

The three next are pigmy Partridges, and exhibit every character of the genus *Perdix*, both as to form and habits; insomuch that I cannot recognise the genus *Rubicola*, Hodgson, proposed for them in the 'Bengal Sporting Magazine' for May, 1837. Col. Sykes unaccountably ranges them in *Coturnix*, as if size alone were sufficient to refer them to that group.

5. *Perdix Argoondah: Coturnix Argoondah*, Sykes, *P. Z. S.* 1832, 153; *P. olivacea*, Buchanan Hamilton; *Java Partridge* of Latham: *Bush Quail* of sportsmen.* Generally diffused over all India, where there is any low cover.

6. *P. rubiginosa*, Valenciennes; *Coturnix Pentah*, Sykes, Ibid; *Forest Quail* of sportsmen. Southern India only.†

7. *P. erythrorhyncha; Coturnix erythrorhyncha*, Sykes: *Black Quail* of Neilghierry sportsmen. Elevated districts of Southern India only.

Addendum.—Since the first portion of this report has been made up at the press, the Society has received from Mr. Jerdon, with numerous other specimens, a skin of his *Timalia platyura* (vide p. 796, note to preceding page), and I consider this bird

* Also termed *Rock Quail* in the peninsula.

† Mr. Frith, however, has since informed me that he is tolerably positive of having once obtained this species in Bengal.

to belong strictly to the Indian form of *Dasyornis* (Jardine and Selby), being the fourth Indian species referrible to it with which I am now acquainted.—E. B.

Museum Economic Geology.

Read the following letter from the Deputy Secretary to the Government of India, of 8th June last:—

No. 575.

To H. Torrens, Esq.

Secretary to the Asiatic Society.

General Department.

Sir,—With reference to the Correspondence noted in the margin, I am directed to transmit for the information of the Asiatic Society, the annexed Extract Paragraph 104, from a despatch from the Honourable Court of Directors in the Public Department, No. 6 of 1842, dated 22nd March, and to request that when several specimens of the same Minerals are received in the Museum of the Asiatic Society, duplicates thereof may be forwarded to this Department, properly packed for transmission to the Honourable Court.

From Officiating Secretary Asiatic Society, dated 12th June 1840, with Enclosure. To ditto dated 17th June.

I have the honour to be, Sir,

Your most obedient servant,

H. V. Bayley,

Depy. Secy. to the Govt. of India.

Council Chamber,
The 8th June, 1842.

Extract from a Letter No. 6 *of* 1842, *from the Honourable Court of the Directors in the Public Department, dated the* 22*nd March.*

2 & 3. Dr. T. Thomson appointed Curator to the Museum of the Asiatic Society on the allowance authorized by the Court. The acknowledgment of the Society presented to the Court for their liberal patronage.

104. As several specimens of the same Minerals are likely to be frequently received in the Museum of the Asiatic Society, we should like to be furnished with duplicate specimens of which the locality has been ascertained.

(True Extract,)

H. V. Bayley,

Depy. Secy. to the Govt. of India.

Read the following Report of the Joint Curator for the month of June last:—

Report of the Curator, Museum Economic Geology, for the month of June.

Museum Economic Geology.—We have been principally employed in this month in searching for, and arranging from the Society's old collections, a suite of Indian Iron Ores; and I have the pleasure of exhibiting a commencement of 69 specimens, comprising 34 species and varieties, some of which are new, as Indian Ores of that metal, as far as I am aware. The crystallised Phosphate of Iron No. 39, from Bundlecund, and the earthy Phosphate No. 66, from Assam, are the most remarkable of these. The series from Bundlecund is valuable as relating to Capt. Franklin's excellent paper and map in the XVIIIth vol. of our Transactions. We have also made some progress in the arrangements of the Indian Copper Ores.

Geological and Mineralogical Museum.—We have to announce here a discovery of the very highest importance to Indian Geology, which is that of Captain Herbert's MSS. Geological Report, and moreover the certainty, from its title page, that it was accompanied by a Geological Map! and

six coloured Views. The following letter, addressed by our Secretary to Government, entreating its assistance in the search for this invaluable document, will sufficiently explain its importance, and it is therefore needless to dilate farther upon it here.

To G. A. Bushby, Esq.

Secretary, General Department.

Sir,—The Committee of Papers of the Asiatic Society of Bengal desire me respectfully to state for the information of Government, that after upwards of eighteen months of persevering search, five volumes of Notes and Field Books, relative to Captain Herbert's Geological and Mineralogical Survey of the Himalayas, have been recovered; and to this they have now to add also, the discovery of the Manuscript of his detailed Geological Report.

2. And from the title page to this Manuscript they further learn, that it was accompanied by a Geological Map and six coloured Views, which appear to have been sent in to Government with it.

3. The importance of the recovery of this great mass of Scientific Knowledge, which with the extensive collection in the Society's rooms are the fruit of this costly survey, they will not dilate upon; but they beg earnestly to bring to the notice of Government, the immense value, both scientific and strictly financial, of the Geological Map could it be also recovered; and in confirmation of this opinion they may refer to the vast labour and expense which for the last twenty or thirty years past, has been bestowed, both in Europe and in America, upon Geological Surveys and Maps of various countries: (and especially of England and Scotland,) under the full conviction of the immense political advantages which have been, and are to be eventually derived from them.

4. They trust then, that under these convictions, and with the hope that this really national loss, (for such it would strictly be both to India and to England,) may be yet averted by the recovery of this valuable document from amongst the archives of Government, they therefore respectfully request, that strict search may be ordered in the records of the General and Political Secretariats, the Surveyor General's Office and any others, for any kind of Geological Maps, Sketches or Survey by the late Captain Herbert or other persons. The date of his Manuscript Report is 1826.

Museum, (Signed) H. Torrens,

1*st July*, 1842. *Secretary, Asiatic Society.*

I may however be permitted to add that, from the great talent, untiring industry, clear and patient detail of facts, and absence of all leaning to hypothesis which distinguished so greatly our lamented associate, Captain Herbert, we may fairly hope, that if the Map is recovered, the Society at no distant day may have the satisfaction of doing full credit to the liberality of Government in the outlay for this costly Survey, and ample justice to his memory.

Amongst the old papers of the Physical Committee, we have also discovered a valuable one by Dr. John Adam on the Geology of Bundlecund, and this has enabled me to recognise Catalogue No. V. of our Geological collections, as being the series pertaining to this very paper, which is now in the press for the Journal. When I state that it extends from Mirzapoor to Jubbulpoor, giving thus an excellent Geological outline for that distance, its value will be easily understood.

I have again renewed every search for the Catalogue relative to Captain Pemberton's Geological Series from his Bootan Mission, to which we have no clue, but a very complete set of numbers on the specimens. Some hints from his Assistant, Captain Blake, lead me to hope, that the references, as in the case of Captain Herbert's collection, may be dispersed throughout his Note and Field Books, and I have written to Major General Macleod on the subject. We have no contributions to announce for this month.

H. Piddington,

Cur. Mus. Econ. Geol.

Museum, 30th June, 1842.

JOURNAL

OF THE

ASIATIC SOCIETY.

Contributions towards a History of the development of the Mineral Resources of India. *By* S. G. Tollemache Heatly, *Esq.*

It is often imagined that whatever of scientific or commercial enterprize has been exhibited in India, bears a very modern date under the British rule; and that the fortunes once so rapidly accumulated here as to originate the mythus of the rupee tree, were simply the results of systematic trading in some, and of systematic peculation in others. Such an idea was easily suggested by the fact, that the already known produce of India, and the silk of Cathay, and the spice of Serendib commanded immediate sale, and enormous prices in the markets of the West; that the private trade of the factors bore a very respectable proportion to that of their Hon'ble Masters; that rajahs and dewans were thickly sprinkled over the land; and that nuzzeranas were legal and weighty in amount, and fine in carat. It was difficult therefore to conceive any inducement for men to engage in the arduous and difficult task of opening new paths to wealth, when the beaten tracks offered certain affluence to moderate exertions. Yet it will be found by the historical student of that period, that in spite of all these serious temptations to engage in active political intrigue, or to confine themselves to the less harassing duties of mercantile speculation, many a clear and powerful intellect employed its energies in the honourable, though wearing, task of developing the resources of the country: and that in many instances they effected, though unaided, almost as much

as has since been done with the help of refined legislation, improved science, public spirit, and the other peculiarities of the nineteenth century. The earlier adventurers to India under the Company's government (I refer to the period between 1750 and 1790) were, a large majority of them, far from being the coarse and vulgar beings it became the fashion subsequently to represent them. Often scions of ancient but decayed houses, men of liberal education, high principle, and intellectual activity, their correspondence exhibits views of commercial policy, national wealth, and the duties of the ruler which will be found far in advance of the age even in the mother country. Those who deviate into these records from the monotonous detail of bloodshed and perjury, cruelty in the strong, and treachery in the weak, which constitutes the staple of the written annals of this period, will find the perusal, what Coleridge called, "its own exceeding great reward." They will learn to estimate at its proper worth, the contemptible defence set up for some acts of Clive and Hastings, that they were suited to the time and the people among whom those statesmen moved. Pure and simple-hearted men will be seen desirous to repair their own fortunes; but anxious at the same time to be of benefit to the land which enriched them; working out their plans with patience and perseverance; oftentimes harassed by the injudicious interference of those in high places; successfully thwarted by the intrigues of others who considered their interests endangered by the out-turn of the new schemes: and not unfrequently stopped, at the very moment when their labours promised a result, by the imperative mandate of the home authorities. Sometimes retiring to repose on their well-earned affluence, they have been brought out again in advanced age, the mismanagement or dishonesty of others having ruined their fortunes; and they will be seen setting themselves cheerfully to rebuild the shattered edifice by some new expedient, the introduction of an exotic growth, a manufacture that might lessen importation from England, or one which might serve as a remittance thither.

Biographies, like these, are not interesting merely in an antiquarian light for the coming generation, but they have their utility for the present, shewing us what has been attempted afore of old time; the causes of failure, and the probability of success, if endeavours be now renewed in the same direction. The discovery and working of coal, iron, copper,

lead, silver and sulphur mines; the boring of cannon; the casting of shells and shot; the glazing of earthen pottery; the manufacture of porcelain ware; of soda and potash; of salt; the introduction of mahogany and other plantations; sugar; cotton; the establishment of fisheries at the mouth of the Hooghly; the reclamation of waste lands in the Soonderbuns and in northern Bengal: each, and all, these belong to the last century—the days of Hastings, Clavering and Francis; of McPherson and Cornwallis. With the last indeed came in a spirit of anti-colonization; all encouragement to European enterprize and ability to work out the capabilities of the empire ceased. The subject being thus deprived of present interest, it is not singular that the memory of past occurrences should have fleeted by in a society constituted as is that of India. The retirement of some, the circulation of others into distant parts of the country, and the death of the rest, effaced at an early period the remembrance of what had been done: and the active duties imposed on all by the subsequently rapid extension of the British rule, left neither leisure nor inclination to the new comers to preserve the fading legends.

Having had my attention drawn some time ago to the history of mining in Bengal, and the liberality of Government in permitting access to their records having enabled me to extend my researches considerably, I propose to arrange their results in the course of two or three papers, in the hope of rescuing from "dim forgetfulness," the recollection of deeds and men already passing into the historical era. I could wish also to stimulate those who possess authentic information relative to the development of other branches of Indian industry to do so likewise, while it is in their power. Not a few of the documents registered in government offices, which would have thrown much light upon my task, no longer exist. A few short years, and what is now difficult, will become impossible.

Memoir on the Discovery and Working of Coal.

The earliest documents which I have been able to trace containing notices of the existence of coal in Bengal, bear date 1774, and they concur in assigning the priority of discovery and working

of coal mines in the districts of Bheerbhoom and Pachete to Mr. Suetonius Grant Heatly. On the 11th August 1774, the Council of Revenue received the following application and proposals :—

To the Hon'ble WARREN HASTINGS, Esq. *President, &c.*

Hon'ble Sir and Sirs,—I have the honour to present to you, in the name of Mr. Suetonius Grant Heatly and myself, " Proposals for working coal mines and selling coal in Bengal," in consequence of our having discovered certain coal mines in Pachete and Bheerbhoom, and I assure you, Gentlemen, that in case you will be pleased to grant us the indulgences we request, that we will endeavour to prevent all disputes with the country people, and in general to render the execution of what we undertake, subservient to every good purpose the nature of the work will admit. I am, &c.

Calcutta, *August* 11, 1774.

John Sumner,
For Sumner and Heatly.

Proposals for Working Coal Mines and selling Coal in Bengal.

That an exclusive right be granted to us for eighteen years of working coal mines and selling coal in Bengal and its dependencies, so long as we can engage to furnish as much pit-coal as ever the Government may bespeak of us for their consumption at the market price of the time, when wanted.

That in case we discover any copper, lead, or any other mineral or metal, except iron, in digging the six mines we have discovered, that is to say, within the space included by the river Adji to the north, the border of Burdwan to the east, the river Dummooda to the south, and a circular line to the west, described from the town of Aytura in Pachete, at the distance of ten miles from Aytura, between the one river and the other, we may have the property of the same, and we agree to pay a fifth part of their produce to the Honorable Company. In case of our discovering iron ore, we will report it to the Board, and wait their pleasure on the subject.

That we will furnish the Honorable Company with ten thousand maunds of pit-coal every year, for five years to come, (if we dig so

much,) at the price of two Arcot rupees, and three quarters per maund, (of 80 Sicca weight to the seer,) and after the expiration of five years; and we will annually, at the market price of the time of sale, furnish the like quantity, and we desire liberty to sell in Bengal, or export whatever quantity the Honorable Company may not bespeak of us.

That some uncultivated lands contiguous to the mines we work may be granted us, both because coal mines are known to vary and spread different ways, when the vein is sometimes lost and found again at a distance; and because we may be able to entice the labourers in future to settle on the spot, and if to this indulgence be added some contiguous cultivated lands, to the amount of about six thousand rupees rent, to be let out to us from the cutcherry of the Burdwan division, we hope it will prevent our workmen from committing trespasses or any encroachments under any pretence on other revenue lands, as they may, within our own circuit, be then furnished with provisions and necessaries by having a market to go to.

That the Government will be pleased to allow us to employ Europeans in the work we are about to undertake, on our engaging to be security for their good behaviour up the country.

That if the above six mines fail, or do not turn out of a quality for the Company's works, we may be allowed on the above terms to dig any other mines that we may discover on our pointing them out to the Government. But we do not desire to have a property in any metals or minerals we may discover, except in such parts of Pachete and Bheerbhoom, as are within the limits of the Adji and Dummooda, &c. as above described.

JOHN SUMNER,
For Sumner and Heatly.

CALCUTTA,
11*th August*, 1774.

On the perusal of these it was resolved,

That the Board approve of the proposals, excepting the latter part of the 4th article, respecting the farm of cultivated lands in the neighbourhood of the mines, which they are of opinion may be allowed as a present indulgence to the proposers; but to be resumed whenever

their possession of them shall become liable to objections, and excepting the 6th article which is premature, notwithstanding the encouragement which they think a discovery of this kind merits from Government; yet as a precipitate acquiescence to them may be attended with ill consequences to the collections,

Resolved,—That we decline coming to a resolution until the sentiments of the Provincial Council of Burdwan have been received upon them, and that this proposal be referred to them for that purpose.

The following letter was accordingly written :—

To GEORGE VANSITTART, Esq. *Chief, &c.*

Provincial Council of Revenue at Burdwan.

Gentlemen,—Accompanying we transmit you copy of some proposals, which have been presented to us by Messrs. John Sumner and Heatly, together with an extract of our proceedings on the subject. We desire you will agreeably thereto, forward to us your sentiments on them. We are, &c.

Warren Hastings,
Wm. Aldersey,
P. M. Dacres,
James Lawrell,
John Graham,
Nicholas Grueber.

Fort William,
The 11th August, 1774.

On the 23d August, the answer was submitted to the Board.

To the Hon'ble WARREN HASTINGS, Esq. *President, &c. &c.*

Honourable Sir and Sirs,—We have been honoured with the receipt of your letter of the 11th instant. If the revenue of the cultivated lands, which Messrs. Sumner and Heatly request to be allowed, be equitably adjusted with the present farmers; if effectual care be taken, that they do not force people to work for them, nor erect Gunges in such a situation as to ruin any that are already established, and further, if the Europeans they may employ be removable without absolute and formal proof of their misbehaviour, and no protection be given by them to Ryots, who may desert from their farmers, with balances due from them on account of their rents; with these precautions,

it does not occur to us that the scheme can be attended with any ill consequences to the collection. We are informed that iron is already manufactured within the limits they describe. We are, &c.

GEORGE VANSITTART,
JOHN BATHOE,
ALEXANDER HIGGINSON,
CHARLES FLEETWOOD.

BURDWAN,
The 15th August, 1774.

The following Resolution was passed on the Burdwan Report:—

Resolved,—That in consequence of the opinion given by the Chief and Provincial Council of Burdwan, a lease be granted to Messrs. Sumner and Heatly, upon the terms of which we have already approved, and with the following Resolutions.

First.—That they shall not compel people to work for them.

Second.—That they do not erect gunges or golahs of any kind, but be allowed only to establish bazars for the use of the people whom they may employ, and those subject to such regulations or occasional orders as the Chief and Provincial Council of Burdwan may think proper to issue.

Third.—That the Europeans or any other persons employed by Messrs. Sumner and Heatly, shall be liable to be recalled by the Chief and Provincial Council of Burdwan, without a reason assigned.

Fourth.—That they shall not receive or grant protection to any ryots who may desert from the farmers or officers of Government, with balances due on account of the rents, on penalty of forfeiting in every such instance treble the amount of the balances which shall be claimed as due from the said ryots by the Chief and Council of Burdwan.

Fifth.—That they shall at all times submit to and agree to abide by the judgment of the Board or of the Provincial Council of Burdwan, in cases referred to the said Council, without any other appeal.

Sixth.—That they shall not transfer the grant to any other persons, unless by express permission of the Board; but in the event of their abandoning the undertaking, surrender it again to the President and Council of Fort William.

Ordered,—That the Secretary do transmit a copy of these Resolutions, together with our former Resolutions of the 11th instant to

Messrs. Sumner and Heatly, and that he do inform them of our acquiescence to their proposals on the terms mentioned in our Resolutions.

On the 4th October, the matter came again before the Board.

To Mr. RICHARD SUMNER,

Secretary to the Revenue Department, Fort William.

Sir,—We have been honoured by the Board's answer, transmitted by you on the 24th August in respect to our proposals offered the 11th August, and we have now to request such orders as may be judged proper to the Council of Burdwan, and to have a grant (for working the coal, &c.) to the names of Sumner, Heatly, and Redfearne, as we all three are proprietors, and this is our firm. Moreover, we hope that as the time for the despatch of the ships is at hand, the Board will be so favourable to us as to represent our discovery to the Honorable Court of Directors, as their sanction will be a great encouragement to us in the work we undertake. We are, &c.

Calcutta, J. Sumner,
30*th September*, 1774. S. G. Heatly.

Order.

Agreed,—That they be admitted joint proprietors, and that the following letter be in consequence written to Burdwan :—

To GEORGE VANSITTART, Esq. *Chief, &c. &c.*

Gentlemen,—Having thought proper to grant to Messrs. Sumner, Heatly and Redfearne, a Grant for working the coal we before corresponded with you about in the districts under your division, we, enclosed, transmit you a copy of the engagements they have entered into. We are, &c.

Warren Hastings.
W. Aldersey.
P. M. Dacres.
James Lawrell.
Nicholas Grueber.

Fort William,
The 4th October, 1774.

Ordered,—That the Secretary do transmit the necessary materials to the Company's Lawyer, directing him to prepare a Grant accordingly.

At this period the partners were employed on active service by Government; Mr. Sumner at the head of a commission, and Mr. Heatly to quell some serious disturbances at Mirzanagore in Jessore. Redfearne never took any part apparently in the coal work, and was stationed at Nuddeah. At length in September 1775, the following letter was received by the Board :—

To The Hon'ble WARREN HASTINGS, Esq.

Governor General, &c. and Council.

Gentlemen,—We have the honour to acquaint you with our having imported from Pachete about two thousand and five hundred maunds of coal, in part of the quantity which we offered to furnish the Honorable Company with, at 2/12, (two Arcot rupees and twelve annas) per maund, and it is now ready to be delivered to your order. We are, &c.

Calcutta, John Sumner,
15*th September*, 1775. *For Sumner, Heatly and Redfearne.*

Ordered,—That the coal be delivered to the Military Store keeper, and that he do report the quality of it to the Board.

The Store-keeper did not, however, furnish any report. Mr. Sumner was deputed with Messrs. Pye and Adair to examine the Hidgellee salt accounts, which very fully occupied his time. And Mr. Heatly was Collector of the united districts of Ramgur, Palamow, Chota Nagpore, and Gautkondory, where he had small leisure for speculations. In November 1777, both having returned to the Presidency, they renewed their endeavours to carry out the work.

To The Hon'ble WARREN HASTINGS, Esq. *&c. &c.*

Gentlemen,—I request the favour of you to order two thousand maunds of pit-coal to be received into the Honorable Company's stores. This quantity is a part of what has been dug out of mines at Pachete by the discoverers, and it has been sometime laying in Calcutta. I am, &c.

Calcutta, John Sumner,
15*th November*, 1777. *For Sumner, Heatly and Redfearne.*

Ordered,—That the two thousand maunds of pit-coal be delivered to the Military Store-keeper, and that he be directed to receive charge of it.

Ordered,—That Messrs. J. Sumner, &c. be advised accordingly.

To Major JOHN GREEN, *Commissary of Stores.*

Sir,—Agreeable to the directions of the Honorable the Governor General and Council, I request you will please to receive into the store two thousand maunds of pit-coal, which has been sometime since imported into Calcutta by Messrs. Sumner, Heatly and Redfearne. When you have received the same, you will please to inform me of it. I am, &c.

Fort William, George Livius,
19*th December*, 1777. *Military Store-keeper.*

Major Green on the receipt of this letter, addressed Mr. Hastings on the quality of the coal not being fit for the purposes for which it was required by Government, and on the 24th December, Mr. Hastings brought the matter before the Council.

The Governor General lays before the Board, the following letter delivered to him by the Commissary of Stores, addressed to him by the Military Store-keeper, and submits to the Board the propriety of ordering, that the coals in question may be first examined and reported fit for use by the Commissary of Stores before they be received, in consequence of the resolution passed on the 18th August 1774, and that if they should not appear to be fit for use, that the Military Store-keeper be directed to return them to the proprietors.

The letter referred to is Livius's. The Board agreed to Mr. Hastings' proposal, and it was "*Ordered,*—That the Commissary of Stores be directed to examine the coals, agreeably to the Governor General's proposition." The report was soon sent in.

To The Hon'ble WARREN HASTINGS, Esq. *&c. &c.*

Honorable Sir and Sirs,—According to your order of the 24th December 1777, transmitted to me by your Secretary, I now enclose

a report of the coal furnished by Messrs. Sumner, Heatly and Redfearne, compared with sea-coal sent from Europe. I have, &c.

FORT WILLIAM, JOHN GREEN,
20th January, 1778. *Commissary of Stores.*

A report of the trial made between the British sea-coal and the country coal furnished by Messrs. Sumner, Heatly, and Redfearne, Fort William, the 13th January, 1778.

Country Coal, one maund.

Two welding heats were given to fifteen seers of iron, one foot long, two and half inches broad, one and half inch thick. The first heat required thirty-seven minutes, the second with the same fire and the remainder of the coals was sixteen minutes.

N.B.—It burns away very quick, the refuse is nothing but clinker slate and dirt, without the least remains of cinders or clean ashes, and it wastes the iron very much. Yet these coals are far preferable to those sent for a former trial.

British Sea Coal, one maund.

Two welding heats were given to fifteen seers of iron of the above dimensions. The first heat required thirty minutes, the second heat five minutes, with a quantity of coals remaining sufficient to have given two more heats.

N.B.—It is plain from this trial between the two sorts of coals, that with one maund of the British, the same work may be performed that can be done with two maunds of the country, in much less time, and with not near so great a waste of iron.

JOHN GREEN,
Commissary of Stores.

The Government resolution in consequence of the report, closes the official correspondence of this period.

Ordered,—That the Military Store-keeper be directed to return the coal to the proprietors; but that they be informed, the Board will give them all reasonable encouragement in the prosecution of their

undertaking, and that they have no doubt from this trial of their meeting with good coal, if they will be at the trouble of searching deeper for it, as this appears to have been gathered only from the surface of the mines.

Mr. Sumner retired at this period to England. Mr. Heatly alone remained in the neighbourhood. Tradition current in our family relates, that he brought out regularly-bred miners from Europe, and local tradition, according to Mr. Jones, confirmed the fact of Europeans having been engaged in the work, but carried off by a destructive fever. The certainty of a market was however gone, and the exertions of the proprietor became consequently less energetic. It happened singularly enough, that at the very time Government declined taking coals of the quality sent, new purchasers suddenly appeared on the very spot. In December 1777, Messrs. Farquhar and Motte addressed Government to be permitted to bore cannon for them, and to cast shot and shells, in a memorial which I shall have occasion to notice in a future paper. It has the following passages:—

" After having obtained the best information in our power, we are " of opinion, that the pergunna called Jerriah, lying between the rivers " Dummooda and Burraker in the province of Pachete, is the fittest " situation for the iron works. The river Dummooda is navigable as " high as that place. It abounds with iron ores, and has the singular " advantage of being contiguous to the coal mines of which Messrs. " Sumner and Heatly have a grant." Another passage runs thus: " By this article, however, we have no idea of prejudicing the rights of " Messrs. Sumner and Heatly, who you know, Gentlemen, have the " exclusive privilege of working the mines of coal or of any mineral or " metal, iron excepted, within certain districts of Beerbhoom and " Pachete."

It is not probable, however, that Mr. Farquhar (known subsequently as the purchaser of Fonthill Abbey from Beckford,) proved any very profitable customer to the mines. Disease and death thinned the number of Europeans employed on them. Government began to see the impropriety of permitting their revenue and judicial officers to engage in farming speculations, and the orders of July 1781, prohibiting

the lending of money on such accounts, was intended as an intimation of their opinion to the service. Mr. Heatly was now appointed to the chiefship of Tirhoot and Purnea, which precluded all personal superintendence on his part. I can trace nothing more at present of his subsequent connexion with the mines. As the iron mines continued to be worked long after, he may have let the coal mines to Mr. Farquhar. If not, the well known economical disposition of the latter makes it exceedingly probable, that he availed himself of the "singular advantage of contiguity" to carry them on for his own benefit, without hindrance on the part of the proprietor.

Independent of the want of a regular market, another powerful cause came into operation a little after, to repress the energies of private speculators.

I have said that Lord Cornwallis brought out a disposition systematically opposed to anything like colonial independence. Smarting under the humiliation inflicted on him by the Americans, he undeviatingly discouraged colonization. No plan which tended to make India a self-dependent state met his approbation, and at no period of the empire here do the records exhibit such a bareness of projects for developing the resources of the country. Under such auspices, it was not to be hoped that either the original proprietor or other individuals would attempt the resuscitation of the mining project, and accordingly in a short time the "young forgot it, and the old had died." Round its history grew

> A daily darkening pall: it sank subdued,
> In cold and unrepining quietude.

A brilliant career was opened to Mr. Heatly whose social qualities, and American-royalist connexions, had made him a personal favorite with Cornwallis, and his time was fully engrossed by it.

It has been said before, that Mr. Heatly was appointed Collector of Ramgur and Palamow in 1775, a situation he held till December 1776. During this period, he was employed in examining the resources of the country with a view to its settlement. Warm with the affairs of his Bheerbhoom coal mines at the very time, I think it is hardly possible that he could have overlooked the mines of coal in Ramgur and Palamow, although the troubles which demanded his vigorous efforts for their settlement may have prevented him from devoting much atten-

tion to them. He applied for a surveyor to complete a map of the several districts under his charge. Lieut. Ranken was, at his request, appointed and prepared a map, which yet exists at the Surveyor General's Office. It does not mention a word about the existence of coal, and I am therefore inclined to attribute the notification of a coal mine situated on the river Coyle, a little below Palamow, to Mr. Heatly, who was on intimate terms with Rennell, then Surveyor-general. Rennell's map of Behar, dated 1779, announces the fact, and Arrowsmith has only copied it into his Atlas from Rennell's.

From this period there is a wide gap. In Williamson's "Wild Sports in the East," (an admirably characteristic work, published in England in 1808, and pretty nearly as unknown now as the times he delights to paint were in his,) there is an incidental allusion to coal. It occurs in pages 7 and 8, Vol I.

"Cooking is carried on in the open air by means of embers; coals "being unknown in India, except in the Ramgur country, where the "Soobanreeka river runs for some miles through a mine of excellent "quality. The country being extremely mountainous, and no navigable "river within at least a hundred miles, though small streams abound, "added to the vast abundance of fuel, occasions that valuable commo- "dity to be neglected. The India Company indeed find it easier to "send coal from England, as ballast, to their arsenals abroad, where "quantities are occasionally used in fusing metals for casting ordnance."

It was singular enough, that at this very period the India Company *did not* indeed find it easy to send coal from England. In a general letter, dated 8th April, 1808, paragraph 24, they point out to the local Government the enormous expense to which they were subjected by the exportation of coal to India; wishing to know the purposes for which it was wanted; whether charcoal will not be equally servicable, and stating if no remedy can be devised, that they must transfer their ordnance works home. The Earl of Minto was then Governor General, and drew the attention of the Military Board to the complaints of the Court of Directors.

To Capt. A. GREENE, *Secretary to the Military Board.*

Sir,—I am directed by the Right Honorable the Governor General in Council to transmit to you the enclosed copies of the 23d, 24th, 27th,

and 28th paragraphs of a General Letter from the Honorable the Court of Directors, dated the 8th April last, for the information and guidance of the Military Board. I am also directed by his Lordship in Council, to call for the sentiments of the Military Board, with regard to the practicability of substituting Bheerbhoom coal for sea-coal for purposes to which the latter is applied. I am, &c.

COUNCIL CHAMBER, T. THORNHILL.
5th Sept. 1808.

I need not quote the whole of the Board's answer. It states, that an ample supply of sea-coal is actually a saving of expense, as charcoal is inadequate to the same work; and "that the Honorable Court in their General Letter of the 12th July 1805, particularly require that this article shall be regularly indented for." This last hint seems to favour a surmise of Messrs. Sumner, &c. that they were unfairly dealt with, owing to the strong interest made by the coal contractors at home. The Board go on in their third paragraph:—

"As the Military Board have never had an opportunity of seeing "or knowing the quality of Bheerbhoom coal, they request to be "favored with a communication of any information that the records "of Government may contain on the subject of it, and in what manner "some of it may be obtained for the purpose of trial at the Agency "Yard."

It was, however, not thought worth while consulting the records of Government, and his Lordship in Council directed the Collector of Bheerbhoom to procure and forward to the Commissary of Stores, a quantity of from fifty to one hundred maunds of the coal to be found in that district, reporting at the same time for the information of the authority, any particulars connected with the object of the proposed experiment which he may be enabled to collect from local enquiry respecting the quality of the coal, and the state and situation of the mines from which it is procured. His Lordship stated as his reason for this inquiry, the desirableness of ascertaining "by experiment whether the coal of which there are reported to be extensive mines in the districts of Bheerbhoom, can be advantageously used or not, as a substitute for

the sea-coal annually required from England."—*Letter from Military Department to Military Board, dated 19th September*, 1808.

On the 17th February 1809, a specimen of Pachete coal, obtained from a mine discovered near the village of Cheenacoory, close to the Damooda river, and which is stated to be very abundant, was forwarded for the above object to the Military Board.

On the 12th May following, a further communication was made to the same end, with another sample of coal, on whose qualities a particular report was demanded by Government. Certain correspondence, in connection with this sample, was also handed to the Military Board, which turned out to be of exceeding interest in regard to the former labours of Mr. Heatly. The letter from the Collector of Burdwan is the first.

To B. CRISP, Esq. *President, and the Members of the Board of Revenue.*

Gentlemen,—Agreeably to the instructions contained in your Secretary's letter of the 7th ultimo, and its enclosures, directing me to ascertain whether coals are to be procured in this district, I applied to Mr. Thomas Marriott, a gentleman whose long residence in this district and local knowledge, qualified him to give the best possible information on the subject. I feel myself much indebted to Mr. Marriott for the trouble he has taken, and should Government propose taking any further measures in the business, I beg leave to recommend him as a very fit person to be employed. I have this day despatched by the Dawk Bangee, addressed to your Secretary, a muster of the coals I have received from Mr. Marriott. I have, &c.

Burdwan, Collector's Office, C. Trower, *Collector.*
8th April, 1809.

I give Mr. Marriott's enclosures in full. This gentleman, I presume, was a son of Mr. W. Marriott, who had been a Member of the Provincial Council of Burdwan in Mr. Heatly's time, and to whom therefore the circumstances of this discovery was familiar.

"My enquiries regarding the coals have been attended with so much success, that I cannot avoid the pleasure I feel in communicating them to you. I returned from Jewszuttee the day before yesterday, and brought with me two seers of coal, which I picked up near that place out of the water, and this morning made a trial of it by burning, and find that it burns excellently, having been lighted early in the morning, and still continues. On my arrival at Jewszuttee, I accidentally met with a man who is a resident of that part of the country where the heap of coal, to which I alluded in my former letter, is lying. Upon enquiry, I found that he was well acquainted with all the circumstances of Mr. Heatly having dug the coal, and of the heap being still in existence; and as a most corroborative proof that he did, he told me that the potters at that place used it for burning their pans, &c. Pleased at having thus obtained so much information, I immediately sent off a peon with a bullock, and ordered every enquiry to be made as to the spot from whence the coal was taken. The coal which I took up from the river is doubtless a part of the heap at Mudjea. But this could not have been the case with the coal taken up by Lieutenant Delamain at the Goomea Ghaut, which is many coss above Mudjea. I have not the least hesitation in giving my opinion, that I shall be able to ascertain the exact spot of the mine, should the Government deem it worth their while to make further enquiries on the subject. I have enclosed a sample of the coal, and I shall forward the bullock the moment it arrives."

T. Marriott.

29*th March*, 1809.

"In reply to your favor accompanying the public enclosures, requiring any information I might possess regarding a stratum of coal said to exist in the vicinity of this district, I have the pleasure to state, that my enquiries on this subject have been attended with much success, to which I was fortunately guided by having previously travelled in that part of the country many years ago, in which the stratum is situated. As I presume that it is unnecessary to trouble you with a repetition of what I have already mentioned in my former letters, regarding my

having seen the heaps of coal lying at Mudjea, in Pachete, on my way to Jellda in 1782, I shall only further observe, that it was entirely owing to that circumstance that I was led, upon receiving your letter, to send people to the spot, to ascertain whether the heap of coal still existed; and also to make enquiry from the inhabitants as to the positive place from whence the coal was originally brought, and by whom.

"My people returned only a few days ago, and informed me, that owing to the floods, the bank at the village of Mudjea had been cut away, and that the coal in consequence had fallen into the river, and spread in different directions to a very considerable distance; that the inhabitants, in the prosecution of their enquiries, from fear or other causes, shewed great reluctance at answering any questions. But they at last met with an aged Bramin, who informed them, that the coal had been brought by Mr. Heatly, from a place named Chenacoory, and also from a spot situated in the Jungle of Damaully. The places are represented as being within nine coss of Mudjea, on the same side of the river, to the westward. It appears to me possible, that Kissencooney, marked in Rennell's map No. 7, is the same village specified by the Bramin; because the distance of that village from Mudjea agrees nearly with the Bramin's name of Cheenacoorey, and this is more likely, as the names of villages throughout Rennell's maps are frequently strangely disfigured by the mode of spelling.

"The stratum of coal is stated to be in the bed of the river, on the verge of the river, lying in flakes, and to be very abundant. The sample of coal which I have sent accompanying is brought from below the village of Mudjea, and taken up from the bed of the river, and is doubtless part of the heap originally collected at that place. Upon inspection, it will appear evident, that it must have laid in the water for a very considerable period, as the angles are in some pieces much fretted and worn off, and in others totally destroyed. I am much vexed that my people did not proceed to Cheenacoory, as they ought to have done. I have sent them back to ascertain the veracity of the Bramin's assertion, and expect that they will return in a few days.

"I shall not presume to offer any scientific opinion as to the quality of the coal, but merely state, that on a trial, I found that it burnt extremely well, afforded a very strong heat, and leaves a residum that is very considerable, compared with the original bulk.

"Regarding the stratum of coal of which Government have received some information through the communications of Lieut. Delamain and others, I have not been able to make any discovery worthy of notice. In my way down from Shahabad in 1797 to Burdwan, I crossed the Dummooda river at the same ferry that Lieut. Delamain did, which is called the Rajeghaut, and also the Goomeahghaut, (vide Rennell's map, No. 8, Gopur). To the north of the ferry, at the distance of three or four coss, there is a brook or rivulet, by the side of which I recollect seeing a hot spring, that in some places burst with a flame and caused a strong sulphureous smell. In the vicinity of this spring a stratum of coal may exist, some fragments of which Lieut. Delamain may have picked up from the bed of the Dummooda river that runs so near to the source of the spring, distant only four coss from the ferry, and into which the rivulet discharges itself. However this may be, it is highly improbable that the coal which I have collected and delivered as a sample, can be from any stratum alluded to by that gentleman, as the ford at which he passed is above forty coss beyond the spot that I have specified.

"As incurring the expense of travelling for local investigation without any immediate prospect would not suit my present circumstances, I must confess, however my inclination leads me, I have not been induced to undertake the journey. But if the Government should deem it worth while to ascertain any further points on this subject, and employ me for that purpose, I am willing to do the utmost in my power, and trust that no objections may be made to defray my travelling charges, which I presume would hardly exceed three hundred rupees. In making this tender of my services, I cannot avoid remarking, that my knowledge as a mineralogist is very confined, and that it appears a business requiring a person well versed in the nature of coal, of which it would be uncandid not to declare my ignorance.

"I beg leave further to state, that during my enquiries regarding the stratum of coal in Pachete, I have been informed by a man belonging to Tellotoo in Shahabad, that the coal is an article well known in that part of the country by the name of *Khaurdhur*, and used there on some occasions medicinally. It is to be found at a place named Thoorah, on the southern side of the Soane river, three coss above the Coyle river. Here are also quantities of coal to be found in the bed

of the Buccooah nulla, that is only half a coss from Kussyaun, a place well known, which evidently discovers that there must be a stratum. It was near to this village that Mr. Prinsep many years ago found copper, and commenced an extensive manufacture of vitriolic acid."

BURDWAN, *April* 6. T. MARRIOTT.

It appears from this letter of Mr. Marriott's, that the sample of coal sent down by him for Government, and by Government to the Board for a particular report, was part of a heap lying at Mudjea, but dug at Cheenacoorey and Damully by Mr. Heatly. Upon this sample we have the subjoined

Minute by Lieut. Col. HARDWICKE.

In compliance with the desire of the Military Board, I have the honour of making a communication on the Pachete coal, submitted to me for experiment and report thereon. In the first place I shall notice some particulars and peculiarities descriptive of the substance in question, and then give the result of the few experiments made upon it. In its appearance and some of its properties, it approaches nearer to the "bituminous oxide of carbon," known in England under the denomination of Bovey coal, than any other substance I can compare it with. In texture it is lamellar, the laminæ subject to two very dissimilar appearances, the one evidently marked with the woody fibre, and resembling pure carbon or charcoal; the other of a full shining black, opaque, very brittle, and breaking with a rhomboidal fracture, both irregular and mixing one into the other. The first rubs easily into powder, and sticks to the fingers on handling; the other does not soil the fingers when rubbed. Its specific gravity is greater than the coal here used, called sea-coal, being to that as 145.75 is to 135, taking water at 100 as the standard of comparison for both. It burns with a clear whitish flame without sparks or crackling, as coal and charcoal commonly do; emits little or no smoke, and without odour, burns for a considerable time without producing ashes, and with little change to either its form, bulk, or weight. The degree of inspissation in this bituminous substance must be very great, and the carbonic principle so prevalent, that it can scarcely be termed bituminous. In combustion, it discovers none of those appearances common to good coal; it

neither runs into mass, nor forms the least adhesion one piece with another; the laminæ shew a partial separation from each other, and sometimes curl up. Its appearance after considerable exposure to heat is slaty, and the few ashes formed, and adhering to the surface, of a ferruginous brown.

Experiment 1*st.*

Two lbs. weight of this coal was exposed to the strong heat of a blast furnace in an open crucible for one hour and forty-five minutes, and lost only eleven ounces of its original weight. The last ten minutes of this experiment it gave no flame. The appearance when cold, was as stated above, with this addition, that many of the black shining parts remain unchanged, shining with a vitreous texture, and more brittle than before.

Experiment 2*d.*

In the smith's forge, I found it inferior to common charcoal for producing the desired heat for working iron: and the same bar of iron which in about eight minutes under the heat of a common charcoal fire threw off scintillating sparks from its surface when taken from the forge, gave a very different appearance after being twelve minutes in the forge heated with the Pachete coal. The bar came forth with a rather dull heat, threw off no sparks, and the iron instead of yielding freely to the stroke of the hammer, flew off in large scales from its surface; and the workmen unanimously pronounced this fuel unfit for their use.

Experiment 3*d.*

I tried it also in combination with the English coal, the result was an inferior heat to that produced from Europe coal and charcoal.

Under such demonstrative proof, I do not hesitate to express my opinion, that the discovery of this coal promises no advantage for the uses of our Blacksmiths in iron work: but for household or culinary purposes, I think it may be found very desirable. For a house in particular to burn in grates or stoves, I think it desirable. It gives heat enough for our houses in India; is free from sulphureous smoke or the suffocating effect of charcoal, and makes little or no dirt. In

kitchens it will be found a desirable substitute for charcoal, if the expense of obtaining it should be less, and which must most likely be the case where the facility of water conveyance is at hand.

May 19, 1809. T. HARDWICKE.

Under such demonstrative proof, with the circumstances known to all parties under which the sample was picked up, the Pachete coal was once more doomed to be shelved.

Simultaneously with the letter dispatched to the Burdwan Collector, similar instructions had been sent to the Collector of Bheerbhoom. His answer stated, that coal had been discovered in the Zemindaree of Jerrea; that the beds were superficial, and *have never been worked, the natives being entirely unacquainted with the nature and qualities of the substance!* He further stated, that the coal was slaty and burned to white ashes without leaving any cinders: that it might be transported to Calcutta by the new road, at an expense of eighty-five Rs. per 100 maunds, but by boat during the rains, the cost would be twelve Rs. per 100 maunds.—*Letter from Mr. Suttie to the Board of Revenue, 2d June*, 1809.

The Governor General in Council, for the present suspends passing any final orders on the subject of Lieut. Col. Hardwicke's report, respecting the specimens exhibited of Pachete coal: it being the intention of Government, at a convenient opportunity, to depute a professional person into that district, for the purpose of making further enquiries into the nature and situation of the coal in question.—*6th June*, 1809.

It is necessary to say a word here of Lieut. Delamain's discovery, not only because it is mentioned by Mr. Marriott in his letter, but because the Coal Committee have assigned to it the palm of priority in the district. On receiving the letter from Government, dated 19th September, stating the orders to the Collector of Bheerbhoom, the Military Board returned a reply on the 27th, saying, that *they* had

been recently informed of there being a considerable stratum of coal in the bed of the Dummooda river, very near to the place where troops coming down the country are accustomed to cross that river in the Burdwan district. On the 3d January, 1809, the Board wrote again, mentioning Lieut. Delamain as the discoverer, and that he had been written to for particulars. Col. Hardwicke, who was the informant of the Military Board, had "no better evidence of the fact than is obtainable from the enclosed note from Mr. Moreton." The enclosed note ran thus:—

"I remember to have seen some pieces of very fine coal in the possession of Lieutenant James Delamain, who had taken them from the bed of the Dummooda, at or near that part of it crossed by the 7th Regt. of Native Infantry on its march from the Upper Provinces to Barrackpore, some four or five years ago. I am likewise informed by a gentleman, who has resided in the district of Burdwan, that he has frequently taken up pieces from the bed of the river at a place about five or six coss above the Civil Station, and if I am not mistaken, you will find some particulars on this subject in a work lately published, and denominated "Wild Sports of the East."

W. Moreton.

On the 24th January, 1809, Lieut. Delamain sent in his explanation.

To Lieut. T. MADDOCK, *Assistant Secretary to the Military Board.*

Sir,—In reply to your letter, dated the 3d instant, I request you will state to the Military Board my regret, that the specimens of coal which I had by me, have in the course of moving, been all lost.

It may afford, however, some slight guidance to mention, that I took the pieces of coal out of the Dummooda river, when the 7th Regiment marched down in December 1802, at the first ford between the village of Gomea and Angbella, (for we crossed it twice). The fragments though numerous, were all small, and strewed about immediately at the ford. As I did not burn any of it, I could not ascertain whether it were of a good or spurious species. It seemed however of a slaty structure, harder than the common coal, soiling the fingers but little when rubbed, and the colour approaching to grey. I am sorry that

no opportunity has offered to enable me to give the Military Board the slightest information relative to the stratum of coal in Burdwan.

I am, Sir, &c.

KISSENGUNGE, J. DELAMAIN,
16*th January*, 1809. *Lieut. 7th Regiment.*

Lieut. Delamain's discovery therefore was confined to picking up some pieces of coal from the bed of the Dummooda in 1802, twenty-eight years after Messrs. Heatly and Sumner had imported four thousand maunds into Calcutta from the district, and while large heaps from their mines were lying about the country, their origin being familiarly known to the inhabitants. It is however interesting to see, that this discovery of Lieut. Delamain anticipates that of Col. Shelton years after, as the locality is precisely the same—the ford of Angbella, on the Benares road.

In 1814, under the spirited administration of the Marquis of Hastings, the slumbers of the Military Board were once more disturbed. Referring to the suspension of final orders on the 6th June, his Lordship stated his anxiety to ascertain beyond a doubt, whether the coal of India was of a quality calculated for the purposes of the forge. So far from being discouraged by the results of previous experiments, he considered them to afford a strong presumptive proof, that there is coal here well calculated for military purposes; that surface coal may be expected to fail here as in England, where some of the excavations reach the depth of 205 yards before proper coal is met with; that a qualified person will be despatched with the requisite apparatus, as soon as possible, to any spot the Military Board think the best, suggesting Cheenacoory to their consideration.

The Board replied, that their information was too limited to permit them to hazard an opinion; suggested the Collectors of Pachete and Burdwan as the best authorities, and recommended that the person to be deputed should examine the district before commencing his boring, and submit his plan of arrangements and details to Government for their consideration.

It was well known at this time, that Mr. Matthew Smith, an eminent shipwright in Calcutta, used the Pachete coal to a large extent in his

forges. To him therefore Government applied directly for information. His answer is dated 14th March 1814. He states, that he has never been to the spot, but is told that it is Jarrea Cottra, about thirty coss from Bancoora; that the coal is from the surface, therefore too slaty and bituminous to answer every purpose of the forge; that even now he met occasionally with very good coal, and was sure that if they dug deeper, much better could be obtained. That he procured it for little more than the cooly hire, or eleven annas the cist, and had imported several thousand maunds, which he used in combination with charcoal. Mr. Smith also stated, that he obtained nails from the same place, manufactured from the iron ores of the neighbourhood with the aid of the coals; concluding with recommending Mr. W. Jones to the notice of Government as a person conversant with mines and collieries, and one "who from his great knowledge of mechanics, could soon ascertain if better coal could be found lower in the earth."

Mr. Jones, who had never been in the district before, was accordingly deputed by Government to examine it on an allowance of 600 Rs. a month. Meeting my father occasionally in town, he soon learnt all Mr. Suetonius Heatly's exertions in the working of coal, and was directed to the various sources of information. On his return, he mentioned that the remains of Mr. Heatly's works were distinctly visible, that the natives knew their origin, and stated them to have been conducted by Europeans, who fell a sacrifice to a pestilential fever. It is not therefore very creditable to Mr. Jones, that both in his papers in the Transactions of the Asiatic Society, as well as in the official correspondence which he held with various Government officers, not a single word alluding to any labours prior to his own is to be found.

From the time of Mr. Jones, the question of the value of Bheerbhoom coal has been settled, thanks to the energy of the distinguished nobleman, who then directed the councils of India. The labours of later discoverers will be found in the reports of the Coal Committee in sufficient detail. I have already sufficiently trespassed in length, having been, to speak in the quaint language of Williams' Natural History of the Mineral Kingdom, "really concerned for the honour of the coal, "and as I reckoned the subject my own, I wished therefore to be its faithful historian."

Memorandum on the usual Building Materials of the district of Cuttack, forwarded to the Museum of Economic Geology, with a set of Specimens. By Lieut. RIGHY, *Executive Engineer, Cuttack Division.*

Sandstone.

No. 1, called by the natives *Kondah*, found at Killah Mootree on the Mohanuddee, about ten miles above Cuttack, little used in the principal parts of buildings, but in constant demand for cornices and screen-work surrounding the roofs of the natives' houses. The stone is cut from the hills as wanted, and the simplest tools are used for that purpose, small or large chisels, according to the size of the portion to be separated. The operation is slow and laborious, and its cost is about three and half annas per yard. The yard of stone is three cubic feet; the carriage per yard to Cuttack is one and half annas.

No. 2, *(Laterite,)* called by the natives *Makrah*, used almost entirely for puckah buildings in this district; and may be had in almost every place, as it is found over a large extent of country, and may be carried in the rains to any part of the district. It is procurable in this presidency over a line of about sixty miles, running South-west from Cuttack, and is, I have no doubt, found over even a greater length in the Madras presidency. It is cut in slabs of from one to four feet in length, and to two feet in breadth, but seldom more than eight or nine inches in thickness, and is only quarried to a depth of two or three feet from the surface, as below that it is too soft for use. The mode of quarrying is simple; a channel being cut to the depth wanted, the stone is split off with a few blows of the hammer and chisel. Exposure to the atmosphere appears to harden these materials.

Soft Argillaceous.

No. 3, called *Bolemallah*, is used for the same purposes as No. 1. Brought from the Chutteah hills, Killah Durpon, cut at about four annas per yard; its carriage to Cuttack thence is, however, six annas for that quantity, which prohibits its use to so great an extent as No. 1.

Greenstone.

I have been unable to discover where this kind, (No. 4,) called by the natives *Moogney* is quarried, as it comes to the bazar only from the old buildings in the district; it is, however, supposed to have been brought from some considerable distance to the Southward. There is much of it in the Black pagoda,

and the images on many buildings are sculptured from it; its price is twelve rupees per yard.

Two kinds of lime are in use in this district. The one made from shells, (Specimen, No. 5,) collected on the coast about Manickpatum, the other from *konker*, (No. 6,) found in numerous rivers in this district, but principally in Debnuddee. The former is collected at an expence of about three rupees and four annas per hundred maunds, and its cost when burnt, is about fifty rupees the hundred maunds, where the shells have to be carried a distance of eight or ten miles. The *konker* is collected at the rate of two rupees, and its carriage to Cuttack is six rupees for that quantity; when burnt, the lime stands at from seventeen to eighteen rupees the hundred maunds.

The foregoing are the principal building materials in use in this district, for bricks are little used, as the generality of the soil is unsuited to their manufacture :—

Specimens of Iron.

Iron, of the three kinds sent is procurable in the bazar in any quantity. The ore is found in the direction of the Mahanuddee river, a considerable distance (about 150 miles) above Cuttack, and is smelted there. The cost of No. 1, per Cuttack maund (150 sa.) is five rupees and eight annas; of No. 2, four rupees and four annas; and of No. 3, three rupees and twelve annas.

Specimens of Timbers procurable in the Bazar.

Timbers of the several kinds subjoined come to Cuttack in the rainy season in large quantities; being floated down in rafts as soon as the Mahanuddee commences to rise. The average size of each, as it arrives, is shewn, as also the price, but Timbers of considerably longer scantling are to be procured in the forests whence these come.

No. 1.—Koorom Timber, length ten feet, and diameter at each end one foot three inches, cost of each one rupee and ten annas, received from Killah Ungool, river Mahanuddee, distance from Cuttack 100 miles.

No. 2.—Jack Timber, length eight feet, and diameter one foot, cost of ditto five rupees; ditto ditto ditto.

No. 3.—Ghamber Timber, length ten feet, and diameter one foot, cost of ditto four rupees; ditto ditto ditto.

No. 4.—Giringah Timber, the length ten feet, diameter nine inches, cost of ditto one rupee and eight annas; received from Killah Ungool, river Mahanuddee, distance from Cuttack 100 miles.

No. 5.—Ubloos Timber, length ten feet, diameter one foot, cost of ditto five rupees; ditto ditto ditto.

No. 6.—Saul Timber, length ten feet, diameter one foot three inches, cost of ditto two rupees and eight annas; ditto ditto ditto, used as rafters.

No. 7.—Peahsaul Timber, length ten feet, diameter one foot, cost of ditto two rupees and eight annas; ditto ditto ditto.

This Timber is greatly in demand for doors, sash frames, and all kinds of furniture, &c. for which paint is used.

No. 8.—Sissoo Timber, the length ten feet, diameter one foot, cost of ditto three rupees and eight annas; ditto ditto ditto.

Takes a fine polish, and is much used for household furniture.

No. 9.—Boudhun Timber, length fourteen feet, diameter nine inches, cost of ditto three rupees and eight annas; ditto ditto ditto.

No. 10.—Kankarah Timber, length eight feet, diameter one foot, cost of ditto one rupee and twelve annas; ditto ditto ditto.

No. 11.—Dhamun Timber, length ten feet, diameter eight inches, cost of ditto one rupee four annas; ditto ditto ditto.

No. 12.—Saul Timber, Barohatty, length sixteen and half feet, and diameter seven inches, cost of ditto one rupee; used for beams, rafters, door posts, &c.

Second Report on the Tin of Mergui. By Capt. G. B. Tremenheere, *F. R. S., Executive Engineer, Tenasserim Division.*

No. 3373.

From the Military Board.

To the Hon'ble W. W. Bird, Esq.

Deputy Governor of Bengal,

Fort William, 1st October, 1842.

Honorable Sir,—In continuation of our letter, No. 3403, dated the 16th October 1841, we have the honor to submit in original, Captain Tremenheere's letter, No. 183, dated the 27th August last, together with his second Report on the tin of Mergui, and to recommend that a copy of this Report, and also of the one forwarded with our letter above alluded to, with the specimens of tin, may be transmitted to the authorities in England, or to Professor Royle.

2d. The Superintending Engineer has reported to us, that he has received from Captain Tremenheere, three more boxes of specimens. These we have called for, and when received in this office, they shall also be forwarded to Government.

We have, &c.

(Signed) J. H. Patton, *Chief Magistrate.*

,, J. Cheape, *Lieutenant Colonel.*

,, T. M. Taylor, *Lieutenant Colonel.*

,, A. Irvine, *Major.*

No. 183.

To Major R. Fitzgerald,

Superintending Engineer, South East Provinces, Fort William,

Sir,—I have the honor to forward by the H. C. Steamer *Enterprize,* my second report on the tin of the Mergui Province, and to advise you of the despatch by the same opportunity of three boxes of specimens, the contents of which are enumerated in the report.

2. I have also to report, that on my return from Mergui, I despatched by the Ship *Ann Ranken,* direct to London, a box of specimens

of the Kahan tin ore to Professor J. F. Royle, at the East India House, and forwarded by the Overland Mail to that gentleman a short account of the locality, and of the additional information I had collected on the subject on my second visit to Mergui.

3. Having consulted with Mr. Blundell, Commissioner, as to the best mode of disposing of the cleaned tin ore, which had been received from Kahan and another locality, he was of opinion, that as it is desirable the produce of the tin localities of the Mergui province should, as soon as possible, become known to English capitalists and adventurers, it would be useful to send the sample already collected, consisting of 229 viss, or 7 cwt. and 51 lbs. of ore from Yahmon, direct to the India House to Professor J. F. Royle, who will take the orders of the Honorable Court of Directors in regard to its eventual disposal. The quantity therefore, 12 cwt. and 38 lbs. in all, was shipped on the 11th instant on board the *Jupiter*, Captain T. Longridge, which has sailed for England direct. Mr. Sutherland, local agent of Messrs. Cockerell and Co., to whom this ship was consigned at this port, has most obligingly procured freight for ten boxes, containing the ore and specimens, on board the *Jupiter*, free from all charges.

I trust the Military Board will approve of the steps which have been taken.

4. In consequence of the inferiority of the Yahmon ore, its collection from that spot has been stopped by the Commissioner; but there are at present 118 viss of the Kahan ore at Moulmain, which await instructions, and more may be expected, as well as a sample of the Thabawlick tin, the most productive stream visited by me last year.

5. I beg to propose that this, as well as any further samples that may be procured, be sent in like manner to the India House, when Professor J. F. Royle will, with the consent of the Court, bring the subject to the notice of private speculators or others, who may be interested on the subject. The produce of the metal from the Kahan ore already sent, will, I should think, repay the expenses which Mr. Corbin, the Assistant Commissioner, has incurred in procuring it.

The report has been submitted to Mr. Blundell.

I have, &c.

(Signed) G. B. Tremenheere,

Capt. Ex. Engr., Tenasserim Div.

P. S.—If it should be thought advisable to send a copy of the accompanying report to Professor Royle, it would afford better information than I was able to give in my hurried communication of May last, alluded to in the 2d para. of this letter.

(Signed) G. B. Tremenheere, *Captain.*

Received from the Military Board by order of Government, for the Museum of Economic Geology of India.

Having in the 16th and 17th paragraphs of my first Report of the 31st August last directed attention to a rich deposit of Tin, existing at Kahan on the Tenasserim river, a few miles from Mergui, I have now to add the following information which has been since collected respecting this locality. Experimental operations have been in progress there since the end of April last, by order of the Commissioner, and under direction of Mr. Corbin, Assistant to the Commissioner at Mergui, with a view to ascertain the value of the spot for mining purposes, and I am happy to have it in my power to state, that these have been attended with complete success. More than eight hundred weight (8 cwt.) of clean ore of the pure peroxide of tin, ready for smelting has been collected by a gang of convicts, and was despatched from Mergui on the 18th July; this has been received at Moulmain, together with some bulky specimens from the same hill of macled crystals of tin or quartz, which in weight and in size of the crystals, surpass any thing I have seen in Cornwall or in Cabinets elsewhere.

2. In the early part of May, I proceeded to Mergui on the Steamer *Ganges*, and on the 10th of that month, visited Kahan in company with Mr. Blundell and Mr. Corbin. The survey of the hill, plan of which is forwarded herewith, was made on the following day. It will be seen therein, and by the portion of map on the same sheet copied from Capt. Lloyd's Survey of the Coast, that Kahan is one of several small detached hills upon what may be termed the Island of Mergui, formed by two branches of the Tenasserim, one of which debouches a few miles to the north of Mergui, and the other to the south, which is divided near the sea into numerous channels by flat mangrove ground. The general surface of the island itself is of level alluvial

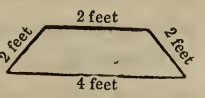
soil, from which these small isolated hills rise abruptly unconnected with each other, and detached entirely from the high granite and slate ranges which stretch along the peninsula. Except a small connected group at the town of Mergui, these have all the same exterior character, but Kahan is the only one in which tin has been found in *situ*. It occurs here imbedded in decomposed granite, consisting of a large proportion of felspar completely decomposed, termed kaolin or china clay, with quartz and mica, which appear to be its only constituents. A soft red sandstone is in immediate contact with the granite.

3. Along the same line of coast, in the southern part of the Malayan peninsula, in the provinces of Malacca and Johore for instance, the tin localities are similarly situated in small detached hills, having no apparent connection with the main ranges, and the ore is procured from a mixture of quartz, gravel, and china clay, which in description very much resembles the surface soils at Kahan. At Mergui, there is evidence of the destruction and denudation of granite hills, and of a considerable wash and deposit of debris from the eastward towards the Coast. The small cantonment there stands on the highest of a group, composed entirely of rounded fragments of quartz and sandstone, identical with that which touches the bed of decomposed granite at Kahan, with scales of mica, white felspathic clay, and likewise containing tin, which has been washed out of the gravels near the town, and from similar gravel hillocks in the neighbourhood which fringe the sea border. Localities of stream tin near the Coast south of the mouths of the Tenasserim are becoming known, and last year I penetrated to a range of hills about twenty miles from the Coast, consisting exclusively of granite, from the debris of which tin was obtained. I am for this reason inclined to think, that many of the small isolated hills before mentioned, as well as others in the low ground to the southward, will be found to consist, like Kahan, of nuclei of granite, containing tin, which have resisted the course of events, and have been left like islands in the alluvial plain between the high ranges and the sea.

4. The Kahan hill is 1921 yards in circuit at base, having a general direction of north-east and south-west; its highest points, C and F, are not more than 150 feet above the level of the surrounding rice fields.

There has been more abrasion, and the slope is more gradual on the eastern face of the hill than on the west; the debris on the east slope being evidently from the disintegration of the granite and adjoining sandstone rock, from which tin may at this day be plentifully procured a few feet below the surface. Some very rich specimens of the mineral were taken from a pit dug by the convicts about five feet deep at the point C in the plan. This face of the hill, as well as the north-east and south-west extremities near the base, have been dug into pits by the Burmese in former periods, and washed for tin in several places. Near the two last points, there are distinct traces of tanks which have been used for washing and separating the ore; the ground is seen there, and along the eastern slope, strewed with glittering plates of mica nearly an inch square, and covered with remains of the soft granitic matrix from which the ore has been extracted. A few persons now at Mergui were engaged here in tin works under the Burmese Government, and Mr. Corbin has ascertained from them, that those who understood the work, and laboured ten hours a day, collected one and a half viss of clean ore per man; but a very rich vein was not unfrequently met with, from which more than double that quantity could be obtained in the same time. No machinery was used, and the tin was procured by surface workings only. The produce, or clean peroxide of tin, was sold on the spot at the rate of five, or five and a half ticals of silver for ten viss of ore, which yielded on an average seventy per cent. of metal. The metal was at that period selling in the bazar at 100 ticals of silver for 100 viss of tin. There are 100 ticals in a viss, and 100 viss = 363 lbs. avoir.

5. On arriving at Kahan, we found that the working party had re-opened the bed of ore at the spot at which I found it last year, on the east face of the hill, marked A in the plan. At this spot, which is fifty-five feet above the level of the rice fields, and 600 feet horizontal distance from the foot of the slope, a pit twelve feet deep had been dug, the lower part of which was sufficiently roomy to allow a man to work easily with a pick-axe. The pit was an irregular four-sided figure of the following shape and dimensions: the three short sides being innermost next the vein, and apparently comprising its total thickness at that point, as far as could then be ascertained. All the three sides and the



entire depth of the pit consist of decomposed granite full of small bunches and strings of tin ore, of varying length and thickness, composed of crystals of the pure peroxide of tin, aggregated loosely together, and easily separable from the matrix in which it is imbedded. This is extremely soft and friable, and I was able with the sharp edge of a Burman *daw*, to cut down the sides of a pit, and expose fresh bunches of ore at every stroke. It is also remarkable for the large scales and crystals of mica it contains, the plates of which are readily separated, and for the abundance and whiteness of the kaolin or decomposed felspar of which the mass is chiefly composed, and to which the quartz appears to bear but a small proportion. Red sandstone touches this decomposed granite, and in the pit alluded to, looks like the enclosing rock of a vein, which is only slightly inclined from the vertical. A good sample of the ore had been collected here, and some rich specimens, shewing it in the matrix as taken from the pit.

6. The convicts had also been occupied in sinking pits near the base of the hill in other places, and had succeeded in obtaining at the north-east extremity, at the point C, some very rich specimens of the ore imbedded in material similar to that above-mentioned, angular as before, and apparently from another part of the vein, or very near it. This was afterwards placed beyond much question, for at the point B at the south-west extremity of the hill, and 280 feet from A, but on the reverse slope, the vein was again exposed to the day by a few hours' digging, and tin collected while we were there. This point is 43 feet above the level of the new fields on the west, at 550 feet horizontal distance from them, and the Burmese had worked there about 20 years ago, as was apparent by the washing tank situated on the level ground near it. It will be observed on the plan, that the points A, B, C, turn out to be in a direct line; A and B correspond very closely, both in substance and in elevation, and are doubtless part of the same vein, or mass of tin-bearing rock; and it seems probable, that this will be found to extend near the surface along the whole length of the hill, or 600 yards, accessible by mere pit digging, or by a straight gallery throughout its whole extent. It has been seen in thickness three and half feet, and in depth twelve feet; but its entire breadth and depth is, in the present stage of the workings, involved in some uncertainty, and can only be ascertained by mining operations systemati-

cally conducted. The upper decomposed portions of granite which have been exposed to view at the surface appear but indications of a most valuable repository of tin. The sandstone in contact with it is highly inclined to the horizon; and holds no water, but this is procurable within three or four feet of the surface, at the base of the hill, and could be easily raised for washing the ore by means of a Chinese wheel, or by the chain and rag pump, or by any simple process. The hill itself is not ten minutes walk from the main river, and a tidal creek touches its south-west extremity near B, and another, the north-east, at C, by either of which the produce of a mine can be carried away at high water. The northernmost creek is accessible by large boats to within 300 yards of the base of the hill.

7. On June the 15th, Mr. Corbin writes, that two pits had been sunk to the depth of eighteen feet on the ridge to the left of the small pagoda, between the points B and A, in which the stratum was found to be very thick and rich in tin. A pit near the pagoda itself had been sunk to nearly the same depth, and a very good thick stratum of tin soil found. Another on the east face, half way down the slope from A, where work had been formerly carried on, had also produced some very good ore; but as the ground had been much burrowed in former times, the surface soil was not very safe. Mr. Corbin on the above date, despatched to Moulmain eighty viss of the clean ore, which has been since received. On the 18th July, this gentleman informed me, that owing to heavy and incessant rain for fifteen or twenty days successively, the whole of the pits having no artificial support, had fallen in, before which however 170 viss more of cleaned ore had been collected, as well as the large specimens before alluded to. These are specimens of great weight and richness, consisting of large macled crystals of tin on quartz, and contain more tin in proportion to their bulk, than any specimens I have before seen. The largest which measured about fourteen inches square by twelve deep was so heavy, as to require some exertion to hold it steadily in both hands. Mr. Corbin had directed the whole of the upper soil at the pits on the ridge between B and A to be removed, and the convicts are still engaged in collecting tin from them. The stratum of tin soil, he says, is exceedingly thick here, he has ascertained it to be upwards of twelve feet. It is found, Mr. Corbin states, immediately "below the

sandstone rock, and consists principally of quartz and mica with apparently a small proportion of the sandstone, giving it a reddish colour: in some spots where the mica predominates it appears dark yellow; in this the ore is found scattered in masses; but lower down, it assumes the general form of whitish clay, where the ore is very little seen but in washing. The hill in this neighbourhood was in former days much burrowed, a pit with short galleries being met within a very few feet."

The following is a list of specimens accompanying this report, which are illustrative of the produce of Kahan :—

No. 1.—A box containing about twenty-one viss of clean ore of the native peroxide of tin.

No. 2.—Specimens of various sizes, not selected for their richness, but shewing the mode of occurrence of the tin ore in small strings and bunches, imbedded in the matrix of decomposed granite; some of these consist of nearly pure kaolin or soft felspar: in others mica and quartz predominate.

No. 3.—Specimens of pure kaolin, from the upper part of the excavations at A and B.

No. 4.—Specimens of macled crystals of peroxide of tin or quartz taken from a pit D, between B and A: with this several similar and larger pieces were found in the loose soil at the bottom of what was apparently an old Burmese shaft, and though Mr. Corbin writes, on the 9th of August, that no more had been met with, it appears from the extreme richness of the specimens, to be a valuable indication of what may be found at greater depths than have been hitherto penetrated. They existed probably in a cavity of the granite mass, before it was disintegrated by atmospheric causes, and wherein the large crystals of quartz and tin were deposited.

8. Ore rich in tin has now been found at seven different parts of the hill, chiefly in the line B A C, but near A, at more than 100 feet to the east of this direction; and Mr. Blundell, who has just returned from Mergui, informs me, that Mr. Corbin is pursuing his excavations to the westward of this line towards the highest part of the hill, and that the farther they proceed in this direction, the richer the ore becomes. This is scarcely, therefore, the character of a vein of ore, but may be more properly termed a bed of decomposed granite, containing tin in great abundance, in small bunches and strings throughout.

9. The mode of occurrence of the ore here more nearly resembles that of Banca, than any of which I am informed. The matrix in which tin is found at the latter, is said to be somewhat harder than that of Kahan, and to require pounding or stamping before it can be separated effectually; but the situation of the ores are, I understand, very similar. Mr. O'Reilly, a gentleman now residing at Amherst, was permitted by the Dutch authorities a few years ago to visit the Banca mines, and has described to me, that the matrix and ore are there dug out of pits in the face of a hill not 300 feet high, and that after being pounded, it is brought within the action of a stream of water, which is led from wells and a small spring on the higher levels. No machinery is used, but the Chinese miners penetrate after a time to a bed of solid silex, where the tin is lost altogether. Mr. O'Reilly has seen the specimens and samples of tin from Kahan, and pronounces them fully equal to Banca tin, and that the grain has precisely the grey glittering appearance, when held to the light, by which the Chinese miners distinguish good ores.

10. In addition to the sample of eight cwt. of clean ore collected at Kahan, 176 viss, or more than five cwt. have peen received from near Yahmon, a conical and isolated hill in the Nunklai district, on the opposite or south side of the Tenasserim, and about a day's journey by water from Kahan, bearing south-south-east from Mergui, distant about twenty miles. The ore is found here as stream tin, in tidal creeks, about three miles from the hill, its colour darker than that of Kahan, being nearly black, which is caused by a mixture of Wolfram sand, or Tungstate of iron.

11. Of this locality, Mr. Corbin writes to Mr. Blundell on the 24th of April: "The following morning we proceeded from Kahan to "Yahmon in the Nonklai district, where we arrived at 5 P. M., it having "taken four and half hours hard pulling to get there from the Kywai "Kuran village, and examined one of the localities, (that which had "been worked during the Burmese Government); here the soil was "rich in ore. The next morning we visited another place in a differ-"ent Nullah, a short distance from the former, where also the tin ap-"peared to abound; but the Chinese objected to the two last spots, in "consequence of the want of a command of running water, for they "make a decided objection to wash out the soil by hand. Of the three

" places, they gave the preference to Kahan; one of their reasons in " favor of this was, its propinquity to the town and the main river, for " procuring their supplies. The tide flows to both of the Yahmon sites " where the Nullahs appear to terminate, and during the spring tides " the water recedes to a considerable distance from where I landed, " leaving the Nullahs dry at this season; their sides are muddy, but in " the middle is a small clear gravelly space in which tin ore is found. " The Chinamen say, this ore is precisely of the same description as " that of Kahan; but from the accounts of the natives, it always sold at " ten per cent. less."

This inferiority, which is marked by its selling price, is owing to the mixture of Wolfram sand, before mentioned, which, from being very nearly of the same specific gravity as tin, it is difficult to separate. It has likewise a strong sulphureous smell, and would require to be roasted before it is put in the smelting furnace. The presence of tungstate of iron with stream tin in the Mergui Province is very common; it has apparently an extensive distribution in some of the minor ranges near the sea, and becomes mixed with the tin in the beds of streams, after both are detached from their original sites. Nearly all the specimens of ore brought by Mr. Corbin last year from Malewan, on the Pakchan river, contain it in such abundance as would most likely interfere materially with the profitable working of tin in many of those localities. It was not present with the stream tin procured last year from the Thabawlick, the Thengdon, and other rivers east of the town of Tenasserim.

12. Two hundred viss of the Yahmon tin ore, in addition to what has been already mentioned, is expected by the next opportunity from Mergui; as well as a sample from the Thabawlick river, which I visited and reported on last year. Some Malays have been there collecting the ore, and have agreed to supply it at half the selling price of smelted tin, or about forty-five rupees per 100 viss.

An analysis of the Yahmon ore gave per cent.

Of Metallic Iron, ...	4.69
" Tungstic Acid, ...	29.46
" Sulphur, ...	1.37
Earthy residue and tin not examined....	64.48
	100.00

The Kahan ore gave on analysis 0.91 per cent. of metallic iron only, and is believed to be free from the tungstate of iron and sulphur.

13. No accurate statement can be made of the probable cost of obtaining the cleaned ore at Kahan from the outlay which has been lately incurred. Convicts alone, who were before quite unaccustomed to the work, have been employed, and for this labour no cost appears. Chinese labourers, who understand the process of washing and smelting are to be procured in any numbers, and many, who have heard that enquiries have been lately on foot concerning tin, have come already from Tacopah to Mergui in search of work. They arrive in poverty, and are glad to accept the wages of common coolies in plantation work, &c. till better employment is to be had. Advances of money for subsistence, and to enable them to make the requisite preparations for getting the ore, both in tools, wheel work, troughs, &c. are only necessary for commencing operations to any extent at Kahan, or at any of the most available sites of stream tin. The wages of Chinese miners in the peninsula are said to be from five to eight dollars per month; but they would be found ready to stipulate for the payment of their labour by a certain fixed proportion of the produce. At the Dutch mines, I am told they are remunerated by 40 per cent. of the actual produce, the remaining 60 being the clear profit and property of Government, which has been found at Banca and in the Straits to be the best mode of paying them. They are in mining operations, as well as in common labour, more skilful and industrious than any class in the East with which I am acquainted. By Rule 4th, concerning grants of waste forest and jungle land, published at Moulmain on 10th May 1841, a tax not exceeding 10 per cent. is leviable on the part of Government on the gross produce of mines worked within the limits of any grant.

The freight of tin from Mergui to Penang with the present craft, (China junks,) plying between the two places, would be two rupees four annas per 100 viss of 365 lbs. Freight from Penang to China by the Penang Price Current of April last, was 55 to 65 cents. per picul.

To Whampoa about 50 cents. more than to Lintin.

From Penang to Calcutta, eight annas to one rupee per picul.

„ „ „ to Bombay ten annas to one rupee ditto.

„ „ „ to London 1*l.* per ton of 20 cwt.

The freight of the metal from Mergui to London, via Penang, may be taken at 2*s.* 6*d.* per cwt.

14. The annual produce of the Banca mines was stated by Sir S. Raffles in 1827, to be 30,000 piculs, but owing to the substitution of late years of Chinese workmen throughout, to whom the mines are farmed, for the less productive labour of the natives, the out-turn has been since nearly doubled. Mr. O'Reilly informs me that in 1841, the actual produce was 54,000 piculs, but a considerable reduction in the amount obtained from the Malayan peninsula, south of Junk Ceylon, has taken place within this period, chiefly owing to dissensions amongst the petty chiefs on the East coast. In 1835, 34,600 piculs were assigned by Ensign Newbold as the annual produce of these states, but the total amount from thence may now, I understand, be estimated at about 22,000 piculs,—and from Banca

54,000

76,000 piculs, or 4523 tons.

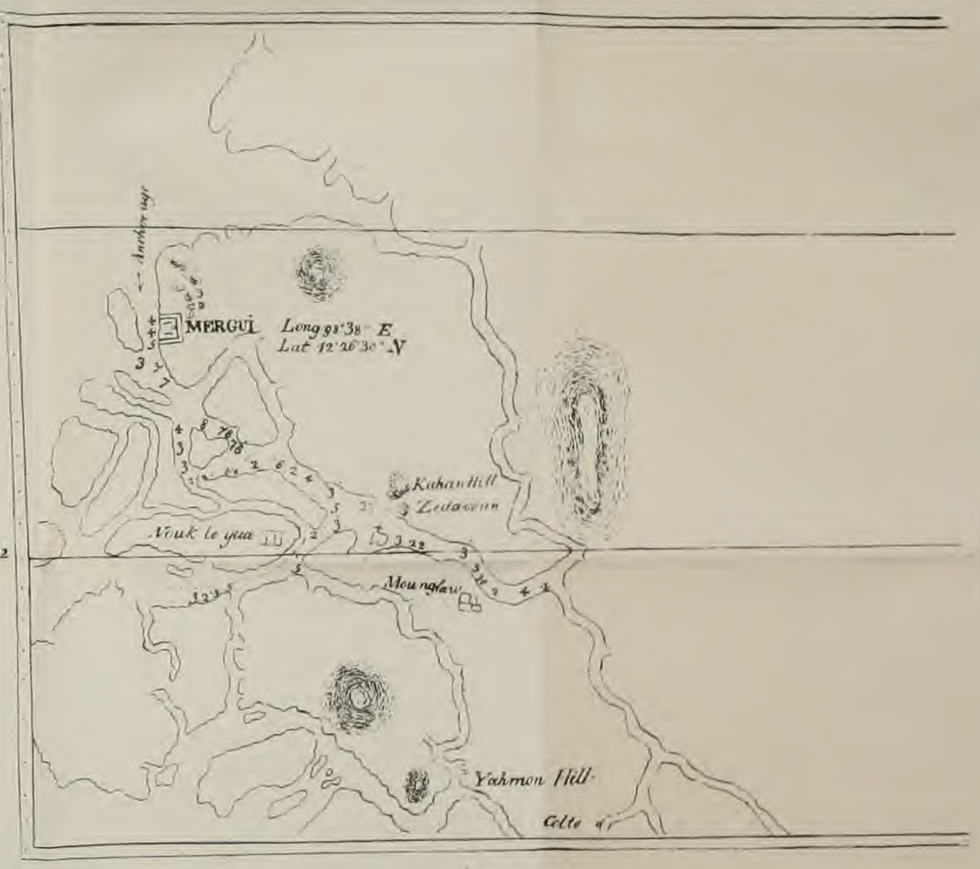
In this most extensive tin region, comprising the whole of the Malayan peninsula, the most extensive known repository of this metal, there is sufficient evidence collected that many convenient and valuable localities exist within the limits of our own territory. The northernmost point at which it is known in the Tenasserim Provinces is amongst the high ranges near Tavoy, where, in the Tounq-byouk valley, it has been seen by the Rev. Mr. Mason, and traces of former works observed above Kaboung and on the Talinq-guwa, twenty miles north of Tavoy. A specimen of very small grained tin from this locality has been recently brought from Tavoy by Mr. Blundell. It was washed out of alluvial soil, and stated to occur more plentifully, and sometimes in pieces at greater depths. The locality is said to be near granite hills, and from the occurrence of tin with the alluvial soils, it exists probably in great abundance in the hills themselves. To the northward of this I have not heard of it, but in Karreenee, the country of the red Kareans, on the Burmese side of the Salween river in 18 north latitude, the metal has been obtained by Captain Warwick from the natives, at the rate of about twenty-five rupees per 100 viss, who states, that a considerable quantity of tin is obtainable there at that cost by indirect barter for beads, broad cloth,

Plan of the Kahan hill near Mergui
Showing the position of the vein of Tin
and its probable direction **BAC.** *May 1842.*

W. — E.

S.

From Captain Lloyds Survey
Showing the relative situations of Mergui & Kahan
distant by the river 11 Miles S. E.



and coloured cottons. It appears by a good specimen of rolled tin stone in the possession of a native at Mergui, which Mr. Blundell has shewn me, that near the head of the Palouk river, about thirty miles north of Mergui, tin ore exists, and the specimen exhibits tin interspersed in a rock very much resembling the ore of the Cornish mines. The existence of tin in the Palouk river was known, and the late Dr. Helfer proceeded on one occasion to examine it, but owing to indisposition, was obliged to return without effecting his purpose. Between the neighbourhood of Mergui and the Pakchou river, our southern boundary, it also occurs at Bokpyeen, and in many streams near the coast, but has not been much sought for, as this part of the province is an uninterrupted jungle, with scarcely any inhabitants.

15. All the tin sites in the Mergui province are believed to be healthy. Kahan is situated on the bank of a large river, where it is more than a mile broad, and a few miles only from the sea, while the spot itself is open, and the level ground entirely free from jungle. The coal mine lately worked on the Tenasserim river, sixty-four miles from Mergui, is farther inland than any of the tin localities yet known, and the country around is clothed with jungle to the summits of the highest hills; the parties of convicts employed there from December 1840 to October 1841, were not subjected to any remarkable degree of sickness, if their daily employment at hard labour, and consequent exposure, is taken into consideration. The European overseers and mechanics under Lieut. Hutchinson were perfectly healthy, and the following Table represents the proportion per cent. of native convicts reported sick at Mergui for nineteen months successively, compared with the proportion at the coal mine during the same period.

	Proportions per cent. reported sick during the month at Mergui.	Proportions per cent. reported sick during the month in the Jungles.	Remarks.
April, 1840.	$10\frac{5}{17}$	$24\frac{4}{15}$ 1840.	The number of convicts from which these proportions were determined, varied at Mergui, from 136 to 230, and in the Jungles from 94 to 204.
May, ,,	20	$21\frac{123}{137}$,,	
June, ,,	$26\frac{6}{7}$	$27\frac{1}{137}$,,	
July, ,,	20	$24\frac{2}{3}$,,	
August, ,,	$15\frac{35}{61}$	$12\frac{16}{57}$,,	
September, ,,	$11\frac{1}{59}$	$27\frac{87}{89}$,,	
October, ,,	$11\frac{25}{31}$	$18\frac{1}{2}$,,	
November, ,,	$14\frac{11}{81}$	$28\frac{34}{97}$,,	
December, ,,	$16\frac{4}{37}$	$35\frac{75}{61}$,,	
January, 1841.	$6\frac{15}{74}$	$11\frac{167}{753}$ 1841	
February, ,,	$3\frac{59}{417}$	$16\frac{1}{2}$,,	
March, ,,	$9\frac{43}{73}$	$16\frac{16}{49}$,,	
April, ,,	$7\frac{27}{39}$	$26\frac{182}{192}$,,	
May, ,,	$8\frac{13}{39}$	20 ,,	
June, ,,	$14\frac{21}{147}$	$27\frac{6}{47}$,,	
July, ,,	$7\frac{39}{73}$	$9\frac{99}{189}$,,	
August, ,,	$9\frac{3}{8}$	$16\frac{8}{37}$,,	
September, ,,	$13\frac{53}{219}$	$8\frac{76}{103}$,,	
October, ,,	$8\frac{16}{33}$	$6\frac{18}{47}$,,	

The receipts of tin ore up to this date are,

From Kahan, corresponding with sample, No. 1.

"	despatched from Mergui, 15th June	80	viss
"	ditto ditto 18th July	177	,,
"	ditto from Mergui 17th Augt.	118	,,
	Total, ...	375	viss or 12 cwt. 24lb.

From Yahmon, corresponding with sample, No. 2

"	despatched from Mergui 18th July	166	viss or 5 cwt. 15lb
	Total from both places, ...	541	viss or 17 cwt. 69lb

MOULMEIN,
27*th August*, 1842.

(Signed) G. B. TREMENHEERE,
Capt. Bengal Engr. Ex. Engr. Ten. Div.

(True copies,) H. V. BAYLEY,
Depy. Secy. to the Govt. of Bengal.

We have lost no time in giving this valuable report and its plan to the public, and we should add here, that the specimens have been divided; a part having been sent home to the Hon'ble the Court of Directors, and a part retained for the Museum of Economic Geology.—ED.

Notes on the Iron of the Kasia Hills, for the Museum of Economic Geology. By Lieutenant Yule, *Engineers.*

We have had much pleasure in giving with this valuable article, (not the last we trust that the Museum will be favoured with from Lieutenant Yule,) the spirited sketch, No. I. which accompanied it, but No. II. was found to be exactly similar to that accompanying Mr. Cracroft's paper on the smelting of the Iron Ores of the Kasia Hills, in Journal As. Soc. Vol. I. p. 150, and being rather graphic than of manufacturing utility, we take the liberty of referring our readers to that volume.—Ed.

These notes are very imperfect, but having no prospect of opportunity to render them more complete, I am unwilling to withhold them, such as they are.

I believe iron ore is excavated at intervals throughout this great range of hills by all the various races who inhabit them, Garrows, Kassias, and Nagas, of many tribes.

The district in which these notes were taken, includes the large villages of Nongkrem and Moliem, near the banks of the Ka-umyam, or Boya Pani, about eighteen miles north of Cherra, and for a space five or six miles in length from east to west by two in breadth, exhibits old or new excavations in every hill-side. So marked an effect have these works achieved on the undulating hills which cover the country, that in many instances what must once have been like their neighbours, round, swelling knolls, appear to have collapsed and sunk to their skeletons, shewing nothing but fantastic piles of naked boulders; the earth which once bound and covered them, having been entirely washed out by the heavy rains following in the track of the miner. So numerous and extensive are the traces of former excavations, that judging by the number at present in progress, one may guess them to have occupied the population for twenty centuries. The mines are so similar, that the description of one will sufficiently apply to all. It presents to view a semi-circular broken slope of debris and boulder, on the hill side, exactly such as is described by the word *scar* used in the north country at home. A small stream of water is conducted along the slope to the site of the present

See Sketch A.

See ditto, b.

excavation. The excavators standing on one side of their work, poke out the soil from between the boulders with long poles terminating in iron spikes. The loosened soil tumbles into the stream, and is carried by it violently down a narrow channel to a point 200 yards distant, and about eighty feet perpendicularly below. Here a little post is fixed at each side of the stream, and against the upper side of these posts, little bits of stick are laid, so as to form a kind of dam, which stops the heavy particles of iron, whilst the lighter grains of soil are carried off by the rapid stream bounding over the obstacle. As the iron accumulates, sticks are added to heighten the dam, and when this is nearly as high as the bank, (about one foot), the ore, a fine black sand is taken out, the dam lowered, and the process repeated. Above the dam a man is constantly employed in turning up the channel of the stream with a hoe, to prevent the ore from sticking in the passage, and with a long hooked fork (F), he occasionally takes out any pieces of stone brought down by the current.

See Sketch C.

See ditto D. D.

See ditto e.

The ore is now removed to the washing trough, which is supplied with water by a small branch of the upper stream. The washing is performed by two women, working the ore against the stream with their feet, and occasionally turning and mixing it with a hoe. It is then put in a heap to dry, and washed again. This washing I was told is repeated four times.

See ditto G.

The ore is then carried to the smelting house. The charcoal used (at Nongkrem) is of all sorts. The best is said to be that made from a small species of oak common near the Boga Pani, and from a tree called by the Kasias *dingsai*, bearing an acorn, but the leaves of which do not resemble the oak. The fir is used, because it grows at the door, but it is not approved of.

The bellows are double; formed of two-half cylinders of cowskin, and worked by a man or woman, with a leg on each swaying from foot to foot. Sometimes this employs two, as in the sketch, where the good man and his wife are at work. The furnace is about twenty inches in diameter; and the chimney about five feet high, made of clay bound with iron hoops. In the village of Sorra Rim, the chimneys

are made of a fine white clay, a quantity of which was furnished to Dr. O'Shaughnessy for his experiments in Pottery.

The iron sand is wetted and placed on a shelf. At short intervals a handful of fern leaves is dipped into the sand, and shoved into the furnace, and charcoal to replenish the fire is poured down the chimney. In some villages, instead of using the fern, as above described, the ore is mixed with pounded charcoal and placed on the shelf. The person who works the bellows, at almost every other sway of his body takes up a pinch of the mixture, with a long handled spoon, and drops it into the chimney.

After an interval (which from the equal size of the masses, must be very regular, though judged by guess,) one of the workmen stirs up the mass with the poker (M), takes it out with the tongs (N), lays it on a block covered with earth, beats it with a wooden club into a sort of hemisphere, and then splits it nearly in twain with axe (O), which like most other Kasia cutting and digging tools, has a heavy-headed handle and a very acute angle. He opens the split further by the insertion of a couple of wedges, and then pitches the hot mass (P) into a trough full of pounded dross, to cool. The metal, impure as it is, is now sent to market all over the hills, and to the plains of Sylhet. The loss of iron purchased in this form is at least three parts in four. Heating in the furnace and hammering, form the only further process of purification.

The Kasia tools appear generally to be of impure iron, though their edges are often good and serviceable, being formed of steel, and welded to the rough blade. The Nagas to the eastward, though said to be much more savage in their habits than the Kasias, appear (judging from their weapons of war) to have much more skill in refining iron. The excavation is only carried on in the height of the rains, as the streams employed in their plan of washing the iron are only then full. Perhaps one year's excavation occupies only twenty days! and it may be still fewer, as the rain in that district does not come near the Cherra mark of thirty inches in twenty-four hours. From four to ten rupees annual rent is paid for a mine, where the proprietor is not the excavator. The men employed as miners receive four annas a day, and will excavate in twenty days in a good mine, the value of twenty five or thirty rupees each. Thus the statement of expense and profit in a good mine for a season of twenty days, will be as follows:—

Expenditure.

3 Men, (excavators,) at four annas for twenty days,	Rs. 15	0	0
2 Women, (washers,) at one and half do. for thirty days,	5	10	0
2 Lads employed in clearing the channel, and watching the dam D. at two annas for twenty days, ...	5	0	0
Rent, ...	10	0	0
	35	10	0

Profit.

The work of three men, averaging a value of twenty-seven rupees each, ...	81	0	0
Deduct, ...	35	10	0
Profit annually, ...	45	6	0

The ore when washed is sold for smelting by the basket, one rupee for seven baskets, or about three maunds.

After smelting, as above described, it is generally sold in the hills by the score of pieces. At Mongkrem one rupee, or one rupee two annas a score. About a dozen of these pieces go to the maund, and at the Pundua bazar, at the foot of the hills, they sell by weight at one rupee four annas a maund. Fourteen or fifteen of these pieces are made in one furnace in a day's work, or where the work is carried on day and night, as is common in some places, from twenty-four to twenty-five in the twenty-four hours. Specimen No. 6 shews the iron in this state. It is also sold in pigs, such as specimen No. 10, at three rupees four annas to three rupees eight annas in the Cherra bazar. Of this the smiths tell me, there will be a further waste of ten or fifteen seers in the maund.

List of Specimens forwarded.

No. 1. Decomposed rock containing the ore.
No. 2. Ditto in a more solid state.
No. 3. Boulders in the ground excavated.
No. 4. Ore partially washed.
No. 5. Ditto ready for the furnace.
No. 6. Metal after smelting as sent to market (half a piece.)

A

b

b

b

e

b

D

G

N

C

7 feet long

3 feet long.

O

P

M

F

6 feet long

D

Sketches to
illustrate notes on the
Iron of the Kasia Hills

Drawn by Lt Yule B.E.

No. 7, 8. Slags from the smelting.

No. 9. Dross detached by beating with wooden club.

No. 10. Metal as sold in pigs at three rupees eight annas a maund.

No. 11. Metal further refined.

No. 12. Is a specimen of slate found about twenty miles from Cherra near the Assam road. I should be glad to know any particulars of the proper mode of working and splitting slate,* and whether it is usually of better quality below the surface. This (found at the surface) does not split into plates sufficiently thin, nor sufficiently parallel.

There is, I am told, an account of the iron works in these hills by Mr. Cracroft, in an old number of the Asiatic Society's Journal. Not having access to the former volumes of the Journal, I cannot tell whether it is such as to render these notes superfluous.

Cherra Poonjee, 21st September 1842.

* This was duly sent.—H. P.

Note by the Curator Museum of Economic Geology.—The granite has nothing remarkable about it, and the iron sand is so minutely dispersed, that it can only be traced at times by a commencement of oxidation. The boulders are of silex.

The ore is composed of minute amorphous grains of the common iron sand, remarkably equal in size, and amongst which all traces of crystallisation have almost disappeared, for it is rare to detect any thing approaching to even an imperfect crystal. Upon digesting some of the slags with muriatic acid, I find that they contain sulphuret of iron (which accounts perhaps for the inferior quality of the metal) but no titanium was detected. Minute specks of the sulphuret resembling gold-coloured mica are visible on close examination in the granite.—H. P.

Captain Thos. Hutton *on* Galeodes *(vorax ?)*

In the 52d and 53d Numbers of the Annals and Magazine of Natural History, are two letters from Messrs. W. S. Macleay and W. E. Shuckard, relating to the occasional capture of small birds by certain species of Arachnidæ; and as the subject is one of some interest, I take the liberty of presenting you with a note long since made by me, on the habits of a large species of Galeodes, common to some parts of India, and for which, if undescribed, I would propose the name of "Galeodes *vorax*."

My first observations on this species were made in 1832 at Mirzapore, where it is very abundant, and of large size. During the rainy season, it was my constant habit on a fine evening, to spread a sheet upon the ground near my house, upon which was placed a small lantern to attract insects.

In a very short time, two or three of these ravenous spiders would make their appearance at the edge of the sheet, but at a respectful distance from each other, and no sooner did a moth, or a beetle, or a cricket alight upon it, than it was snapped up and devoured before I could lay hold of it. There seemed indeed to be no end to the appetite of these creatures, for they continued to seize and devour every thing indiscriminately, that came within their reach, even to large and hard winged beetles, cutting them to pieces with their powerful jaws with the greatest ease. Many were the deadly fights I witnessed among these marauders, as they trespassed upon each other's beats to get possession of some newly alighted prey, and often was I obliged to kill them, in order that I too might in turn obtain some share of the booty. This species is, strictly speaking, nocturnal, though I have sometimes seen them active in the day time; they live beneath stones and in holes in the ground, and never construct a net or other trap for their prey, seizing every thing by main force, as they roam about in search of food.

Again I fell in with this species abundantly at Neemuch, where they were also sometimes of large size. One of these I kept for some time in a vessel, the bottom of which was well supplied with earth, which had been purposely hardened by pouring water on it and then allowing it to dry.

The Galeodes soon began to dig a hole, and in a very short time succeeded in making itself a subterranean retreat, in which it usually resided, seldom coming forth beyond the mouth of its den. It proceeded to dig out the earth at first with its strong jaws, cutting it away in a circle, and having thus loosened the soil, it gathered it together into a heap with its anterior palpi and threw it out behind, as a dog does in scratching a hole. When it had by this means succeeded in excavating a hole sufficiently large for it to enter, instead of throwing out the loose earth as at first, it gathered a quantity together, and surrounding or embracing it with the anterior palpi, shoved the load

by main force before it up the mouth of the cave, and then returned for more. Having completed its task, it remained for a few days stationary and refused to feed, although previously it would devour several insects at a meal, and even small house lizards. I now perceived that it was a female, the ova being distinctly visible through the skin of the abdomen, which was much distended.

The ova were deposited in the cave, to the number of more than fifty (50,) the parent remaining motionless amidst them. In the course of a fortnight, these, which were of the size of a largish mustard seed, and of whitish hue, were all hatched.

The young are at first motionless, and appear devoid of animation until the period of three weeks has elapsed, at which time they cast the first skin. Their colour, which up to this time was pure milky white, now gave place to a faint tinge of pale brown, and the jaws and palpi became deep brown.

The young ones now threw off their lethargy, and began to move about and occasionally sallied forth from the den, but instantly retreated on the slightest appearance of danger. All this time, however, they took, apparently, no food whatever, and yet they continued to grow both in size and activity.

It was indeed very interesting to watch the motions of the parent at this season. From the general bad and ferocious character which the spider tribe bears, I fully expected to see the parent, at the first craving of appetite, commence an attack upon her own family, and devour them; but the all-wise Creator has endowed even this ferocious spider with that most powerful feeling—maternal love; and thus is the Galeodes, the very tiger of the insect world, subdued at this period into the anxious and tender mother. Placing herself in front of the aperture of the cave, she seized and examined between her anterior palpi, every thing that entered. I tried repeatedly to arouse her anger by thrusting in straws, hoping to make her forget her good behaviour, but all in vain, for though she bit and pulled at the straws in evident anger, not once did she turn upon her offspring, although crowding round and crawling over her very body. I then threw in some beetles and flies, upon which she vented her fury by speedily devouring them, and I thought by this means to play her a trick. Accordingly, I withdrew two or three of the young ones from the cave, and threw in alter-

nately a beetle and a young Galeodes, thinking to deceive the parent, and make her in the blindness of her fury, *commit infanticide.* But nature was not to be thus deceived; the unfortunate beetles were instantly seized and devoured, but the mother knew her offspring, and drew them into the den without the slightest injury; the beetles were gathered into her jaws, but her own offspring were merely seized between the anterior palpi, and allowed to pass on unhurt.

This whole family, much to my regret, effected their escape from the vessel in which I kept them, which being of glass and deep-sided, I thought sufficiently secure, and therefore left uncovered.

The Galeodes, however, being furnished with a *retractile sucker* at the ends of the anterior palpi, had contrived to crawl up the side of the glass, and make their escape. I succeeded more than a month afterwards in recapturing the old one in the same room, but her offspring I never again saw.

This species is extremely voracious, feeding at night upon beetles, flies, and even large lizards, and sometimes gorging itself to such a degree, as to render it almost unable to move.

A lizard three inches long, *exclusive of tail,* was entirely devoured; the spider sprung at it, and made a seizure immediately behind the shoulder, never quitting its hold until the whole was consumed. The poor lizard struggled violently at first, rolling over and over in its agony, but the spider kept firm hold, and gradually sawed away with its double jaws into the very entrails of its victim. The only parts uneaten were the jaws and part of the skin, although the lizard was at least five inches long from nose to extremity of tail. After this meal, the spider remained gorged and motionless for about a fortnight, being much swollen and distended.

A young sparrow, about half grown, was placed under a bell glass with a Galeodes; the moment the luckless bird moved, the spider seized him by the thigh, which he speedily sawed off, in spite of the sparrow's fluttering, and then as the poor bird continued to struggle in pain, the savage seized him by the throat, and soon put an end to his sufferings by cutting off the head. It *did not, however, devour the bird nor any part of it,* but seemed satisfied with having killed it.

On another occasion, I gave it a large garden lizard, which was instantly seized by the middle of the body; the lizard finding that

it could not shake off its adversary, turned its head and bit the Galeodes on one leg, which obliged it immediately to quit its hold and retreat; this was owing to the seizure having been made too low down on the body, for in general the Galeodes seizes as close behind the shoulder as can be, in order to put it out of the victim's power to turn and bite; the lizard was allowed to escape with only a severe wound in the side, but as it lived for some days before I allowed it to run off, the bite of the Galeodes would not appear to be poisonous.

On another occasion, my friend Dr. Baddeley confined one of these spiders in a wall-shade with two young musk rats, (Sorex Indicus), both of which were killed by it.

When two of these spiders are confined in a vessel together, both endeavour to make their escape, as if conscious of their mutual danger. If in their efforts to get away they are brought into contact, the one instantly seizes the other and devours him, the victim making no struggles whatever; but if they meet face to face, both enter into a wrestling match for life or death.

They plant their true feet firmly on the ground, the body at the same time being elevated, and the two pairs of palpi held out in front to ward off the attack. In this attitude they advance and retire, according as either gains a slight advantage, endeavouring to throw each other to one side, so as to expose some vulnerable part, or form an opening for attack, and when this is once effected, the fortunate wrestler instantly takes advantage of it, and rushing in, seizes his adversary behind the thorax, and the combat is ended; the vanquished victim yielding himself without further struggle to his inevitable fate.

The same species occurs in the Bhawulpore country, from whence I obtained it when constructing the road for the advance of the Army of the Indus in 1838. It is also abundant in Afghanistan, where in all probability it is the species mistaken by Elphinstone for the *Tarantula*, which he describes as common in that country, but which I neither saw nor heard of.

The usual size of an adult specimen of "Galeodes (vorax",) *mihi*, is about $2\frac{1}{2}$ to $2\frac{3}{4}$ inches long, and the body or abdomen equal to a thrush's egg. When in motion, the body is elevated off the ground, and the two pairs of palpi or feelers are stretched out ready to make a seizure; it progresses therefore solely upon the true legs, which

spring from the thorax, and are six in number. The head is armed with two strong and formidable chelæ, or double jaws, answering to the long cheliform fore-arms of the scorpion; these jaws are denticulate, and the ends are curved, sharp pointed, and extremely hard and horny, of a dark brown colour. Eyes two, and placed on the top of the head between the base of the jaws; the colour generally is sandy brown, and the body soft and clothed with short mouse-coloured hairs; the limbs, and especially the palpi, are furnished with long coarse hairs; beneath these are ten obtriangular plates springing from the under side of the thigh or coxæ of the posterior legs, five on each, the inner one being smallest, the outer one largest; these are of an obtriangular form, and their use appears to be still unknown. I never saw them used to assist progression in any way.

The true legs are furnished at the end with strong hooks or claws, but the two pairs of pedi-palpi are destitute of them, the anterior pair being the largest and strongest, and furnished at the end with a white retractile sucker; this in a state of rest is withdrawn into the last joint of the palpi, and it appears to be used to assist in climbing up surfaces, or in hanging against gravity, in the same way that flies and lizards use their feet, by the exclusion of air. In seizing its prey, one pair of jaws keeps hold, while the other is advanced to cut, and they thus alternately advance and hold till the victim is sawed in two; the only sound they emit is a hissing or rustling, caused by the friction of the two pairs of chelæ, as they are advanced and withdrawn; this is only heard when the spider is suddenly disturbed or irritated.

From the tenor of Mr. W. S. Macleay's remarks upon *Mygale* and the large species of *Epeira*, which he has discovered in the vicinity of Sydney, it would appear, that although these spiders may occasionally feed upon the juices of warm-blooded animals, which accident may throw in their way, yet that their natural food consists of insects, and the fact of their killing birds at all, must be regarded as a very rare exception to the general rule of their habits; and from the above remarks on Galeodes, it will be seen that the habits of this spider in some measure corroborate Mr. Macleay's opinion, for although strictly speaking, the proper food of Galeodes consists of insects, yet when accident throws a lizard in its way, it will not fail to seize and devour it. With regard however to its preying at all upon warm-blooded ani-

mals, we have as yet no testimony whatever, for in the experiments above cited it will be observed, that although the sparrow and musk rats were easily killed by the spider, yet that it fed upon neither of them.*

Mussoorree, 21st June, 1842.

* Should this paper meet the eye of Mr. Macleay, I may add, that I shall be happy to do my best in determining the habits and economy of any species found in my neighbourhood, if he will kindly point out his wants and wishes, and I shall likewise be happy to assist him with duplicates from my own collection. I would likewise gladly effect exchanges with any one collecting in the Islands, or on the Continent of India.

Proceedings of the Asiatic Society.

(Friday Evening, 12th August, 1842.)

The Hon'ble H. T. Prinsep, President, in the Chair.

The following Gentlemen proposed as Members were unanimously elected ; viz.

Captain R. Shortrede, Assistant Surveyor Grand Trigonometrical Survey.

Brevet Captain W. J. E. Boys, 6th Regt. Light Cavalry.

R. Houston, Esq. C. S.

Ordered—That the usual communication of their election be made to the parties, and that they be furnished with the rules of the Society for their guidance.

Messrs. J. Mackenzie, and A. S. Gladstone were proposed as Members of the Society by the Hon'ble the President, seconded by the Secretary.

Library.

The following Books were presented.

Books received for the Meeting on the 13th August, 1842.

The Calcutta Literary Gleaner. Calcutta, August 1842. Vol. I, No. 4, from the Editor.

The Calcutta Christian Observer. August 1842. New Series, Vol. III, No. 32. Presented.

Abstract of the Proceedings of a Committee for the investigation of the Coal and Mineral Resources of India. Calcutta, April 1842. Two copies, from Government.

Reports on projected Canals in the Dehli Territory, Allahabad. From Government.

Sixth report of the Egyptian Society, 1842, pamphlet. From the Society.

Laws and Regulations of the Egyptian Society, pamphlet. From the Society.

The Annals and Magazine of Natural History, Vol. VIII. No. 53, Vol. IX, No. 56. Purchased.

History of British Birds, by W. Yarrell. London, 1842, part 30. Purchased.

The Secretary submitted the proceedings of the Royal Society of Agriculture and of Commerce of Caen, received by the Mail.

Ordered—That the thanks of the Society be communicated for the same.

Read the following letter from Mr. Piddington.

To H. Torrens, Esq.

Secretary, Asiatic Society.

Sir,—Having examined attentively the five books of Dr. Voysey's Notes, I beg to report, that there is in them much geological information of the very highest interest, for they principally relate to that stupendous geological phænomenon, the great trap and granite formation of Central India.

I have further to bring to your notice, that from a fragment of a report amongst the papers, it would appear that there must have been reports made by him to Government (the Supreme Government of India), from 1819 to 1824, apparently, at least, once a year.

I beg to suggest then that, as doubtless containing much matter of value, an application be made to Government for permission to examine and publish such parts of them as may be of general utility.

I am, Sir,

Museum, 19*th July*, 1842. Your obedient servant.

H. Piddington,

Curator, Museum Economic Geology.

P.S.—I should perhaps remark here, that there are two *special* reports published in the Journal of the Asiatic Society for 1833; but these do not appear to me to be Dr. Voysey's official summaries of his annual labours, and from the fragment above alluded to, more I think must be found.

The Secretary, reported that the foregoing letter was, agreeably to the directions of the President, submitted to the Government, with a request that its Records may be searched for the highly valuable documents therein alluded to.

Read summary description of two new species of Flying Squirrels and of an Eagle, by H. B. Hodgson Esq. with observations by Mr. Blyth, Curator.

Referred to the Secretary for publication in his Journal.

Read a letter from Capt. W. E. Hay, of the 1st European Light Infantry Regiment, noticing amongst other matters, that he had been the means of bringing before the public a number of new Coins, which Lieutenant Cunningham would notice in his forthcoming work on the successors of Alexander the Great. In some instances circumstances had demanded his permitting them to pass into other hands,

which although a matter of regret, yet he still fortunately possessed a few that were supposed to be unique, and of great value.

Read letter from J. H. Batten Esq. of 10th July last, forwarding continuation of Major Manson's valuable Journal, with Lieutenant Weller's Notes, and promising by next opportunity, the Journal by Lieutenant Weller, of the country beyond Oonta Dhoora, at the same time proposing Brevet Captain Boys, 6th Cavalry, (with his consent,) as a member of the Society.

Captain Boys was accordingly proposed in due form as a Member of the Asiatic Society, and the Journal referred to by Mr. Batten made over to the Secretary for publication in his Journal.

Read letter from Reverend J. H. Pratt, of 11th August 1842, on the brass Astrolabe from Herat, presented to the Society by Major E. Pottinger, also made over to the Secretary for the Journal.

Read the following report from the Curator for the month of July, 1842 :—

Sir,—The most interesting recent accessions to our collection of vertebrated animals pertain to an important class, that of Reptiles, which hitherto I have been too much otherwise occupied to investigate except casually.

From Dr. Strong, we have been favored with a fine specimen, but just dead, of *Chelonia midas;* the Edible or Green Turtle, which has been mounted. It may be as well to remark, that this was not captured in the neighbouring Bay.

Having intimated a wish, not long ago, to possess some of the so called "Iguanas" that inhabit the tanks of the Botanic Garden, the Society has accordingly been kindly favoured by Mr. DeCruz, of that establishment, with three fine specimens, which have proved to be of as many different species. These it may be useful to Indian students of Natural History to describe.

1. *Varanus Bengalensis*, Dumeril and Bibron, in whose excellent 'Histoire des Reptiles', III, 480, will be found its synonymes. Length of the specimen (a female) forty-one inches, of which the tail measures twenty-four inches: head, to auditory orifice, three inches; to anterior margin of eye an inch and three-quarters; and the nostrils oblique, and situate half-way between the eye and tip of muzzle: entire length of fore-limb to end of middle claw five inches and three-quarters, and of hind limb, to end of claw of longest toe, seven inches and a half; the toes well developed, and claws, especially the anterior, very large and strong.* The head is covered with minute polygonal plates, nearly uniform in size, and the superorbital bone projects far over the eye: the nape is studded with scales of a rounded oval form, very much bulged, and each appearing like a nail set at the extremity of a digit; on the back this unguicular appearance is more strongly marked, the nail-like part being smaller,

* A very fine and bulky male, since procured in the same quarter, measured fifty-five inches in total length, of which the tail was thirty-one inches ; from muzzle to auditory orifice three inches and a half ; and length of hind-limb, to tip of the claw of longest toe, nine inches and a quarter: colouring exactly as in that above described.

and the scales flatter: on the fore-limbs anteriorly, the scales form hexagons, and are larger than elsewhere: the tail is clad with transverse series of oblong subquadrangular scales, those of its sides a little carinated, and the inferior scarcely exceeding them in size; along the ridge of the tail is a double serrated crest of laterally triangular scales, more strongly developed than in either of the following species: the under surface of the neck, breast, and inside of the limbs, are clad with rounded oval scales, and the belly with transverse series of others having an elongate subquadrangular form. The colour of this specimen is greenish olive-brown on the upper parts, very prettily and uniformly marbled with meandering lines of black scales, this black being nearly as broad as the intervals of ground-colour left between its courses: the head inclines to yellowish green, and has the black markings large and bolder; and the extremity of the tail is similar in hue, having the markings gradually fewer till they disappear: the under-parts are whitish, deeply tinged with yellowish-green on the neck, which is marbled as on the upper-parts, only that the lines are broken or not continuous; and the breast and belly are merely spotted with black, though the whitish scales are also minutely freckled with the same, the markings on the under surface of the tail being less defined. A constant character of this species is to have a black streak proceeding backward from the eye, which is broader and more developed than in the following species; and the toes have each a distinct yellow streak along their upper surface. Of various young *Varani* which we possess in spirits, there is only one which I incline to refer, with some hesitation, to the present species, the principal objection being that its claws do not appear to be proportionally large enough: the situation of the nostrils and proportion of the superorbital bones are, however, the same, and I can perceive no characteristic difference in the scaling; but the markings are more different, appearing on the upper parts of this one as irregular transverse series of pale yellowish-olive spots—each occupying three or four scales—on a dusky ground-tint, while beneath the colour is almost uniform yellowish, having transverse narrow dusky streaks on the throat and neck, and others extending downwards from the sides, but interrupted along the middle, where are only a few scattered specks; the under surface of the tail being altogether without markings.

2. *V. Picquotii*, Dumeril and Bibron. The specimen sent of this reptile, measures thirty-two inches in length, of which the tail is seventeen inches, being deficient of about an inch and a half of its extremity; from muzzle to orifice of ear is two inches and a half, and the nostrils are only half an inch distant from the former, being placed considerably more forward than in the preceding species; length of fore-limb to end of middle claw four inches and three-quarters, and of hind-limb to end of longest claw five inches and a quarter, the toes being comparatively very short, and the claws, especially the posterior, small for a *Varanus*. The head is covered with small polygonal plates, and the scales of the body are considerably larger than in either of the others, their form an elongate oval and much carinated, but becoming circular towards the occiput, where especially they are much larger than in the preceding species. The tail is more compressed towards its base than in *V. Bengalensis*, and also less attenuated or drawn out at the tip; the double serrature of its upper ridge is less strongly marked, and its scales are smaller and much narrower or more elongate, being also but little larger on its under surface than on the sides: those on the under part of the neck are nearly circular, becoming more oval towards and

upon the breast, while those of the belly are of the usual oblong-quadrangulate form. The general colour is yellowish olive-green above, irregularly banded with reddish-brown having dusky margins, which latter throw out lines across the greenish, so as to separate this into large round spots; these markings, however, are not very strikingly conspicuous: the tail is barred with successive pairs of transverse dusky bands, enclosing somewhat rufous brown interspaces; and the under-parts are pale and spotless, inclining much to yellowish-green on the belly, and having a few very faint dusky bars across the neck: above, the neck is uniform-brown, and the crown darker; there is a narrow streak of blackish behind each eye; the fore-limbs are sulphur-yellow, and the hinder coloured like the back and tail. Of several young which we possess in spirits, the largest measures nineteen inches, of which the tail is ten inches and a half; general colour similar to the last, but much paler, and legs green (the latter, however, may have faded), the dusky cross-bands underneath the neck are more distinct, the head and neck above are very pale, and the darker colour—though less deep than in the preceding—is more predominant on the back, so as to leave only a series of irregular whitish cross-bands. Another ten inches and three-quarters long, with the tail five inches and a half, is intermediate in its markings to the two preceding, but much darker than either; the cross-bars beneath its neck are very distinct, and there are others descending from the sides of the body, but interrupted along the middle of the under-parts, which lines are considerably less distinct in the last specimen, and but just visible in the large one. Still smaller examples, but six inches and three-quarters long, of which the tail measures three inches and a half, are more like the large one, but differ in having their markings well brought out and brightly contrasted: one has alternate broad and narrow cross-bands of pale greenish more or less divided into spots; and another has the same kind of bands less regular, both these having also the nape pale greenish, and banded with dusky-brown, which is broadest at the median line. It is clear that the particular markings of each individual specimen are permanent for life, as regards disposition, but become gradually indistinct, and more or less effaced, with age; the dark, which at first appear of uniform tint changing to brown where broad, leaving dusky edgings only; while different specimens vary at all ages considerably from each other, and are pale or dark, very probably according to the soil on which they inhabit.*

The *V. Picquotii* is remarkable for its comparatively short toes and small claws, and for the strong yellowish tinge which prevails more or less on its olive-green ground-tint. M. M. Dumeril and Bibron remark that they have every reason to believe that the *Monitor flavescens* figured by Hardwicke and Gray represents this species, although the scales are not shewn to be carinated, which, however, may have been an omission of the draughtsman; and accordingly they have included that denomination as a synonym, but without stating that the name *Picquotii* had been published prior to that of *flavescens*, which latter appears in the 'Zoological Journal,' III, 225. There certainly can be no doubt of the correctness of this identification.

3. *V. binotatus*, Dumeril and Bibron. The example sent of this species measures four feet and a quarter in length, of which the tail is thirty-one inches, thus exceed-

* I have since obtained other adults of this species, but none so large as that of which the dimensions are above given. They vary considerably in their markings, and in some the rufous brown colour predominates over the usually prevailing olive-green. In all the tribe, the colours of the living animal are much brought out by putting it into water.

ing, by more than half, the aggregate of the head, neck, and body: the head measures nearly four inches to auditory orifice, and two inches from eye to muzzle, the anterior margin of the nostrils being within half an inch of the tip of the latter: length of fore-limb to end of middle claw seven inches, and of hinder to end of longest claw nine inches; the toes well developed, and furnished with large claws, though inferior in size to those of *V. Bengalensis.** The head of this species is much more elongated than in either of the others, and has a curvilinear series of eight broad transverse scales above each orbit, conspicuously developed, while in the others the corresponding plates must be sought for to be observed: the auditory orifice is broad and open. The scales of the upper parts resemble those of the last species in form, being oval and much carinated, but their size is much smaller, especially upon the nape and towards the occiput; on the sides of the tail they are small and oblong-quadrangulate, and on the under surface of the tail they are very much larger, a particular in which this species differs from both the preceding: they are of an oval shape upon the throat, breast, and inside of the limbs, inclining to circular on the latter; and upon the belly they nearly resemble those of the under surface of the tail. This fine specimen has black scales with whitish intervals on the upper parts, and is banded across the body with several distant rows of white rings; immediately behind the scapulars the first of these rows is less distinct, forming merely an obscure broad whitish band, anterior to which a broad longitudinal black streak proceeds backward from above each fore-limb, surmounted by a whitish one, not conspicuously developed in this specimen, but which is usually well marked, and from it is derived the specific name which the reptile bears; the anterior limbs have a white spot on each scale, in addition to which the hind-limbs have scattered wholly white scales, imparting a speckled appearance: the under-parts are dull white, with incipient dark stripes from the sides of the body, and the throat and under surface of the neck are speckled with black, having besides a series of V-like cross-streaks pointing forwards; tail minutely mottled black and whitish, with broad bars of the former, indistinct for the basal two-thirds, and the rest successively blacker to the end. Another specimen, of similar size, which we possess as a skin, differs only in having no markings underneath the neck, the black bands are less distinct on the tail, and the transverse rows of pale rings on the body less conspicuous: in this the lateral pale shoulder-streaks are but just visible, and varieties of this species have been met with altogether black. We do not possess examples of the young.

I kept the specimen of *V. binotatus* here described alive for some days, chained to a tree, which occasioned me to notice that it climbed the trunk with facility, and I also observed that its regular mode of defending itself was by slapping smartly with the tail, for which purpose it turned itself with the tail towards any one who annoyed it: but I make no doubt that, like other lizards, it would also bite if it had the opportunity, when the compressive force of its jaws would render its small teeth of some efficacy as a weapon.

A fourth Indian species of this genus already described, and which is common to Bengal, Siam, and the Malay countries, is the *V. nebulosus* of M. M. Dumeril

* The larger of two specimens since obtained, measured sixty-one inches in total length, of which the tail occupied thirty-four inches; from muzzle to auditory orifice four inches and a half; and length of hind-limb, to the tip of claw of longest toe, ten inches and three-quarters.

and Bibron; being stated to be one of those wherein the muzzle is most pointed. Accordingly, this is at once a distinction which separates from it a small specimen in the Society's Museum, which appears to be of an undescribed species, and I shall therefore venture to designate it *V. Bibronii*. It is remarkable for the great length of its tail, but in other respects is nearly allied to *V. Bengalensis:* its naral apertures are situate as in that species, but the head is less flat, and a peculiar character consists in a group of central plates between the eyes, which are considerably less minute than the remainder of those upon the head. Length of the specimen twenty inches and a quarter, of which the tail measures thirteen inches, being very much drawn out at the end; at base it is perfectly cylindrical for about two inches, when the double serrated crest commences, which is not so strongly marked as in *V. Bengalensis*, the tail becoming thence more compressed to its extremity. General colour bright olive-brown, marked all over the body with longitudinal rows of alternately larger and smaller angular black spots; head tinged with yellow, and marked with a dark ring surrounding the group of larger scales between the eyes, behind which is a dark semi-circle pointing backwards, then another ring, flanked by a lateral black line along each side; the usual dark mark behind each eye, but narrow, and continued along the side of the neck; fore-limbs mottled with brown, olive, and yellow, having a streak of the last along each toe; the hind limbs and also the flanks shewing scattered pale yellow spots, which are surrounded by dusky-brown forming *ocelli*; tail indistinctly mottled, and yellowish for its terminal two-fifths, beneath, and the rest of the lower parts, also yellowish, irregularly marked with brown, the neck banded with dusky underneath, and between each of the bands a transverse row of spots. The specimen thus described is preserved in spirits: and I find that we have also a stuffed skin, which appears to be referrible to the same. This was received from Madras, and confiding in the judgment of an eminent Zoological acquaintance who has much studied the Indian *Reptilia*, I referred it to *V. binotatus* in my first Report to the Society. The length of this is twenty-three inches, of which the tail measures thirteen inches, but the neck is made rather longer than it ought to be. Colour above dusky brown-black, relieved with a few scattered inconspicuous whitish scales; beneath yellowish-white, mottled with spots and specks of dusky except under the tail, while the fore-neck is greyish and rather more densely mottled: the group of larger scales between the orbits is paler than the rest; and on the flanks and thighs are scattered ocelli as in the other specimen. I have little doubt that this is the species which I observed to be brought in considerable numbers to the bazar at Madras, being much eaten there by the natives; but I hope soon to receive some large specimens from that locality, which will determine the question. I certainly remember to have particularly noticed the great length of tail in the Madras species, by means of knotting which round the limbs the dealers disabled them from running away.

A species of *Varanus*, additional to those described in the very excellent work of M. M. Dumeril and Bibron, was obtained in the island of Mindanado by Mr. Cuming, and is described as *V. Cumingi* by Mr. Martin in *Proc. Zool. Soc.* for 1838, p. 69; and in the same work for 1831, p. 137, is a notice of the anatomy of a *Varanus* by the same author, which had lived for some time in London at the gardens of the Zoological Society.

By Mr. Piddington, we have been favored with a male specimen, and by our Secretary with a female, of an Agama common in the neighbourhood, appertaining to the subdivision *Calotes*, being probably the *C. Tiedmani*, Kaup, *Isis*, XX, t. 8, as quoted in Gray's *Synopsis Reptilium* appended to the 9th Volume of Griffith's Animal Kingdom', where the following synonymes are attached,——*Agama versicolor*, Daudin, t. 44, *A. flavigularis*, Daudin, and *A. Indica*, Gray. This species averages fifteen inches in length, whereof the tail exceeds eleven inches and a half; the longitudinal series of vertical scales forming its nuchal crest are tolerably elevated, those along the back are much smaller, and at the base of the tail they are nearly obsolete; there is also another series above each ear, divided into two groups, each of which has a single pointed scale longer than the rest. Colour changeable, but usually vivid-green, more or less tinged with yellowish, especially on the sides; beneath, whitish, the throat of the male often bright red: the markings also vary, but when well brought out consist of a row of large quadrangular spots along the back, changing from yellowish-brown more or less black-edged to wholly black, and a similar row along each side, between which and the former the ground-tint forms in some a pale band. The very long tail of this beautiful little animal is commonly raised to curve over the back. "It is the liveliest by far," remarks Mr. Torrens, "of the Lizard tribe that I ever saw: its motion is a most rapid darting run for from six to twelve yards, standing high on the fore-legs, and carrying its head singularly erect; it then comes to a dead stop, and remains motionless with the head erect for sometimes a minute and a half, when the rapid motion is resumed to be succeeded by a similar halt: it is very active, leaping from the ground upon shrubs, and its demeanour is markedly vivacious. This specimen I have watched for some weeks: it frequented a flower-pot opposite my dressing room, and seemed to harbour under a particular shrub."

Our Museum contains also a single example of a species closely allied, but nearly as large again, with the nuchal and dorsal crests more developed; this I presume to be *C. ophiomachus*, Kaup, v. *Lacerta calotes* of Seba and Linnæus, whereof the colour should be brilliant blue, but the fine tints of these animals wholly fade in specimens consigned to spirits.

From J. Baker Esq., Civil Surgeon of Noacolly (Bullooah), near Calcutta, has been received a species of *Trigonocephalus*, stated by him to be of rare occurrence, at least in this district. It appears to be nearly allied to *Tr. erythrurus*, Cantor, *P. Z. S.*, 1839, p. 31, (which also is indigenous to the Gangetic delta,) having the same number of abdominal plates and subcaudal *scutellæ;* but the tail has merely a very faint reddish tinge, and there is no black serrated line enclosing the abdominal plates. Length thirty-two inches, of which the tail, posterior to the vent, measures four inches and three quarters. Colour wholly dark grass-green above, beneath greenish white, the tint deepening towards the vent and along the under surface of the tail; sides of upper lip, and below ears, bluish; and wholly without markings, through the lateral row of scales bordering the abdominal plates are lighter-green than those above them, and may form a line more or less defined in younger specimens.

The only additional examples of this genus we possess consist of two small and probably young specimens, nearly allied to each other and to the above, and possessing the same number of abdominal plates. One, measuring twenty-three inches and a half, of which the tail is four inches and a half, and consequently longer in proportion than

that of the preceding species, is wholly of a leaden-blue colour above, with whitish under-parts; no lateral line; a remarkable (though probably merely individual) distinction consisting in four or five of the plates immediately anterior to the vent tending to assume the divided form of those of the tail, being in fact more or less divided and oblique. The other specimen is twenty inches and a half long, with tail four inches and a quarter; and is also leaden-blue above, and whitish gradually more suffused with blue for the first third of its under surface, the rest uniformly bluish and deepening to under the tail: it has also a narrow yellowish-white lateral line commencing under the eye and continued for its whole length. This is allied to the *Bodroo Pam* of Russell's 'Indian Serpents', plate IX., as indeed are the others also, and likewise to the *Tr. purpureo-maculatus* figured by Hardwicke and Gray.

From Dr. Thomson, who has already favored us with a highly interesting box of insects from Afghanistan, I have now to record the donations of a mounted human skeleton (that of an Englishman), excellently prepared and set up, and of an extensive collection of insects, filling 21 glass-fronted cases exceeding a foot square, and of which the contents of 18, consisting of the orders generally, were obtained in the vicinity of Agra, while the remaining 3 are filled with Himalayan *Lepidoptera*. This fine collection has arrived in most satisfactory condition, and constitutes, of course, a very important accession to our entomological cabinet, (the previous extent of which is briefly noticed at p. 604,) albeit a greater community of species occurs than would perhaps be anticipated in the entomology of the neighbourhoods of Agra and Calcutta.

Our esteemed contributor, Robt. Ince, Esq., has favored us with some specimens of a small Weevil known as the Mango Beetle, which prevails, as he informs us, "in the districts of Sylhet, Furreedpore, Dacca, Tipperah, Backergunge, and *half* Jessore—but strange to say, our own mangoes which, in 1835, I brought as grafts from Santipore, and planted in a pucka terrace with a wall round, are quite free from them; however, there is no accounting for them, for on enquiry it appears that frequently with two trees planted close to each other, the one has the insect and the other not." I have not the means of determining the genus of these insects which are found in all stages within the fruit of the Mango.

A fine Hawkmoth, of the genus *Sphinx*, has been presented to the Society by Mr. Borradaile. The only bird with which we have been favored since the last Meeting is a skin of *Cryptonyx coronatus*, from Captain Macleod.

In this class, I have also little to report on as concerns our own collecting. For a long while, in consequence of the heavy rains, not any were brought to the bazars, and the only rare species to the neighbourhood, which has been procured, is a fine male of *Oxylophus Coromandus*. Due progress has, however, been made in mounting our great accumulation of skins, and I have procured fine series of two species of *Euplectes* in addition to the common Weaver-bird, or *Eu. Phillipensis*. These do not appear to have been hitherto distinguished, and the females and young of both may be alluded to as *Eu. aurinotis* by Mr. Swainson, *Class. Birds*, II, 279.

Eu. Phillipensis, the common Baya or Weaver-bird of India generally, as also of the Malay countries, does not appear to attain its full colours until the third or fourth year. The young are like the females, and the once moulted males vary much in the intensity of the yellow colour upon the head, which in some attains its full brightness,

while others exhibit little more than a yellowish tinge; and there is also seldom any trace of yellow upon the breast at this age, beyond perhaps a feather or two, the rest being light rufous-fulvous, while the isolated yellow feathers alluded to are not new and indicative of a moult going on. In this state of plumage, great numbers may be now (June and July) purchased of the dealers, while no yellow-breasted specimen will be found among them; the latter, however, may be procured at the breeding assemblages, though only in a small proportion to the number of birds; and these again differ much in the quantity of yellow exhibited on their under-parts, it being perhaps not until the fourth or fifth year, varying in different individuals, that the full amount of this colour is thrown out. This species has its yellow paler and much less inclining to orange than in the others, which latter, too, are devoid of any upon the breast, and the female has no yellow lateral neckspot nor other trace of this colour, as occurs in both the other species.

Eu. Bengalensis; Loxia Bengalensis, Lin.: *Coccothraustes chrysocephala*, Vieillot: *Eu. albirostris (?)*, Swainson. Length five inches and three-quarters, by nine inches and a quarter across; wing from bend two inches and three-quarters, and tail an inch and three-quarters. In all states of plumage this may be readily distinguished from the next species by the following characters;—the rump (and head and neck of the female and young) are not uniformly striated with the back and scapularies, but streakless, and the breast also is not marked with numerous longitudinal black streaks, but is uniform pale fulvous, with a broad black pectoral cross-band more or less developed; bill also more neatly formed, of a glaucous colour, *i. e.* bluish or pearly white in the adult male, whereas in the other it is deep black (as in *Eu. Phillipensis*). The mature male has the crown brilliant golden-yellow, with a slight inclination to flame-colour; back nearly streakless, and in one specimen dusky-blackish, while the rump is plain dingy grey-brown; a very broad black band crosses the breast, and the throat is white, and ear-coverts and sides of the neck suffused with dusky. Another specimen is generally paler, and has the throat, ear-coverts, and sides of the neck, pure white, with a tinge of yellow beneath each eye; the pectoral band is likewise interrupted in the middle, and considerably less broad than in the preceding. An old female has the pectoral band entire, but somewhat narrow; the crown streakless dusky-brown, slightly tinged with yellow; a bright yellow spot on each side of the neck, beyond the ear-coverts; superorbital streak of the same, paling towards the occiput, and throat deeply tinged with yellow, which forms a sort of moustache-streak on each side. Irides of all dark, and legs dusky flesh-colour. These are the only adults I have seen, among multitudes of the young in (presumed) second plumage. The latter were first brought to the bazar early in May, when great numbers were to be seen, all very similar, and such as I have kept alive from that time have as yet undergone no alteration: their feathers were worn, occasioning the black pectoral streak to appear conspicuously in all; whereas in another large quantity of these birds recently brought, and from among which I selected the adults, this pectoral streak was more or less concealed by terminal edgings to the feathers, of the same pale fulvescent hue as the rest of the under parts: in other respects all resembled the adult female, but the newly moulted birds have generally the eye-streak, neck-spot, and throat of a brighter yellow, than when this plumage becomes worn: bill flesh-coloured. Dr. McClelland, to whom I shewed both this and the next species, is disposed to doubt whether either of them occurs in Bengal;

and whence the dealers are supplied with them I cannot satisfactorily assert, as they pass from hand to hand among them, and the statements of such people, concerning what they do not in the least interest themselves about, are not trustworthy. It is even a common practice with them to pass whatever they can off as Chinese, thereby, it would seem, thinking to enhance its marketable value.* However, there are specimens of the next species among those collected by the late Sir A. Burnes in the Western country; and Mr. Jerdon notices the present one, remarking, however, that he had not himself met with it, "but finds it recorded in Mr. Elliot's notes, as found occasionally in the Southern Mahratta country. That gentleman says that, 'the male has the yellow crown only in the breeding season. At other times only eye-brow and ear-spot are yellow. Their nests, though similar, are smaller than those of the common Baya, and have two chambers. Habits the same as those of the Baya.'" It will be seen that I differ in opinion from Mr. Elliot regarding the phases of plumage of these birds, which seem to depend on age and not on season.

Eu. striatus, nobis, n. s? Size of the last, or a trifle larger, having a black mesial stripe on each feather of the breast and flanks; the rump (and head and neck of the female) uniformly striated with the back and scapularies; neck, throat, and cheeks, of the male, dusky-black; and bill deep black, that of the female yellowish horn-colour. Crown of the male brilliant golden-yellow, and black generally predominates on the upper-parts, which are much more streaky than in the adults of the preceding species. The female is very similar to the young of *Eu. Bengalensis* in newly acquired second plumage, having the same yellow superorbital streak and neck-spot, more or less bright; and the under-parts are usually tinged with yellow, but are readily distinguished (like the crown and rump) by their streakiness. These birds have lately been sold in great numbers by the dealers, mingled with the preceding species, and it is remarkable that all of this kind have been in fully adult plumage, the males at least having the crown very brilliant yellow, as indeed have some of the young males of *Eu. Phillipensis*. It may be, therefore, that the mature plumage of this one is assumed at the first moult.†

I have the honor to be,
Sir,
Yours obediently,
Ed. Blyth.

Report of the Curator Museum Economic Geology, for the month of July 1842.

Museum Economic Geology.—We have to announce here the arrival of three boxes of specimens from England, procured for us by Captain Tremenheere. The letter accompanying them, of which copy is transmitted by Government, is as follows:—

* Great numbers of small birds are continually brought to Calcutta from Singapore, which taken hence to Europe, are there regarded as natives of this country; whereas, in truth, many of them do not inhabit this region.

† I have recently been assured that this species breeds abundantly in the reeds, margining some large tanks, a few miles to the southward of Calcutta; and that *Eu. Phillipensis* occasionally resorts to the same situations, in lieu of suspending its beautiful nests to the fronds of the fan-leaved palms, as is its usual habit. It is remarkable that the beak of *Eu. striatus* becomes gradually white after breeding, commencing at the base, but never bluish-glaucous like that of *Eu. Bengalensis*.

No. 141.

To J. H. Young, Esq.

Deputy Secretary to the Government of Bengal.

Sir,—I have to acknowledge your letter No. 123 of the 12th ultimo, advising the receipt of three boxes addressed to me, to the care of Mr Phillips, Museum of Economic Geology, No. 6, Craig's Court, Charing Cross, London.

2nd. In reply, I beg to inform you, that these boxes contain specimens of metallic ores, or others, illustrative of metallurgical processes, which are intended for the Museum of Economic Geology, established in January 1841, in one of the rooms of the Asiatic Society at Calcutta.

3rd. The Specimens in question, form part of a Collection designed to aid in the development of the mineral resources of India, the first portion of which was brought out by me at the period above-mentioned, under sanction of the Honourable Court of Directors. For its progressive increase, I arranged, before leaving England, with Sir H. T. De la Beche, F.R.S., &c. &c. Director of the Museum of Economic Geology in the Department of Her Majesty's Woods and Forests, for the occasional transmission and interchange of specimens of mineral products. I was likewise promised by gentlemen, connected with mines and manufactures in Cornwall, Northumberland, and Wales, several series of specimens suited to the objects in view.

4th. It was arranged that these boxes of specimens, when ready, should be forwarded to the care of the Curator, Mr. Phillips, of the London Museum of Economic Geology, from whence they were to be forwarded to Calcutta by the proper authorities at the India House, who had instructions from the Court of Directors to that effect.

5th. Any boxes therefore that may in future arrive, addressed in a similar manner to those which are the subject of this letter, may, unless marked "Private," be transferred at once to the Government Museum of Economic Geology at the rooms of the Asiatic Society.

I have the honor to be &c.

(Signed,) G. B. Tremenheere, *Captain,*
Executive Engr. Tenasserim Provs.

Revenue Department, the 20*th June*, 1842.

(A true Copy.) Fred. Jas. Halliday,
Moulmain, 19*th April*, 1842. *Secretary to the Govt. of Bengal.*

The contents of the boxes are as follows:—

One box ores of copper, &c. copper and tin with other minerals as fluor spar, &c. indicating the modes of occurrence of the ore in the veins.

One box larger specimens, mostly duplicates of the foregoing.

One box coal, from the Newcastle coal-field.

We have also received from Major Ouseley, Agent to the Governor General, N. W. frontier, specimens of gold and gold dust from the Brahminy river;

Specimens of Garnets from the Bora Sambur, a tributary from the South to the Mahanuddee;

And of an ore of lead and antimony, with the matrix in which it occurs from near Hazarcebaugh.

The last mineral is under examination, and will be duly reported on.

From J. H. Batten, Esq. C. S. an assortment of ores of iron, copper, lead, &c. from Kemaon, have just arrived while I am writing. These will also be noticed in more detail in the next report.

Geology and Mineralogy.—I have the pleasure of congratulating the Society upon the recovery of Captain Herbert's Geological Map, as will appear from the following letter, in reply to that addressed by our Secretary to Government.

No. 582.

To H. Torrens, Esq.

Secretary to the Asiatic Society.

General Department.

Sir,—In reply to your letter dated the 1st instant, I am directed to acquaint you, for the information of the Committee of Papers of the Asiatic Society, that Captain Herbert's Geological Map, and the twelve colored Views of mountain scenery, referred to by the Committee, were forwarded to the India House, under date the 1st February 1827, and that an application will be made to the Hon'ble the Court of Directors for copies of the Map and Views, for preservation in the Asiatic Society's Rooms with the MS. Report recently recovered. I am, Sir,

Your obedient servant,

G. A. Bushby,

Secretary to the Government of India.

Council Chamber, the 20th July, 1842.

We have thus succeeded, I trust, in a public service of no small importance to the cause of science, which I doubt not will be fully appreciated by Geologists in Europe, to whom the remarkable phœnomena presented by the formations of India, are of the very highest interest.

I am happy also in being able to announce, that there is every probability of the recovery of the Catalogue of Capt. Pemberton's valuable Bootan specimens, alluded to in a former report; for in a reply received from Capt. Blake, now at Sepree, who commanded the Escort, he describes so distinctly the book in which the notes were kept, that there is little doubt it will be found amongst his papers. General Macleod has again been written to on the subject, and I need not add, that we are certain of his most zealous assistance in all things. Capt. Blake's reply is as follows :—

Seepree, 7th July, 1842.

My dear Sir,—I have had the pleasure to receive your letter of the 21st ultimo, regarding the Geological specimens handed to you by Col. McLeod. I extremely regret, that I have no clue whatever by which you would be able to assign localities to the different specimens. Pemberton used to put down in a note book (with a parchment cover which you may perhaps yet find) whenever he picked up, or broke off a specimen, its locality, numbered it, the dip of strata if we happened to be amongst stratified rocks, and whatever other information he thought useful. The loss of the book vexes me much, for my esteemed friend took an infinity of trouble to make every information regarding the unknown land of Bhootan as full as possible. I was hurried

away from Calcutta at so short a notice, that I had not time to fill in a Section of Bhootan, (which I had prepared on a large scale,) so as to shew the Geology throughout every mile. This outline I left with Pemberton, who gives it on a smaller scale in his printed report, but he *may* have filled up the one he got from me; if you have the luck to get it, much trouble will be saved you. In Pemberton's Report there is a Synoptical Table, showing, amongst other things, the Geology of every stage, which will enable you to lay out the specimens not far from the truth, but it is not of course altogether satisfactory. Regretting extremely my inability to give you the required information, I remain,

Very faithfully your's,
M. T. Blake.

I have been also engaged in examining five volumes of Dr. Voysey's Journals. My report on them is partly stated in my letter of the 19th instant, addressed to our Secretary, and with the approbation of the Honorable the President, Government has been addressed as therein recommended; and when I add that Dr. Voysey's whole time may be said to have been spent in crossing and recrossing the vast field of the trap formation from the Kistna to the Ganges, and from Cuttack to Bombay, noting day by day his acute and able remarks on it, it will be conceived with what interest these will be read in Europe, and how much they may contribute to advance our knowledge of the Geology of India. Our Secretary has authorised me to employ a Copyist for the purpose of extracting the geological and mineralogical details, (which require to be separated from various others with which they are mixed up) for the purpose of publication in the Journal, and I hope also to recover from our neglected stores, some of the series of specimens to which the Journal refers.

30*th July*, 1842. H. Piddington,
Curator Museum Economic Geology.

For the contributions and presentations, the thanks of the Society were accorded.

Proceedings of the Asiatic Society.

(Friday Evening, 2d September, 1842.)

The Hon'ble H. T. Prinsep, Esq. President, in the chair.

Messrs. James Mackenzie and A. S. Gladstone, proposed at the last Meeting, were ballotted for, and unanimously elected Members of the Society.

Ordered—That the usual communication of their election be made to Messrs. Mackenzie and Gladstone, and that they be furnished with the rules of the Society for their guidance.

The Secretary submits in Persian and Oordoo MS. the work entitled "Tareekh-i-Nadree," proposed to be printed. The Secretary stated, that he had taken every care to procure the best MS. for collation. He had sent for the purpose to Lucknow, and had received thence, and from other parts of the country, nine MS. some of them having the character of great correctness. These MS. would be collated by Molvee Gholam Ukbar, Persian Librarian to the Society, with the aid of some native friends of the Secretary, who after careful perusal of the MS. produced by the collation, would submit it for approval to the Hon'ble the President. Ordered accordingly.

Ordered—That the Librarian of the Society be directed, with the aid of Readers, to prepare a List of the Readings of the Books, vol. 1 to 8.

Library.

The following Books were presented:—

Books received for the Library of the Asiatic Society, for the Meeting on the 2d Sept. 1842.

The Edinburgh New Philosophical Journal, by Professor Jameson, No. 64. Edinburgh, 1842, from the Editor.

Minutes of the Committee of Council on Education. London, 1841, from Govt.

Reports on the training of Pauper Children. London, 1841, from Govt.

Naturalist's Library.—Ornithology, Vol. XII. British Birds. (Purchased.)

————————.—Entomology, Vol. VII. Foreign Moths. (Ditto.)

Lyell's Principles of Geology, sixth edition. London, 1840, 3 vols. (Ditto.)

Merrat-ul-Janaun, Maroof Tarikh-ia-pha-i, 1 vol.

The Calcutta Literary Gleaner, Vol. I, No. VII. Sept. 1842, from the Editor.

Oriental Christian Spectator, June 1842, second series. Vol. 3d, No. 6, from the Editor.

Journal of the Bombay Branch of the Royal Asiatic Society, January 1842, No. 3, from the Society.

The Report of the British Association for the advancement of Science, for 1841. London, 1842, one vol. from the Association.

The Trials of P. and M. Wallace. London, 1841, one vol. from A. Rogers, Esq.

Yarrell's History of British Birds. London, 1842, Vol. III. pt. 29, purchased.

London, Edinburgh and Dublin Philosophical Magazine and Journal of Science. Vol. XX, Nos. 129 and 131, purchased.

The Annals and Magazine of Natural History, Vol. IX, No. 57, purchased.

Royle on the Production of Isinglass along the Coast of India. London, 1842. Two Copies, from the Author, P.

Hesychii Glossographi discipulus. Edidit B. Kapitar. Vindobonæ, 1840.

Wilson's Translations of the Vishnu Purana. London, 1840, 1 vol. from the Author.

A Bengalee Pottee MS. from ——

Read following letter from Professor Wilson of 2d July, 1842.

To H. Torrens, Esq.

Secretary, Asiatic Society of Bengal.

Dear Sir, East India House, 2d July, 1842.

The Society will probably have been apprised by Messrs. Allan and Co. that the bust of Dr. Mill has been sent by them to Calcutta by my desire. I hope it will arrive in safety; it is one of the most successful of the late Sir T. Chantrey's works. The change from a picture to a bust, agreeably to the Society's instructions, involved an expence exceeding that for which provision had been originally made. £180 had been remitted by Mr. J. Prinsep to Messrs. Morris and Provost to await Dr. Mill's order, but Sir T. Chantrey's charge, as the Society is aware, was 200 guineas. I have paid the balance £30 to his executors, from the £200 in my hands on account of Mr. Prinsep's bust, as the whole sum will not I expect be required for the latter.

Little progress had been made in Mr. Prinsep's bust at the time of Sir T. Chantrey's death, and the executors were willing to transfer the model for completion to Mr. Weekes. I delayed, however, giving authority to Mr. Weekes to proceed until the model should have been seen by Sir E. Ryan and Mr. Wm. Prinsep, as they were expected in England. They have now seen the model, and suggested various alterations; and in fact, Mr. Weekes has made an entirely new model, under Mr. W. Prinsep's guidance. He and Sir Edward Ryan have both expressed their approbation of the model, and their favourable opinion of Mr. Weekes's talents, and I shall therefore direct him to complete the bust without delay. His terms are lower than Sir T. Chantrey's, and I hope therefore to be able to discharge them from the money of the Society in my hands, notwithstanding the deductions on account of the bust of Dr. Mill. There may be perhaps a surplus, and in that case it may be advisable to provide a set of Pedestals of Scagliola, or imitation marble, for the Society's busts; but for this I shall require further authority, as well as information of the height and diameter of the Pedestals, should the Society think it desirable to have them sent out. I am, Dear Sir,

Yours truly,

H. H. Wilson.

The proposal of the Professor to provide a set of Pedestals of Scagliola, or imitation marble, for the Society's Busts, with the surplus fund in his hand was declined, pedestals having been already provided.

Read following letter from Captain R. Wroughton of 27th August, 1842:—

To the Secretary of the Asiatic Society, &c. &c. &c. Calcutta.

Chunar, 27th August, 1842.

Dear Sir,

I beg to inform you, that I have placed under the care of Mr. Digney, proceeding to Calcutta, the three following specimens of Natural History, which, perhaps you

will do me the favor to present to the Museum of the Asiatic Society, in my name.

1st. The skin of a female Gour or Bison of the rocky forests, bounding the basaltic table land of the Nagpoor State, and killed by my people near Umurkuntuk, the source of the Nerbudda river, in the month of April last.

2nd. The skin of a common Crocodile, killed near the Soane river, south of Mirzapoor.

3rd. The nest of a species of Vespa Crabro. This insect is indigenous to the forests of the basaltic table land confining the Nerbudda river at its source. I never saw the insect myself, because I only reached that part of the country in March last, at which time it appears, they usually leave their nests, and return to them at the commencement of the rains. I am in hopes I shall be able to secure and send to the Museum some of the Hornets preserved in spirits, and for which I have written.

By this time I had hoped that I should have been able to forward some other specimens of Natural History, peculiar to the interesting country about Umurkuntuk, but unfortunately the Rev. Mr. Loesch of the Berlin Mission, who located himself with five German artizans, near Umurkuntuk in March last, with the express object of winning over the wild "Goands," to settled habits, the useful arts, and the advantages of civilized life, and though last not least to the inestimable blessings of mental culture and pure religion; has, I grieve to say, with the whole of his companions been carried off by Cholera, which has for some months past been depopulating that country! Mr. Loesch and his friends promised me much assistance, which we are now deprived of.

It so happens, that the skins have been not only injured in the preparation, but otherwise by friction. I regret this, but accidents of the kind are unavoidable when quadrupeds or other large animals are skinned by ignorant people. In addition to this, the difficulty of conveying weighty specimens great distances over rugged and almost untraversed tracts, renders it impossible to pack them in such a way, as to preclude their injury during the transit from one place to another. I beg to subscribe myself,

Dear Sir,

Yours very faithfully,

Robt. Wroughton,

Captain, 69th Regiment N. I.

Ordered—That Captain Wroughton be specially thanked for his contribution and exertions to furnish information.

Communicated by H. V. Bayley, Esq. a letter from Baboo Eshan Chunder Banerjea of the Hoogly College, forwarding a MS., being, as he presumed, a correct Genealogical History, in Sanscrit and Hindwi verses, of the Nagbongshus of Chota Nagpore, presented to the Baboo while at Kishenpore, by Lál Debnath Shahdeo, of Şehag.

The Secretary reported, that on the examination of the MS. by Dr. Roer and the Pundit of the Society, they were found to contain ge-

nealogical tables of the Nagbongohur, composed in the Hindee language, but written in Bengalee character.

Read the following report from the Curator, Mr. Blyth :—

Sir,—Although the Ornithological department of our Museum may now be considered rich in examples of the species inhabiting Bengal and the Himalaya, it has hitherto been extremely deficient in specimens of those proper to Southern India; wherefore it is with much satisfaction that I now report on a fine collection of specimens from peninsular India, which has recently been presented to us by Mr. Jerdon, and which may be regarded as the first instalment of desiderata, from that quarter, which Mr. Jerdon is kindly endeavouring to procure for us,* whereof the value, too, is enhanced as verifying the actual species described or indicated by that naturalist in his "Catalogue of the Birds of the Peninsula of India," published in successive numbers of the 'Madras Journal of Literature and Science,' from XXIV to XXIX inclusive.

Of Mammalia, are sent

**Herpestes*† ———? A Mungoose from the Neilghierries, allied to (but certainly distinct from) Mr. Hodgson's *H. auropunctata, J. A. S.* V, 235, identified by Mr. Ogilby as *H. Edwardsii:* this will shortly be described by Walter Elliot, Esq., the author of the excellent "Catalogue of Mammalia in the Southern Mahratta Country," published in the 'Madras Journal,' Nos. XXIV and XXV. It is also distinct from the allied Malayan *H. Javanica*, of which Mr. Elliot possesses a specimen, and as I can aver from recollection of the living *Javanica*.

**Sciurus Delesserti;* lately figured and described, as Mr. Jerdon informs me, in the 'Magasin de Zoologie.' This animal is allied to the *Sc. insignis*, Horsfield, figured in the 'Zoological Researches in Java' of that naturalist, and also to another small species, from Bootan, in the Society's collection, which I presume to be undescribed, and shall therefore venture to designate *Sc. Pembertonii.*‡

* *Kemas hylocrius*, Ogilby, *P. Z. S.* 1837, p. 81; a head with the skin on. I have been assured by Mr. Elliot that this, and no other, is the so-called Ibex of the Neilghierries, noticed by me in a letter published in the 'Proceedings of the Zoological Society' for 1841, p. 63: and as, according to that naturalist, its habits are quite those of a wild Goat, keeping to the steepest and most inaccessible situations, the term *hylocrius* imposed by Mr. Ogilby, under the impression that this animal was the *Jungle Sheep* of Anglo-Indian sportsmen, becomes objectionable as applied to it. I have now been long satisfied that the so-termed *Jungle Sheep* of sportsmen refers to the Muntjac, Kakur, or Barking Deer, and a very intelligible description of the latter, as the *Jungle Sheep*, is given in a notice of certain of the Mammalia of the Tenasserim provinces, in the 'Bengal Sporting Magazine' for 1841, p. 445, which thus corroborates the information which I have received from other quarters. It is remarkable, however, that a rude figure of what certainly appears to be the *K. hylocrius* is contained among the drawings of Gen. Hardwicke bequeathed to the

* A second large collection of bird-skins has since been received from the same gentleman.

† The species with an asterisk prefixed are new to the Society's Museum.

‡ Vide p. 887.

British Museum, labelled *Warry-atoo* from the Chittagong hills: and I may add, that a Neilghierry specimen of this animal which Mr. Elliot shewed me, at Madras, was so much finer than that mounted in the Museum of the Zoological Society, with horns so much larger and longer, that if I had not a very perfect recollection of the latter, in addition to possessing drawings of it, I might perhaps have hesitated in identifying them as the same; the head now sent, however, has the horns about equally developed with those on the Zoological Society's specimen.

The Birds presented consist of

**Aquila imperialis*, Temminck, vel *Heliaca*, Savigny; *A. chrysaëtos* of Mr. Jerdon's Catalogue.

**Aq. Vindhiana*, Franklin, *P. Z. S.* 1831, p. 114: young.

**Aq. pennata; Falco pennatus*, Auct.; *Spizætus milvoides*, Jerdon: young male.

Spizætus grandis; Nisaëtus grandis, Hodgson, *J. A. S.* V, 230; *N. niveus*, Jerdon's Catalogue.

**Heteropus perniger*, Hodgson; *Aquila pernigra*, Ibid., *J. A. S.* V, 227; *Nisaëtus ? ? ovivorus*, Jerdon, Supplement to Catalogue, and indicated only in the latter as a Black Eagle frequently seen on the summit of the Neilghierries: male and female, the latter particularly fine.

**Pernis cristata:* a young male, white beneath,—a female in more advanced plumage,—and a male still more advanced.

P. Ellioti, Jameson: a female, nearly white below,—and a male in more advanced plumage.—*N.B.* I feel far from satisfied of the distinctness of these two alleged species.

**Limnætus punctatus*, Jerdon; olim *Spizætus punctatus*, Supplement to Catalogue.

**Buteo longipes*, Jerdon.

**B. rufiventer*, Jerdon, Supplement.

B. teesa, Gray and Hardwicke; *Circus teesa*, Franklin; *Astur Hyder*, Sykes: an adult female and young male.

**Circætus albidus; Falco albidus*, Cuvier, Temminck; *Buteo melanotis*, Jerdon, Supplement.

Circus Swainsonii, A. Smith; *C. pallidus*, Sykes: male.

Falco Juggur, Gray and Hardwicke; *F. Luggur*, Jerdon: young female.

Falco subbuteo, female; the European Hobby Falcon. In *J. A. S.* ante, p. 162, I attempted to cast a doubt as to whether the true Hobby inhabited this country, suspecting that the specimens referred to it had either been females or young of the nearly allied *F. Aldrovandi*, vel *severus*, Horsfield; but although there can be no doubt that the Darjeeling male *F. Aldrovandi* which I there described was correctly referred to that species, a more decidedly characterized specimen of the adult *subbuteo* which I killed on the wing very late one evening in the immediate vicinity of Calcutta, leads me, after much consideration, to identify not only Mr. Jerdon's specimen as specifically the same, but also the two which I described as the female and young female of *Aldrovandi* on the occasion cited. The two species must certainly be very intimately allied, and I regret that we do not possess a specimen of *Aldrovandi* that might now serve for further comparison, and also that I do not know, and cannot find a description of the immature plumage of this species, which probably approximates very closely indeed to the corresponding garb of *F. subbuteo*.

**F. vespertinus*, Lin.; *F. rufipes*, Tem.; *F. subbuteo*, Var. A., Latham, *Gen. Hist.* I, 121, being the only notice of an Indian specimen which I have met with previous to the present instance, which latter relates to that described in *J. A. S.* XI, note to p. 162, as a small red-billed Falcon procured upon the Neilghierries in January.

**Accipiter minutus?*, Auct; *A. Besra*, Elliot and Jerdon: young male.

**Astur Indicus*, Hodgson, 'Bengal Sporting Magazine,' 1836, p. 177; *A. palumbarius*, Jerdon, Catalogue, vide Supplement to the latter. A typical Goshawk, having an occipital crest: young male, and very fine old female.

**Strix longimembris*, Jerdon.

**Syrnium Sinense.*

Meseidus Newarensis, Hodgson, *As. Res.* XIX, 168; *Bulaca monticola*, Jerdon, Supplement: male.

**Scops castanopterus* ? Horsfield.*

Ketupa Leschenaultii.

Tephrodornis sylvicola, Jerdon.

**Dicrurus macrocercus*, Vieillot; *D. annectans*, Hodgson.†

D. æneus, v. *muscicapoides*, Hodgson.

D. retifer, Temminck, — *Malabaricus*, Gould, — *cristatellus*, Nobis, *ante.* Vide p. 799, *ante.*

**Hypsipetes Neilgheriensis*, Jerdon.

Tricophorus virescens, Jerdon. So far as can be judged from the specimen, this does not appear to differ from *Tr. flaveolus*, Gould, *P. Z. S.* 1836, p. 6.‡

**Tr. Indicus.*

**Goldana* (G. R. Gray) *atriceps; Brachypteryx atriceps*, Jerdon.

**Myophonus Horsfieldi.*

Petrocincla Manillensis, vel *Pandoo* et *Maal*, Sykes: male and female.

**Turdus simillimus*, Jerdon; the Neilghierry Blackbird: male, female, and young.

**T. (Oreocincla*, Gould,*) varius (verus)*, Horsfield; from the Neilghierries, *vide* Jerdon's Supplement.

**T. Wardii*, Jerdon. A remarkably coloured species, from Mysore, connecting the Blackbird group with the *Oreocinclæ* of Gould.§ Length about eight inches, of wing four inches and three-quarters, and tail three inches and three-eighths; bill to forehead (through the feathers) an inch and one-eighth, and to gape an inch and three-eighths; tarse an inch: third primary longest, and a little exceeding the fourth, second and fifth equal, and first rudimentary. General colour deep black,

* A small species, procured in the vicinity of Madras. Mr. Jerdon, in a letter which I have recently received from him, doubts the propriety of my referring it, hesitatingly, to *Strix castanoptera*, Horsfield, remarking that Lesson has described the latter, from a Paris specimen, as a *Noctua*, and the description does not tally. It is probably a new species, and will be described as such by its discoverer.

† I have since obtained both this and the next species in the vicinity of Calcutta, where the latter is tolerably common in the cool season, and the former not rare. To the synonymes of *D. æneus* (p. 800 *ante*), add *D. æratus*, Stephens (p. 801 *ante*).

‡ Mr. Jerdon, however, to whom I have since forwarded a skin of *Tr. flaveolus*, considers them distinct, and I expect to receive other specimens from him of *Tr. virescens.*

§ The *T. mollissimus*, Nobis, *J. A. S.* XI, 188, links the *Oreocinclæ* with the *T. musicus* group.

with a conspicuous pure white eye-streak; all the wing-feathers broadly tipped with white, except the four first developed primaries, which have more or less of their outer webs white-edged; under-parts from the breast white, tinged with carneous, the plumage of the flanks, however, only tipped with white: under surface of the wing marked with white, as in the *Oreocinclæ*: the upper tail-coverts are somewhat broadly tipped with white, and a tolerably large patch of the same is formed by the ends of the smaller wing-feathers: tail having its middle feathers but slightly tipped with white, the next largely, and the rest shewing successively more white on their inner webs, till on the outermost the feather is more than half white, being also, together with the penultimate, marked on the outer web with white towards the base. Bill dusky above and at the tip of the lower mandible, the rest yellowish: legs yellow. A female specimen.

**Garrulax cachinnans; Crateropus cachinnans*, Jerdon.

Dasyornis striatus; Megalurus striatus, Jerdon, Supplement; *D. locustelloides*, Nobis, *J. A. S.* XI, 602.

Pellornium ruficeps, Swainson, *Fauna Americana-borealis*, II, 487; *Cinclidia punctata*, Gould, *P. Z. S.* 1837, p. 137; *P. olivaceum*, Jerdon.

**Malacocercus Malcolmi; Timalia Malcolmi*, Sykes.

**M. griseus; Turdus griseus*, Latham.

**M. Somervillei; Timalia Somervillei*, Sykes.

**M. subrufa; Timalia subrufa*, Jerdon.

**Timalia hyperythra*, Franklin.

**Trichastoma*, (Nobis, *J. A. S.* XI, 795-6,) *poiocephala; Timalia poiocephala*, Jerdon, Supplement.

**Pomatorhinus Horsfieldi*, Sykes.

**Saxicola nigrorufa*, Jerdon.

Dimorpha (Hodgson,) *leucura; Muscicapa leucura*, Latham, Swainson: adult, being the *Saxicola rubeculoides* of Sykes.

**Phœnicura (?) major*, Jerdon, Supplement.

**Calliope cyana; Larvivora cyana*, Hodgson, *J. A. S.* VI, 102; *Phœnicura superciliaris*, Jerdon, Supplement.

**Curruca orphea.*

**C. garrula.*

Phyllopneuste rufa.

**Acrocephalus montanus; Sylvia montana*, Horsfield.*

**Prinia sylvatica*, Jerdon.

**P. socialis*, Sykes.

**P. inornata*, Sykes.

* *P. gracilis*, Franklin.

* *P. rufifrons*, Jerdon.

**P.* —— n. s. Differs from *P. sylvatica* in its smaller size, the less grey but more fulvescent hue of its upper-parts, shorter wings, and especially in its smaller and pale bill. Length five inches and three-quarters, of which the tail measures two inches and a half, and wings two inches and one-eighth; bill to feathers under half an inch, and above five-eighths of an inch to gape; tarse exceeding three-quarters of an inch.

* Not rare about Calcutta during the cool season.

Upper-parts slightly olivaceous brown, the tail obscurely barred, and its outer feathers successively more distinctly tipped with dusky and then whitish; under parts dull fulvous-white, except on the throat and middle of the belly, which are pure white; bill pale brown, darker near the ridge of the upper mandible; legs, also, in the dry specimen, pale reddish-brown; the crown a trifle darker than the rest.

Cisticola cursitans; Prinia cursitans, Franklin. This small species extends into Nepâl, where there is another nearly allied to it.

* *Parisoma? vireoides*, Jerdon: mutilated.

* *Motacilla variegata*, Vieillot, not of Latham: do.*

Muscipeta paradisea: a particularly interesting specimen, as demonstrating — what I have for some time been convinced of, from observation of the living birds, and especially their notes, — that this and the *M. Indica* v. *castanea*, Auctorum, are but different states of plumage of the same species, both sexes of which attain the white garb with full maturity, though breeding before they assume this livery. In the present specimen, a male, which is only sent for inspection and exhibition, as it belongs to a friend of Mr. Jerdon, the whole under-parts, some of the upper tail-coverts, and the upper tertiaries of the wings, are pure white, the last displaying the usual black markings, while the rest of the plumage is bright chestnut, except the head and neck, which are glossy green-black as usual; and it moreover does not appear that this bird was moulting, but that the individual had thrown out this intermediate garb at the last renewal of its feathers, a few of these (among the interscapularies) being partly white and partly of the chestnut hue of reputed *M. castanea*. One of our taxidermists assures me, however, that he has shot a male of this species during its moult, in which the chestnut feathers were all being replaced by white ones, and mentions particularly that one only of its long chestnut middle tail-feathers had been cast, and that a new white one was growing in its place. I may further add, that Mr. Hodgson has already presented the Museum with white and chestnut specimens, referring both to *M. paradisea;* and that I have seen a white male paired with a chestnut female, though more frequently pairs of the same colour associate. This bird is not uncommon in the vicinity of Calcutta at all seasons: and I have seen a nest of young ones, which were dull chestnut, with merely a slight indication of the black hood.

It was necessary to enter into the foregoing details, because in Col. Sykes's Catalogue of the Birds of the Deccan (*P. Z. S.*, 1832, p. 84), it is remarked that — "these two birds have lately been erroneously considered to belong to the same species. They were never found however by Col. Sykes (who shot many,) in the same locality, nor did he observe any intermediate state of plumage. The difference between the females of the two birds noticed above at once decides the distinction of species"! Both white and chestnut-coloured individuals may commonly enough be observed in the Calcutta Botanic Garden, and frequently about thick bamboos in other districts of this neighbourhood.

Muscicapa melanops: here not rare during the cool months.

**M. albicaudata*, Jerdon.

**M. superciliaris*, Jerdon; *Dimorpha* (Hodgson, but wrongly so located by me,)

* I have lately obtained a fresh, but much injured, specimen of this bird, taken by a shikaree, and am told that it is not very rare in the vicinity of Calcutta during the cool months.

albogularis, Nobis, *J. A. S.* XI, 190, where an allied species is described by the specific term *superciliaris*, which accordingly may now give place to *hyperythra*.

**Pericrocotus*, (Boié, *Phœnicornis*, Swainson,) *erythropygius; Muscicapa erythropygia*, Jerdon, Catalogue.

**Crypsirina leucogastra; Dendrocitta leucogastra*, Gould.

**Pastor fuscus?* Wagler; *P. Mahrattensis*, Sykes: very closely allied to, but distinct from, *P. cristatellus*, which latter is here common, but appears not to have been observed by Mr. Jerdon in the peninsula.

**Spermestes ———?* No. 173, *bis*, of Mr. Jerdon's Supplement. Decidedly distinct from *Sp. leuconota*, as is also Mr. Hodgson's *Munia acuticauda*, *As. Res.* XIX, 153.

Corypha baghaira; Alauda Dukhunensis, Sykes: identical with the so called 'Ortolan' of this part.

**Mirafra Javanica:* a specimen from Madras, according very well with the description by Stephens; and a specimen from the northern part of the Deccan, sent as the *M. Javanica* of Mr. Jerdon's Catalogue, which, it may be, is distinct, but the variation of plumage to which these birds are probably subject, requires further investigation.

**Anthus rufescens*, apud Jerdon.

**A. rufula*, ditto.

**A. similis*, Jerdon.

A. agilis?, Sykes; identical with the Bengalese, Nepalese, and Malayan specimens which I have hitherto referred to *A. Malayensis*, Eyton. It may be either, so far as the descriptions go, which are both very deficient in the necessary measurements; and it is not unlikely that both descriptions refer to the same species, perhaps in summer and winter dresses respectively.

**Cuculus sparverioides:* adult and young.

**C. Sonneratii;* v. *C. Himalayanus* of Mr. Jerdon's Catalogue.

C. niger, Latham: v. doubtfully cited *C. flavus* of Mr. Jerdon's Catalogue, adult male and female.

**Phœnicophæus Jerdoni*, Nobis; *Xanclostomus viridirostris*, Jerdon.

**Xanclostomus Sirkee; Eudynamys (!) Sirkee*, Hardwicke and Gray, and *Sirkeer Cuckoo* of Latham: female.

**Cinnyris polita;* male and female.

**C. minima*, Sykes: young male.

**Dicœum concolor*, Jerdon.

Arachnothera inornata; Cinnyris longirostris, Jerdon's Supplement.

Upupa epops, from the Neilghierries: this bird is common in the neighbourhood of Calcutta during the cool season, but in the peninsula is generally replaced by *U. minor*.

**Chætura gigantea; Cypselus giganteus*, Temminck: a specimen from Penang; and another which I consider to be identical in species, from the Neilghierries. Very closely allied is the *Ch. macroptera*, Swainson, v. *Ch. nudipes*, Hodgson, *J. A. S.* V, 779; but this has constantly the whole chin and throat conspicuously pure white, forming a large and well defined patch, and the spinous extremities of the caudal feathers are much less developed than in the other.

I add a description of the specimens which I refer to *Ch. gigantea*. Presumed

length of the recent bird, (*i. e.* making due allowance for the skin being inordinately stretched lengthwise,) about eight inches and a half; of wing eight inches; and middle tail-feathers, to their spiny points, two inches and five-eighths. Back dull hair-brown, the head, neck, wings, and tail, dull iridescent black, and under-parts brownish, tinged with the same, especially about the breast; under tail-coverts, and line along the sides reaching to them, white; and chin slightly albescent, the loral feathers still less so. This description is taken from the Penang specimen; the Neilghierry one being a trifle less in length, its wing measuring seven inches and a half, and tail two inches and five-eighths. The chin is whiter than in the other, and the loral feathers are also white; but there is no other difference.

**Cypselus alpinus*, vel *melba*: from the Neilghierries.

**C. australis (?)*, Gould, *P. Z. S.* 1839, p. 146; or a closely allied species, having the tail above half an inch shorter than is stated in the description cited: from Penang. Length about six inches and a half, of wing seven inches, and outer tail-feathers two inches and seven-eighths, the medial two inches and a quarter. General colour dusky-brown overlaid with shining green-black, the feathers of the breast and belly margined with whitish; rump white, having dusky shafts to the feathers; and throat and fore-neck whitish, being similarly shafted.

C. —— ? A specimen from the Deccan, only differing from the last in being smaller, generally somewhat browner, particularly on the head and nape, and in having the abdominal feathers more slightly margined with whitish: the foot is, however, so decidedly smaller, that I cannot regard it as the young of the preceding species; bending the hind-toe backward, the span barely exceeds five-eighths of an inch, whilst in the other it is fully seven-eighths of an inch. Length five inches and a half, of wing six inches, and outer tail-feathers two inches and a half, the medial an inch and three-quarters.

C. affinis, Hardwicke and Gray. A Neilghierry specimen is also sent as different from this, but which appears to me to be only the young of *affinis*. Length of wing four inches and three-quarters, and of tail an inch and five-eighths. Colour more brownish and less glossed than in the adult *affinis*.

**C. concolor; Hirundo unicolor*, Jerdon, Catalogue, but since correctly referred in the Supplement to the latter to the present genus, wherein already a distinct *C. unicolor*, from Madeira, has been figured and described by Messrs. Jardine and Selby, in their 'Illustrations of Ornithology,' Pl. LXXXIII, for which reason I have altered the specific name bestowed by Mr. Jerdon on the present species.

**Hirundo domicola*, Jerdon, Supplement.

**H. urbica*: from the Neilghierries.

**H. inornata*, Jerdon, Supplement.

**H. concolor*, Sykes.

**Vinago aromatica*, female; being the *V. affinis*, Jerdon, Catalogue, where the *V. unicolor*, Jerdon, is likewise the female of *V. bicincta*, Jerdon.

Carpophaga œnea.

**Ardea nigra*, Vieillot.

A. lepida, Horsfield.

Porzana rufescens; Rallus rufescens, Jerdon: also met with in the vicinity of Calcutta.

**P.* —— ? New species. Allied to the last, but smaller, and otherwise differing.

Gallinula chloropus (?), var. *Indicus;* male, sent as *G. akool*, Sykes. This bird is common enough in the vicinity of Calcutta; and it appears to me, judging from memory, to be constantly inferior in size to the British species. As in the latter, the female is larger and much finer-coloured than the male. A handsome adult female measured twelve inches and a quarter long, by nineteen inches and a half in spread of wing: in Dr. Fleming's 'British Animals', the dimensions of the European bird are given as — "Length fourteen inches; breadth twenty-two inches"; but Mr. Jenyns assigns only thirteen inches by twenty inches and three-quarters, which are probably the admeasurements of the European male bird. In other respects there appears to be no difference whatever.

Machetes pugnax; sent as *Tringa Hardwickii*, Gray, which is evidently the Ruff in winter dress, as *T. Indica*, Gray, is the female or Reeve.

**Charadrius russatus*, Jerdon.

**Strepsilas interpres.*

From the Barrackpore Menagerie, we have received a specimen of a young Sambur Deer *(Cervus hippelaphus)*.

I now proceed to describe the small Bootan Squirrel, which has been already mentioned (p. 880) as being nearly allied to *Sciurus insignis*, Horsfield, and to the Neilghierry *Sc. Delesserti.*

Sc. Pembertonii, Nobis. Total length nine inches, of which the tail with its hair measures four inches; tarsus, to end of claw of longest toe, an inch and one-eighth. General hue of the fur dull brownish-fulvous, grizzled with black, and slaty-black at base; under-parts albescent-brown: a black stripe on the nose, anterior to the whiskers which are also black; another black mesial stripe commences between the shoulders, and is continued to the croup, besides which is a narrow lateral black stripe, adjoining a broader pale fulvous one external to it, which commences on the side of the neck, and is continued to that of the base of the tail, becoming narrow over the croup: the ears are rather small, and are lined internally with minute close fulvous-white hairs; their edges are black; and the fur outside the ears is longer, and terminates in a white tuft which shews conspicuously, contrasting with the black edge of the ear: the tail is grizzled nearly like the back, but black predominates on its upper surface, and fulvous on the lower: orbits fulvous; and feet coloured like the sides.

I may also here describe another small rodent, presumed to be from the Himalaya, which I shall designate

Georychus fuscocapillus, (vide *J. A. S.* X, 928), or Dusky-capped Lemming. Length about four inches, exclusive of the tail which measures a quarter of an inch, or with its hair half an inch: tarse, to end of claw of longest toe, seven-eighths of an inch. Ear-conch very minute, and concealed underneath the fur: the latter is of an Isabella colour at the surface, or nearly that of *Bathyergus maritimus*, but slaty-black for the basal two-thirds; the upper part of the face and head being dusky brownish-black, which gradually passes into the hue of the body: whiskers reaching to the ears, a few of the anterior being whitish, and the rest dusky. The rodential tusks of this species are pure white, and the upper pair project very remarkably forward.

Having taken a fortnight's excursion up the river since our last Meeting, and gone much on shore to observe and collect whatever fell in my way, a few remarks on the

Zoology of the district as observable during the latter part of July, when the rainy season has moderated, though heavy showers are still of frequent occurrence, leaving periods of sunshine at most but of a few hours' duration, may be acceptable to some readers of the Journal in Europe, who may not be prepared to hear of the remarkable paucity of animals which fell under my observation, in a region so generally understood to teem with animal life at all seasons.

I may notice that, keeping on shore almost constantly while the weather permitted it, I did not advance above fifty or sixty miles above Calcutta; the country being almost everywhere so thickly populated that it was dangerous to point a gun near the ground: to this cause, however, must not be attributed the scarcity of birds in particular, so remarkably noticeable during the epoch of the rains, for the contrast in this respect presented during the cold season is very striking.

There was a total absence of water-fowl upon the river; and the only species of wading or water-fowl observed on land, were a few Egrets *(Paddy-birds)* of different species in the rice-fields, with occasionally an *Anastomus* seen on the wing, and now and then a solitary *Ardea Javanica* would be put up from secluded tanks generally surrounded by jungle; I also observed two or three individuals of the larger Whistling Duck *(Dendrocygna major*, Jerdon*)*, a pair of the Pygmy Greenshank *(Totanus Horsfieldi)* on the margin of a brook, and the only *Rallidæ* seen were two or three individuals of *Gallinula Javanica* vel *phœnicura*.

The *Raptores* were not more extensively represented. The White-backed Vulture (*Vultur leuconotus*, of which *V. Bengalensis*, Auct., is merely the young,) was duly numerous, collected wherever there was, or had been, aught to entice its appetite, or sailing in quest of such delicacies high in the bright sunlight. The *Haliætus Pondicerianus* ('Brahminee Cheel'), so very numerous at other seasons, was seen only once or twice; and the common Indian Kite *(Milvus cheele)*, which literally swarms in Calcutta during the greater part of the year, quits it entirely at the time of the rains, and of this I saw two or three individuals high in air: the only remaining bird of prey observed was *Circætus undulatus*, a pair of which were hovering over Barrackpore park, and another was shot some miles higher up the river.

There are five species of Parrot more or less common in this neighbourhood throughout the year; viz. *Palæornis Alexandrinus*, *torquatus*, *mystaceus*, and *Bengalensis*, and *Psittacula vernalis*. *Pal. torquatus* is the most numerous, and *P. Bengalensis* next so; these I have marked down in my list as having been observed on the present occasion, as also a large flock of what appeared to be the little Crimson-rumped Lorikeet *(Psittacula vernalis)*.

Of Woodpeckers, *Picus Bengalensis* is extremely abundant at all seasons, and *P. Macei* less so: in addition to these was obtained *P. badius*, Raffles, which is not common in this part of Bengal, though I had before observed it. Of Cuckoos, *Cuculus fugax* was numerous, *Oxylophus edolius* less so, and *Centropus Phillipensis* common. *Bucco cyanops* and *B. Phillipensis* abundant. The Kingfisher tribe was as plentiful as at other seasons, consisting of *Halcyon Capensis*, tolerably common, *H. Smyrnensis*, *Ceryle rudis*, and *Alcedo Bengalensis*: the fine *Halcyon amauropterus*, Pearson, *(J. A. S.* X, 635*)*, which is tolerably common near Calcutta during the cool season, I did not observe. The Roller *(Coracias Indica)*, so very plentiful in the cool months, had almost disappeared: and the pretty little green Bee-eater *(Merops*

Indicus), which during the cool season is one of the very commonest birds we have, had not been once seen by me for two or three months in places where it had abounded, when in the course of my late excursion I observed three or four upon one occasion hawking over a paddy field. Of Swifts, we have two species common throughout the year; viz. *Cypselus affinis*, Gray, which frequents towns, and is chiefly seen in their immediate neighbourhood, and *C. palmarum* which mainly affects rural districts, building its nests within the fronds of the fan-leaved palms, sometimes twenty or thirty pairs of them associating in those of a single tree, while it is also rare to meet with one of the same palms clustered with the pensile nests of the Baya, (*Euplectes Phillipensis*,) that does not also harbour two or three pairs of this elegant little Palm Swift.

Among the perchers, the common Indian Crow (*Corvus splendens*, Vieillot), the common Mynah (*Pastor tristis)*, and the common House Sparrow (*Pyrgita domestica)*, were, of course, everywhere abundant about habitations. No other Mynah or allied bird fell under my notice, except the Pied Starling (*Sturnus contra)*. The Indian Black Crow (*Corvus macrorhynchos)*, was here and there seen along the river bank; *Crypsirina vagabunda* in the trees. In the various green lanes, orchard-gardens, and other most likely places to meet with small perching birds in general, scarcely a chirp could usually be heard, and not a bird be seen for perhaps five or ten minutes together: but *Columba tigrina* was numerous in most places, perpetually uttering its coo, and about the most conspicuous feathered inhabitant of this part of Bengal throughout the year is the gregarious and noisy *Malacocercus terricolor*, (Hodgson, here called *Chatarrhœa*, or, oftener, *Saat Bhye*, vide *J. A. S.* X, 650); the tiny but loud chirping Tailor-bird (*Orthotomus Bennettii)*, and the various-chirping *Iora typhia* vel *scapularis*, are other conspicuous species at all seasons; also the Indian Black-headed Oriole (*Oriolus Hodsonii*, apud Swainson), and two species of Bulbuls (*Hæmatornis* of Swainson, the *Ixos Cafer* and *I. jocosus*, Auctorum). The assemblages of Bayas (*Euplectes Phillipensis)* all but invariably select a fan-leaved palm wherefrom to hang their curious and beautifully constructed nests, preferring the immediate vicinity of human abodes; but on one occasion I noticed a number of these pensile nests upon two small exogenous trees, which stood alone near the margin of a rice-field. Small flocks of *Pyrrhulauda crucigera* were occasionally put up in the rice-fields; and among conspicuous species should not be omitted the Fingah (*Dicrurus Fingah)*, though it appeared to be considerably less numerous than at other seasons; the Butchanga of the Bengalees (*D. æneus)* was likewise met with. The Dial (*Copsychus saularis)*, whose pleasing song reminds one of the Robin of Europe, though inferior in quality, being intermediate to that of the British Robin and Redstart, was also frequent; *Muscipeta paradisea* seen now and then; small troops of *Pericrocotus peregrinus* not rare; and the restless Dusky Fantail (*Rhipidura fuscoventris)* moderately common; this bird has a very pleasing, short and tinkling, song. I obtained one specimen of *Tephrodornis superciliosus;* and observed two or three individuals of *Anthus agilis*, which in the cool season is most abundant. Finally, upon the blossoms of the cocoa-nut palms, were seen feeding the brilliant little *Cinnyris sola*, which was tolerably plentiful, its weak chirp and song recalling to mind those of a *Regulus*, and the dull-coloured *Dicæum Tickelliæ*, Nobis (or *Nectarinia minima*, Tickell, *J. A. S.* II, 577), which was less abundant. *D. ery-*

thronotum had also been procured by me a few days previously to this small excursion.

The foregoing brief list comprises all the species of birds I remarked, during daily rambles of several hours; and very scantily were they, in general, dispersed. Of mammalia, the common species were, of course, the Jackal, and the Palm Squirrel and Musk Shrew about habitations. I obtained the *Gerbillus Indicus*, for the first time I had seen it from Bengal, and learned that it was not uncommon about rice-fields. Of Bats, nothing new was met with, at least additional to what I have procured in the immediate vicinity of Calcutta. I observed the Hoonuman Monkey (*Semnopithecus Entellus*) in great numbers, along the banks of a nullah about fifty miles from this metropolis; scarcely less tame than domestic animals, and a great annoyance to the villagers whom they plundered incessantly. As soon as my boat was moored, the trees around and almost hanging over were crowded with them, peering with curiosity, though not unmixed with distrust; nor without due cause, for desirous of getting a fine specimen for the Museum, I soon brought one down, and the villagers, to my considerable surprise, gave every encouragement to shoot others, although themselves would not think of doing so. The sacculated stomach of this individual was quite filled with *finely masticated foliage*, a diet which the conformation of the molar-teeth and stomach in this genus had led naturalists to suspect these animals more or less resorted to,* though the actual fact of their doing so had not, I believe, previously been ascertained. These Monkeys were perfectly at home upon the huts of the villagers, and their surprising agility recalled forcibly to mind M. Ruppell's description of the habits of *Colobus Guereza*.† Their deep and loud, heavy voice, calling to one another among the trees, could be heard to a great distance.‡

Of Reptiles, I scarcely met with anything. The pretty *Calotes Tiedmanni* was now and then seen, and once a sort of Scinque, under a fallen tree, which I failed in secur-

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* Vide Mr. Owen's paper on the stomach of the present species, published in the Zoological Society's *Transactions*, Vol. I.

† The *Colobi* have recently been ascertained by Professor Owen to resemble the *Semnopitheci* in the conformation of the stomach.

‡ The following very interesting observation relative to the habits of the *Semnopithecus Entellus*, I quote from the 'Bengal Sporting Magazine' for August 1836, page 98.

"In the extensive jungles which exist in the Burdwan district, the large black-faced Monkey, the *Honooman* I believe of the natives, is found in considerable numbers, as also in the topes or groves which are scattered over the cultivated parts of the country: which latter circumstance has afforded the means of remarking the curious method which is observed by these animals, for regulating the sexual intercourse of the species. The Monkeys are always found in packs occupying particular trees, and it is remarkable that, in each, only one adult male will be found; the remainder consisting of females and their young. It is also surprising that this individual should exhibit great animosity towards the male young, pursuing them on every occasion, and never failing to destroy them when they unfortunately fall into his power. To obviate this, the mothers make use of many ingenious expedients, keeping their progeny as much as possible out of sight, and when hotly pressed, throwing them from one branch to another into the hands of other she-monkeys, who take charge of them with as much solicitude as if they were their own. The young female monkeys, on the contrary, are not molested in the least.

"At a particular season of the year, the great body of he-monkeys, which had been leading a monastic life deep in the woods, sally forth to the plains, and mixing with the females, a desperate conflict ensues for the favours of the latter. This continues for several days, at the end of which

ing. A large Cobra was observed swimming in the river, but no other snake whatever. Of *Batrachia*, I procured a few Tree-frogs (*Hyla maculosa* of Hardwicke and Gray), which passed the day asleep upon low herbage; also a species of Toad undertermined, additional to that common about Calcutta, and the young of a third species.

Of Fishes, nothing but what is common in the Calcutta bazars.

A few *Testacea* and *Crustacea* were collected, and a considerable number of fine Insects, particularly *Orthoptera* and *Lepidoptera*, but not many species additional to what I had previously met with.

Such is a brief summary of the products of a fortnight's quest for specimens to enrich the zoological collections in the Society's Museum, undertaken, however, chiefly for purposes of observation, to which collecting was regarded as subservient. Of course there were many species which eluded observation, but fewer of birds than of the other classes, whence my list of these will tolerably well illustrate what are to be met with in this part of Bengal at the season when birds are rarest. The frequency of the rain was a great impediment to carrying on any researches of the kind, by rendering many places impassable alike under-foot, and drenching the bushes and under-wood, so that traversing them was as bad as experiencing the effects of a shower; but my little party did their best towards securing whatever they could for the Museum, and while the showers fell, there was work enough inside the boat in preparing what specimens had been collected. I do not, however, recommend any other party to select the same season for similar investigations.

With much respect,
I now subscribe myself,
Yours obediently,
Edward Blyth.

time, one male, more valorous or strong than the rest, will be found in possession of the whole female part of the flock, his discomfited fellows remaining at a short distance from the scene of their defeat. An interesting scene now follows: a kind of conference takes place, the female monkeys delivering up their half-grown male offspring to the care of the former, who troop away to the jungles, reinforced by the juniors, who at the next season return with their foster-fathers to take part in the contests which ensue on their periodical migration."

Though rather out of place here, I shall cite another observation from the same work (for September 1836, page 158), relative to the habits of the Rhinoceros, concerning which it would appear that the nasal horn is not the most formidable weapon of this powerful beast. "At one time," remarks the writer, "I thought it was so, but have long been satisfied that it is merely used *in defence*, and not as an instrument of offence. It is with the tusks they wound so desperately. I killed a huge male, which was cut and slashed all over its body in fighting; the wounds were all fresh, and as cleanly cut as if they had been done with a razor,—the horn could not have been used here. Another we had wounded, stood, and out of pure rage, cut at the jungle right and left, exactly as a hog uses his tusks. One of my friends had a man, who was sauntering through the forests, actually embowelled by a Rhinoceros. He examined the wound immediately, and I heard him say afterwards, that, had it been done with the keenest cutting instrument it could not have been cleaner cut;—that could not have been with the horn." Other facts to the same effect have been related to me by a sporting friend, who has had considerable experience in Rhinoceros hunting; and since transcribing the above, I see that Mr. Robinson mentions, in its 'Descriptive account of Assam,' p. 97, that "the Rhinoceros makes no use of its horn as a weapon of defence, but for this purpose invariably uses its teeth."

I may also here notice, that I have just ascertained the fact of *a plurality of species* being, there can be no doubt, confounded under the appellation of *Hoonuman*, which greatly detracts from the value of what had been hitherto ascertained regarding the geographic range of the alleged *Semnopithecus Entellus*. January 20th, 1843.—E. B.

Read the following letter from the Curator of the Museum Economic Geology.

H. Torrens, Esq. *Secretary, Asiatic Society.*

Sir,—Upon examining the official reports of the late Dr. Voysey, I learn, that with that of 8th August 1821, (Cons. of 21st August 1821,) he forwarded a Geological Map, which was soon after sent to the Honorable the Court of Directors. No record appears of any copy having been made to retain here.

I beg therefore to suggest, that the Society apply to Government to obtain for us copy of this and any other of Dr. Voysey's Maps or Plans, as being documents of the highest possible importance to us, and in fact, almost the only existing materials we have for a Geological Sketch Map of much of that part of India.

I am, Sir,

Your obedient servant,

H. Piddington,

Curator Museum Economic Geology.

A copy of the foregoing letter was forwarded to the Secretary to the Government in the General Department, on the 27th August last, with a request that copies of the Geological Maps of Dr. Voysey alluded to, may be procured from the Honorable the Court of Directors, for the use of the Museum Economic Geology. The Secretary reported, that assurances had been held out for a compliance by the Government with the request of the Society.

Read the following report from the Curator Museum Economic Geology:—

Report of the Curator Museum of Economic Geology for the month of August.

Museum Economic Geology.—I announced in my last report an ore received from Major Ouseley, Agent to the Governor General S. W. Frontier. As I supposed, it has proved to be an argentiferous ore, of sulphurets of lead and antimony in varying proportions, with iron pyrites in a quartz matrix. I obtained from 500 grains of the ore, fairly taken as an average, one and a half grain of muriate of silver, equal to one grain of pure silver. This would give about 70 oz. of pure silver to a ton of well picked ore, which in England would be worth working. I have written to Major Ouseley for more specimens, (those sent being merely the out-crop of the vein,) when we may perhaps find ores of a quality better worth attention; the presence of the antimony being a favourable indication.

We have received from Miss Lloyd, (Darjeeling,) a white earthy powder found in the bed of one of the mountain streams, and used by the Lepchas to whitewash their houses. Upon analysis, this substance is found to be composed of

In 100 Parts.	Carbonate of Lime,	55.20
	Carbonate of Magnesia,	19.04
	Alumina,	6.00
	Silex,	8.00
	Iron,	None
		98.24
	Loss,	1.76
		100.00

In a separate report on this mineral, addressed to our Secretary, I have pointed out the importance of examining the sediments below these deposits, and the river courses above them, so as to trace the rock, and to ascertain if any metallic ore exists in it or in the sediments.

The earthy deposits would make good lime, which is so great a desideratum at Darjeeling.

From Government we received in July, (in which month's report it was omitted by an oversight,) a report by Captain Campbell, Assistant Surveyor General, on the Natural History of Southern India, with two specimens manufactured by himself, from the iron sand of that quarter.

Our zealous member, G. T. Lushington Esq. Commissioner, Kemaon, has also sent us a valuable collection of sixty-four specimens of ores of iron, copper, and lead from Kemaon, which, with the foregoing, are upon the table.

From Mr. Garnier, Engineer, through our Secretary, we have received a specimen of the rose-coloured sienitic granite of the interior of the Pyramids, and one of the limestone from the exterior of them.

Geological and Mineralogical Museum.—I have been continuing the arrangement of the minerals, and we have received herein from the Reverend J. H. Pratt, Chaplain to the Lord Bishop, an excellent little series of fifty-six Geological specimens from Gwalior to Jubulpoor in Bundlecund, comprising several curious and instructive specimens of the Geology of that interesting tract of country.

From Mr. Garnier also, we have a specimen of fossil wood, from the large deposit of it in the Desert between Cairo and Suez.

H. Piddington,
Curator Museum Economic Geology.

No. 465.

To H. Torrens, Esq.
Secretary to the Asiatic Society.

General Department.

Sir,—I am directed to transmit to you, for the Museum of Economic Geology, the accompanying copy of a Letter and Report by Captain Campbell, Assistant Surveyor General at Madras, on the manufacture of Natural Steel in Southern India, received from the Government of Madras, together with the specimens of Steel therein referred to.

I have the honor to be,
Sir,
Your most obedient Servant,
H. V. Bayley,
Deputy Secretary to the Government of India.

Council Chamber, *the 15th June*, 1842.

No. 496.

Fort St. George, 30*th May* 1842.

To the Secretary to the Government of India.

Public Department.

Sir,—I am directed by the Right Honorable the Governor in Council, to transmit to you, for submission to the Supreme Government, copy of a report upon the manu-

facture of Natural Steel in Southern India, received with the accompanying letter from Captain Campbell, Assistant Surveyor General, dated 9th instant.

I have the honor to be &c.

(Signed,) H. Chamier,
Chief Secretary.

(Copies.)

To the Secretary to the Government of Fort St. George, in the Public Department.

Sir,—With reference to a report in October 1841, I have the honor to forward a report on the "Manufacture of Natural Steel in South India," which I request may be laid before His Lordship, the Right Honorable the Governor in Council.

2. Accompanying I have also forwarded a small piece, as a sample, of this steel in the rough state, after having been forged, on removal from the furnace; as also a piece made up into the shape of a Native carpenter's chisel, which has been in use long enough to prove, that the steel will bear a temper as good, if not better, than that of similar articles made in England.

3. The purposes to which this steel might be applied, and in which the Government must now expend vast sums of money are very numerous; viz. ramrods for muskets, axes, bill-hooks, and jumpers for the corps of Sappers and Miners, the various tools of artificers, &c. &c. all of which could be made with iron and steel manufactured in India, for very much less than they now cost from England.

4. With reference to my proposal to undertake to manufacture iron, I shall be happy at the same time to undertake to supply this steel at the rate of 150 rupees per ton, and in quantities probably as large as can be required.

5. I have the honor to remark, that in specifying the above rate for the cost of the manufacture of this steel, and also of the iron, without requiring any further outlay on the part of Government, I have been guided by the *certain* results of my experiments, so as to secure myself against any loss, and do not deny, that the rates mentioned, will probably afford me a very handsome remuneration; but that should His Lordship, the Right Honorable the Governor in Council, be pleased to have sufficient confidence in my knowledge and information in the various branches of physical science, to recommend that I should be employed to institute the manufacture in question, at the risk and immediate expence of Government, I shall be happy to endeavour to economise the expence of manufacture to the lowest possible rate, which I am led to believe might be reduced as low even as 60 rupees per ton, as I hope in that case that there may be no objection to a proportionate increase of my monthly salary.

6. In presuming to propose the institution of my manufactures in question, I am quite aware that it has been stated as a dogma by political economists, that it is objectionable for a Government to meddle with the manufactures of a country, or to attempt unnatural fostering of any particular branch; but with deference, I beg to be allowed to suggest, that a sufficient distinction has sometimes not been made between fostering a trade, and fostering the dissemination of the knowledge necessary

to establish, or to improve a trade. In Europe, of course the latter can never be requisite; but in the present state of India, I believe it will be allowed, that without the fostering aid of Government, no new manufacture can be introduced in which natives of the country may be expected to participate.

7. In the present instance there is no one acquainted with the theory or practice of the processes which I employ, and even if they were well known in Europe they could never be put in practice in India; because being very simple, it is more than probable that in less than five years, the natives will have learned and taken them out of the hands of the first institutors, while the modes of manufacture common in England, which from the great expence of the furnaces, &c. required, are retained in the hands of capitalists, cannot be generally employed in India, in consequence of the manner in which the ore and fuel are distributed through the country.

I have the honor to be, &c.

(Signed) J. Campbell, *Capt. Assistant Surveyor General.*

Ryacottah, 9*th May* 1842.

Report upon the manufacture of Natural Steel in Southern India. By Captain Campbell, *Assistant Surveyor General, Madras Establishment.*

1. In England, steel is made by cementing bars of Swedish or Russian iron, at a high temperature, while embedded in powdered charcoal. In this manner the cheapest kind is produced called "blister steel."

2. By drawing out this steel into small bars under a "tilt hammer," the quality is much improved, and it is then called "tilted steel;" and by combining bars of "blister steel" at a welding heat, and drawing them out under the hammer, "shear steel" of still better quality is formed, and by fusing pieces of blister steel together in a crucible "cast steel" is produced, which is the finest kind of steel made in England.

3. The wholesale prices of the above varieties of steel in the English market vary from 30 to 80*l* per ton, and blister steel is sold at Madras in retail, at the rate of 560 rupees per ton.

4. In Mysore, steel is made by a process which admits of considerable improvement, and is sold in retail at the rate of 373 rupees per ton. In quality this steel is sometimes far superior to any English steel, but as considerable practical knowledge is required to select the good from the bad, and as the quality is very uncertain, it is not probable that while the manufacture remains in the hands of natives, it can ever supersede the use of English steel.

5. The cheapest steel made in India, sells at about 233 rupees per ton, and being of very inferior quality, it is only used by the natives for making axes and bill-hooks.

6. In Germany and Styria, a kind of steel has long been made, by treating cast iron in a particular manner, called "natural steel," or "German steel," which at one time was imported largely into England, and is still used on the Continent, in

consequence of its cheapness, for all rough purposes, such as tipping ploughshares, making axes, &c. &c.

7. This kind of steel is not made in England, in consequence of the bad quality of the iron made from the commoner ores of England.

In a former report, I have shewn that this "natural steel" can be produced immediately from the ore in smelting the "iron sand" of South India, at a very cheap rate; but on further investigation of the process, I have found that by treating the cast iron procured from this ore, in a manner similar to the German methods, a natural steel can be produced without any uncertainty in the result, for less than 150 rupees per ton, which is less than iron now sells for in South India.

9. By experiments on steel which I have made in this manner, I have found that it is fitted for every purpose for which natives now use steel, while the process is so very simple, that it can be learned and practised by natives with very little difficulty, and the apparatus requisite costs hardly any thing.

(Signed,) J. Campbell. *Capt. Asst. Surveyor General.*

Ryacottah, *9th May*, 1842.

(True Copies.)

(Signed) H. Chamier, *Chief Secretary.*

(True Copies.)

H. V. Bayley, *Dept. Secy. to the Government of India.*

JOURNAL

OF THE

ASIATIC SOCIETY.

A Monograph of the Indian and Malayan species of Cuculidæ, or Birds of the Cuckoo family. By Edward Blyth, *Curator of the Asiatic Society.*

In the present state of Indian Ornithology, there is nothing so much required, as a series of carefully prepared monographs of various groups, in which the object should be less to describe new species, than to attempt an analysis of those which have been already made known, more or less satisfactorily, by numerous writers, whose information at present lies scattered in a great variety of works, many of difficult access, and others in which few would think of looking for notices of the kind. In proceeding to offer a series of such monographs, I am quite sensible of my own deficiencies, arising alike from a paucity of expensive works of reference, and from the circumstance of my having so recently commenced the more especial study of Indian zoology; but, on the other hand, the peculiar advantages of my position afford considerable facilities for the undertaking, and I am desirous to commence at once, and publish with as little delay as practicable, such information on many groups as will enable students of zoology in this country to turn their observations to more account, by letting them know whitherto their attention can be advantageously directed, hoping thus to elicit from them those various additional details, which, were I to postpone the publication of these monographs until my own researches should have supplied me with all such desiderata, there would be little chance of their ever appearing at all, and even if they did appear,

it is very doubtful whether they would prove to be of as much practical utility.

The species of Indian *Cuculidæ* are rather numerous, and to these I shall first invite the attention of our zoologists, commencing with those members of restricted *Cuculus*, which, like the included European Cuckoo, have short and half-feathered tarsi—alone a sufficient indication of this particular group.

In the European species of this genus, the sexes are usually similar, though the female has generally some trace of barred markings on the sides of the neck, which are likewise present in a few of the young males of the preceding season, while they are absent in some old females; but I have seen one instance, and heard of others, wherein the adult (presumed) female of *Cuculus canorus* has been entirely clad in a barred livery, quite different from that of the young, and corresponding to the garb which seems to be the ordinary one of certain of its allied Indian congeners, in which state it has been described as a separate species by the name of *C. hepaticus*. A specimen of this kind has been noticed by my friend Mr. Thompson of Belfast, in the 'Proceedings of the Zoological Society' for 1834, p. 29; it was killed at the end of May, as was likewise that which fell under my observation; and it seems probable that the converse occasionally obtains with certain of the Indian species, some females of which may resemble the mature males in plumage, while perhaps the latter in some instances, at least on casting their first or nestling feathers, may assume a dress resembling what in them is the ordinary one of the other sex; this remains to be certified by actual observation.

At least five species of typical *Cuculus* inhabit this country, two of them being characterised by having a shorter and less graduated tail, and markings on the under-parts, which, as observed by Mr. Jerdon in the instance of one of them, have the same character as those of the Hawks, being longitudinal in the young bird, and becoming transverse with age: such are—

1. *C. sparverioides*, Vigors, *P. Z. S.* 1831, p. 173, — Gould's *Century*, pl. LIII.* (Accipitrine Cuckoo.) Length about fifteen inches;

* Probably also the "Ferruginous-necked Cuckoo" of Latham, *Gen. Hist.* III., 269, though differing in the colour of the bill and feet, and in having the wings of ordinary length.

of wing eight inches and a half; and middle tail feathers eight inches, the outermost an inch and a quarter shorter; bill to forehead (through the feathers) an inch and one-sixteenth, and to gape an inch and a quarter; tarse seven-eighths of an inch. General hue of the upper-parts (in the specimen before me) a bronzed dark brown, but slightly tinged with ashy, though I think it probable that older birds would be greyer: crown, occiput, and sides of the upper-part of the neck, very dark ash-colour; the sides and front of the lower-part of the neck bright ferruginous, marked a little with dark ash, and white at the bases of the feathers; chin dark ashy, the throat white streaked with the same, mingled with rufous; lores also whitish: under-parts from the breast fulvescent-white, transversely streaked with dusky, but the vent and lower tail-coverts pure white, with one or two dark bands on only the longest feathers of the latter: tail of a paler brown than the back, and crossed with five dark bars, one of them basal, another subterminal (which is very broad), the extreme tip being whitish, and the penultimate dark bar much narrower than the others; the space immediately bordering the dark bars beyond them being paler than the rest and rufescent: primaries and secondaries obscurely marked on their outer webs with narrow bars of dull pale fulvous, and on their inner webs banded with white internally. Bill dusky horn-colour, with some yellow on the lower mandible; "the irides and feet both pale gamboge-yellow, the feet with a slight buff tinge" (Jerdon). A young specimen has all the upper-parts transversely barred with rufous, except the crown which is dark ashy without markings: under-parts fulvous-white, each feather having a mesial blackish streak: there are six dark bands upon the tail, and the rufous colour bordering them is more developed than in the adult: the head and throat are nearly as in the mature plumage.

Both this and the next species are included in the catalogue of Dr. Royle's birds procured at Saharunpore and in the Himalaya, as migratory, appearing in March; and the present would seem to be chiefly a mountain species. I have not yet met with it in Bengal, but Mr. Jerdon has lately procured two specimens in peninsular India, from which I have drawn up the foregoing descriptions. Of its particular habits and notes I can say nothing.

2. *C. fugax*, Horsfield, *Lin. Trans.* XIII. 178; *Bhrou* (i. e. *burra*

or large) and *Bychan Cuckoo*, and the young—*Sokagu Cuckoo*, of Latham, *Gen. Hist.* III., 264-5; *C. Lathami*, Hardwicke and Gray; *C. radiatus* (?), Gmelin, or *le Coucou brun et jaune à ventre rayé*, Buffon, *Hist. Nat., Ois.*, VII., 379.* (Whistling Cuckoo.) Length thirteen inches and a half, by twenty-two inches in extent; wing from bend seven inches, and tail six inches and three quarters, its outermost feathers an inch and a half shorter than the middle ones: bill an inch and one-sixteenth to forehead (through the feathers), and an inch and a quarter to gape; tarse three quarters of an inch. Colour of the upper-parts uniform ash-grey, the winglet and coverts of the primaries darker: fore-neck and breast pale rufous, each feather light-grey in the centre: belly and flanks white, barred with adjoining lines of grey and rufous; the white hardly visible anteriorly, from the overlapping of the feathers: thighs, vent, and lower tail-coverts, pure white; the first a little barred: throat grey, and some white at the base of the bill and sides of the throat: tail grey, tipped with faint rufous and finally whitish; having a broad dusky subterminal band, and five other narrow undulating zigzag bands (one near the base), composed of a dusky bar and then a whitish one adjoining, with some traces of rufous: quills barred with white on their inner webs for the basal two-thirds or three-fourths of their length: bill dusky, the lower mandible, except at its extreme tip, and the sides of the base of the upper

* Since writing the above, I have seen Sonnerat's figure of his *Coucou à ventre rayé de l'Isle Panay*, and am less inclined to identify it with *C. fugax* than I was previously. It is described to be nearly as large as the European species, *having an even tail:* "the upper part of the head of a blackish-grey; throat and sides of the head vinaceous *(couleur de lie de vin)*; breast dull orpiment-yellow, the belly faint yellow, *and both barred with black;* back and wings dull brown-black; the tail composed of feathers of even length, tipped with white, *and marked with series of white round spots* [upon the shafts], so arranged as to form [interrupted] bars: bill black; the irides pale orange; and feet reddish." Dr. Buchanan Hamilton referred the *C. fugax* to this species; and it appears that the latter has never been verified as distinct, to judge from every succeeding writer having copied from his predecessors.

One of the specimens referred by Latham to his *Sokagu* is described as having "the under-parts of the body to the thighs pale slate-colour," while the description of the back suits very well the young of *C. fugax:* another has "the body beneath pale ash-colour, marked with roundish black spots on the sides of the neck and body"; and a third has "all the under-parts dusky-white, marked with longitudinal streaks of pale brown," which agrees with all the young of *C. fugax* which I have seen no inconsiderable number. It remains for future observers to substantiate these various indications, which however, mostly resting on drawings of more or less questionable fidelity, their value is thereby much deteriorated.

one, wax-yellow: orbits brilliant gamboge-yellow; irides the same: feet comparatively dull yellow. An adult female had the bill pale-greenish at the basal half of the upper mandible, and on nearly the whole of the lower mandible, the rest being dusky; irides brownish-yellow. Size exactly that of the male, and plumage only differing in being less vividly coloured, the breast mottlings dingy and indistinct. The young have the irides paler and greenish; the usual rufous barring of the upper-parts not very distinct, being almost obsolete on the back, and chiefly visible on the wings and about the nape; head ashy; and the longitudinal markings of the lower-parts much less dark than in the preceding species. Very young birds have the bill wholly yellow.

This Cuckoo, originally discovered (if identical with *radiatus*) in the Phillipines, and since observed in Java by Dr. Horsfield, is very common in Bengal, and apparently throughout India—equally so with the British Cuckoo in England. It feeds largely on fruit, especially (as remarked by Mr. Jerdon) on the small figs of the banyan tree, but it also preys on caterpillars and other insects. It is a noisy bird, and has two or three different notes, the most remarkable of which is the shrill whistling *crescendó* note adverted to by Mr. Jerdon, and which Mr. Elliot endeavours to express by the sound "*whe-wheewa, whe-whee-wa, whe-whe-e-wa,* uttered eight or ten times, and sometimes oftener; at first lower, and gradually rising till the later repetitions become extremely loud and shrill;"—indeed, so much so, that it is impossible for one's attention not to be aroused by it, and the bird often delivers this cry perched conspicuously upon a bare branch near the top of a high tree, being answered to, at times, by others, and not unfrequently two or three of them may be heard engaged in noisy contest, emitting then a continuously reiterated squeaking cry, which also increases gradually in loudness. This bird is the *Choke-dello* of the Bengalees, a name meant to be imitative of its note, but which is not very expressive of it.

3. *C. canorus,* Lin. (The European Cuckoo.) This species is tolerably common on the Himalayas, and Lieut. Tickell informed me that it is not rare in the jungles of Borabhúm and Dholbhúm, but Mr. Jerdon states that "it is seldom met with Southward of North latitude 20° [that is, in India, for in Africa I believe it is not unfrequent in the

Cape colony]. Its well known note was often heard in Goomsoor." Colonel Sykes mentions it as found, though rarely, in the Bombay Deccan; and Major Franklin designates it "the common Cuckoo of India": but I have never yet heard its note in the vicinity of Calcutta, though I possessed a living specimen for some months which was taken in the neighbourhood. It is a very rare bird, according to Dr. Horsfield, in Java, and in the specimens from that island "a very slight difference from the bird as it occurs in Europe is observed." Can it be, therefore, that the nearly allied *C. micropterus* is here mistaken for it? I possess an example of the latter from the Malay peninsula, and the Javanese *C. striatus* of M. Drapiez would seem to be no other. The *C. canorus* measures fourteen inches long, by twenty-six inches across; wing from bend eight inches and three-quarters, and tail seven inches, its outermost feathers two inches shorter; bill to forehead (through the feathers) an inch, and to gape an inch and three-sixteenths; tarse seven-eighths of an inch.

4. *C. micropterus*, Gould, *P. Z. S.* 1837, p. 137; probably *C. striatus*, Drapiez, *Dict. Class. d'Hist. Nat.* IV., 570* (1823); *Dunmun Cuckoo, var. A., Latham, Gen. Hist.* III., 264,—that previously described by him being either a variety, or (more probably) merely an imperfectly moulted young specimen, retaining its nestling white-tipped larger wing-coverts,—erroneously (I presume) referred by this author to the *Coucou vulgaire d'Afrique* of Levaillant, or *C. gularis* figured and described in Shaw's *Zoology* (IX, 83), which would seem to be very closely allied. (Great-billed Cuckoo.) Differs from *C. canorus* in its inferior size, larger bill, the darker hue of its upper-parts, and differently coloured iris, while its note is very distinct: length of a male twelve inches and a half, by twenty-three inches

* "Taille, douze pouces. Parties superiéures d'un brun cendré, bleuâtre; remiges brunes, frangées de blanchâtre, le deux premiéres dentelées de roussâtre; rectrices peu etagées [if we except the outermost pair, this holds good in *C. micropterus*], noirâtres, avec l'extrémité et des taches le long de la tige blanches; gorge et devant du cou d'un cendré bleuâtre, très-clair; parties inferiéures blanchâtres, rayées transversalement de noir; bec noir, roussâtre en dessous à sa base; pieds rougeâtres. De Java. On nous a communiqué sous le nom de *Cuculus dasypus*, un espéce de même taille venant également de Java, qui pourrait bien être le Coucou a ventre rayé [*striatus*] dans son jèune age; il en diffère en ce que les parties superiéures sont toutes traversées de bandes rousses, et qui la gorge et la devant du cou sont semblables au restes des parties inferiéures."

in extent; wing from bend seven inches and a half, and tail six inches, the outermost feather two inches shorter: another specimen had the tail six inches and three-quarters long: bill to forehead (through the feathers) an inch and one-eighth, and to gape an inch and five-sixteenths; tarse three-quarters of an inch. Bill coloured as in *C. canorus*, but the irides pale dusky, and the orbits and feet light wax-yellow: the abdominal cross-streaks are, also, usually broader and wider apart than in *C. canorus;* but perhaps the most ready distinction is afforded by the comparative shortness of the wings. Colour of the upper-parts darker, and in old birds uniform pure dark ashy; in specimens once moulted a bronzed ash-brown, with the head and neck grey, the throat and breast pale grey, and slight traces of rufous on the sides of the neck and on the wings. A young Malayan specimen has much white about the head, occupying the whole loral feathers, broadly margining the lateral feathers of the crown, and passing backward as an ill-defined streak to the occiput; ground-colour of the upper-parts dull brown, with a slight gloss of bronze; the nuchal feathers having one broad bar of white, which is little seen from their overlapping, and slightly edged with pale rufous; the interscapularies with a narrow single bar of pale rufous, and margined with the same; scapularies, wing-coverts, and tertiaries, more broadly tipped with dull white, and together with the primaries and secondaries more or less barred or spotted with dingy rufous; inner webs of the primaries marked with white, as in the adult; the white markings on the shafts of the tail-feathers more developed, and the medial tail-feathers spotted with faint rufous along both margins; the upper tail-coverts are barred with rufous and tipped with whitish, the lower almost spotless: under-parts fulvous-white, barred with dusky, which latter is almost hidden on the throat and breast by the broad pale margins of the feathers.*

This bird is common on the Himalaya, and I was informed by Lieut. Tickell that it is of frequent occurrence in the neighbourhood of Chyebassa, in Central India, but I cannot find it recorded

* This young bird seems to agree, except in being a trifle smaller, with the *Brown Cuckoo* of Latham, *Gen. Hist.* III., 291. "Length thirteen inches, bill bent; general colour of the back and wings brown, mottled with white; head, neck, and under-parts, white, with dusky markings; tail long, cuneiform, whitish, barred irregularly with dusky; legs bluish; toes before and behind tolerably hooked. Inhabits Ceylon."

in Mr. Jerdon's catalogue, though I doubt not it is occasionally met with throughout the wooded parts of the country. A specimen from the Malay peninsula has already been noticed, and I presume it to be the Javanese *C. striatus* of M. Drapiez, if not also Dr. Horsfield's Javanese slight variety of *C. canorus;* I also find it included in Mr. Vigne's catalogue of his collection of birds procured in Kashmir and Little Tibet (*Proc. Zool. Soc.*, January 26, 1841). About Calcutta it is not rare, though I have hitherto been able to procure but one recent specimen; but I have often heard the musical note of another in possession of a native, and from which is derived its Bengalee appellation of *Bocuttácko*. Lieut. Tickell termed this a double repetition of the sound *cuckoo*, and the tone of utterance is much the same as in the last species, or it may be styled a melodious deep-toned whistle, agreeable to hear despite its monotonous reiteration. Among the natives this bird is an especial favorite. The captive specimen had the same pale feet and orbits, as compared with the European species, and light dusky irides, as in that which I procured for the Museum: but neither of these were in the final pure grey plumage, but in what I have described as their second dress. The name *Dunmun*, which according to Dr. Latham this species bears in Calcutta, seems to be quite unknown here.

5. *C. poliocephalus*, Latham, *Gen. Hist.* III., 181,—the grey old male; *C. Himalayanus*, Vigors, *P. Z. S.* 1831, p. 172,—Gould's *Century*, pl. LIV., but the tarse erroneously represented as unfeathered;—not of Jerdon, *Madr. Jour.* XI., 220: the female, or dress corresponding to that occasional livery of *C. canorus* upon which was founded the fictitious *C. hepaticus*. (Small Himalayan Cuckoo.) Male exactly resembling the mature examples of the last species in colour, except that the specimen examined has a stain of rufous on the breast, as often happens in younger males, and especially females, of *C. canorus*, (though the bird here described had nearly quite assumed this livery for at least the second time); but the size is very much smaller, this measuring but ten inches to ten and a quarter in length, the wing five inches and seven-eighths, or commonly a trifle less, and tail five inches and one-eighth; bill from forehead eleven-sixteenths of an inch, and from gape an inch; tarse posteriorly five-eighths of an inch. It is possible that old females assume a similar garb; and that young males, once moulted,

do not differ in their colouring from ordinary females. The latter have all the upper-parts fine rufous-bay, spotless (or nearly so) on the forehead, sides of the neck, and rump, but elegantly barred with dusky across the scapularies, wings and tail, and faintly on the crown, hind-neck, and interscapularies: under-parts barred more broadly than in the male, including the lower tail-coverts, which in the male are spotless; the throat, fore-neck, and breast, whitish along the middle, and stained with rufous laterally, having also dark bars more or less distinct; and there are the same white markings along the shafts, and at the tips of the tail-feathers, as in the male of this in common with the foregoing species, which white markings are wanting in *C. niger* and probably *Sonneratii.* A specimen in full-grown nestling plumage has the bill shorter, less curved, and wholly black; and the plumage altogether as in the darker examples (which I believe are always females) of the young of *C. canorus:* the head, neck, and smaller wing-coverts, being dusky-black, margined, as is the whole upper plumage, with white; fore-neck and breast the same, but with a white bar across the middle of each feather; a similar bar, but faint rufous, across the scapularies and interscapularies, and two or more such bars on the upper tail-coverts; tail as in the female, but having the white markings more produced, as are also the rufous bars of the primaries.

Upon a former occasion, I referred this species to *C. Sonneratii,** but have since met with another from peninsular India which I cannot doubt is the latter, while the adult male of the present one is distinctly the *C. poliocephalus* of Latham. It appears to be peculiar to the Himalaya, and the specimens here described are from Darjeeling. I have been informed that its note is proportionally very loud.†

* Vol. XI, p. 168.

† Here may be noticed the *C. rubeculus*, Swainson, *Nat. Libr., Birds of Western Africa*, II, 181. "Wings six inches and a half long; breast and sides of the neck rufous; body beneath fulvous-white, with broad black bars; tail black, with three white spots down the shaft; the tips white. This Cuckoo is at once known from the last [*C. nigricans*, Swainson,—"Above and beneath black, glossed with blue; quills internally white, with blackish bands; tips of the lateral tail-feathers whitish; bill and legs black;"] by the colour of its tail and the greater breadth of the black bars on the body. A young specimen, in a state of moulting, has obviously been prepared by the Senegal bird-stuffers; but what we consider as the adult bird is a specimen sent, as we are informed, from India: both, however, agree in the length

Two species are confounded with it in Mr. Jerdon's elaborate catalogue of the birds of peninsular India, namely, the young of his doubtfully cited *C. flavus*, which is *C. tenuirostris* of Hardwicke and Gray, and evidently identical with *C. niger* of Latham and Gmelin, and the closely allied species which I refer to *Sonneratii*, Auctorum, both of these having been sent me by Mr. Jerdon as the adult and young of *C. Himalayanus* of his list. One of them agrees with all the preceding in having the tarse half-feathered, but the plumage of both is much more closely barred, and the tail in particular (of *C. niger* at least, for the other has this part too imperfect to judge from,) presents as many as fifteen cross-bars in the young bird, wherein this agrees with the female Cöel. There would appear to be other Indian species allied to these, which are at present very imperfectly known: and I much suspect that all will prove to have the males glossed dusky-ash of some shade, without markings except on the tail, while the females are permanently barred or spotted, in which respect they would resemble the Cöels (subgenus *Eudynamys*.)

6. *C. Sonneratii* Latham, *Ind. Orn.* II, 215; *le petit Coucou des Indes* Sonnerat, *Voy. Ind.* IV, 216; *C. Himalayanus* apud Jerdon, *Madr. Journ.* XI, 220, where *C. tenuirostris*, Hardwicke and Gray, is introduced as a synonym, the young of this being con-

of the wings and the peculiar colour and markings of the tail, so that we have but little doubt that they are of one species; although, in the young bird, the rufous colour of the breast, and the bands on the body, are not so dark as in the supposed adult from India. The vent and under-tail-coverts are light buff-colour."

It may be remarked that Mr. Swainson is one of those authors who, in general, use the term *India* in the vaguest signification, including the Burmese and Malay countries, if not all Southern Asia eastward of the Indus. Thus, to select one of many instances, he remarks, of the *Eurylaimi*, that "their geographic limits seem to be restricted to the hottest parts of India" *(Class. Birds*, II, 81*)*; the truth being, that no species has yet been discovered in the "hottest parts of India," properly so called, but there are two on the flanks of the Himalaya, a third in Assam, and proceeding thence southward, to the east of the Bay of Bengal, the number increases in the ceded Tenasserim provinces, and attains its maximum in the Malay Peninsula and Islands; the two species first alluded to, however, not extending southward, so far as has yet been observed. Consequently, one of the distinctive features of the Ornithology of India, on the one hand, and of the Burmese and Malay countries on the other, consists in the developement of this remarkable group in the latter; and the impropriety of designating the whole by the appellation *India*, is especially apparent in the case cited.

founded with the present species. (Sonnerat's? Cuckoo.) The only objection I can perceive to the propriety of referring a specimen before me to the *Little Indian Cuckoo* of Sonnerat, is that, that author states the bill, feet, and irides of his bird to be yellow, whereas in the one here described the feet appear to have been dusky-plumbeous, with at most a tinge of yellow, and the bill is wholly black, mixed with whitish on the lower mandible. It resembles so much the female and young of the next species as to have been confounded with them by so acute a discriminator as Mr. Jerdon; but may, nevertheless, be readily distinguished from them by having the tarse half-feathered, and by the greater length and stoutness of the bill, which is also less compressed towards the tip. Probable length of the recent specimen about nine inches and a half, of wing five inches and one-eighth, and tail (the medial feathers being wanting) four inches and one-eighth; bill to forehead (through the feathers) above an inch, and to gape an inch and one-eighth; tarse three-quarters of an inch, and externally feathered nearly to the toes. Another distinction from the females and young of the next species consists in the whole under-parts from the throat, being white, but very faintly tinged with fulvous on the flanks, and marked throughout with numerous narrow dusky bars, agreeing thus with the description given by M. Sonnerat; the sides of the head and neck are also white similarly barred, but the ear-coverts are coloured like the back, and the frontal feathers white at base, shewing conspicuously just over the bill; upper-parts uniformly greenish-dusky, with numerous cross-bars of rufous, excepting on the coverts of the primaries, while the latter have only an indication of these bars on the extreme edge of their outer-webs. Of the tail only two feathers exist in the specimen, which appear to belong respectively to the second and third pair; their colour is rufous, with a broad dusky bar near the end, the external webs almost wholly dusky, with traces of rufous barring on the extreme edge, more conspicuous towards the base, and fragments of numerous other bars on the inner web; its two external feathers are also seen, on turning up the rump plumage, to be growing, and what appears of them is rufous with a whitish tip, a dusky outer web and subterminal broad bar, with other narrower bars on the inner web. The body-plumage had recently been renewed, and I judge the specimen to be a mature female, and

have very little doubt that the adult male will prove to resemble much that of the next species.

Mr. Jerdon states of this bird, though it is necessary to bear in mind that he did not properly distinguish it from the following species, that "it is found, though rarely, all over the peninsula, in thick forest jungle. I have observed it once or twice only, in Malabar, and in the Coonoor Ghaut, but have seen specimens from Travancore, where it appears tolerably abundant, and also from the eastern range of ghauts, about the latitude of Madras. The stomach of the only specimen I shot contained caterpillars."

7. *C. niger*, Latham, *Gen. Hist.* III. 285*; *C. Bengalensis niger*, Brisson, IV. 141,—as cited by Latham; *C. tenuirostris*, Hardwicke and Gray,—the middle-aged female; doubtfully quoted as *C. flavus*, *honoratus*, *Sonneratii*, and *lugubris*, by Mr. Jerdon, *Madr. Journ.* XI. 220, but distinct from all of these,—the adult male. (Plaintive Cuckoo.) Distinguished from the preceding by its smaller, shorter, and more curved bill, and wholly naked tarse. Length, of a male, nine inches, by thirteen inches in extent; wing four inches and a half, and tail the same, its outermost feathers an inch shorter; bill to forehead (through the feathers) barely seven-eighths of an inch, and to gape fifteen-sixteenths of an inch; tarse somewhat exceeding five-eighths of an inch. Plumage varying much in colouring according to age and sex. What I infer to be the fully mature male is described by Mr. Jerdon to have "the plumage above entirely cinereous, with a slight indication of greenish gloss on the wings only; beneath pale cinereous, vent and under tail-coverts white; the quills with a broad white band on the internal webs; and tail black, its inner webs banded with white, except the two central feathers, and all tipped white. Irides of a fine ruby red." Another is described by him to be "entirely of a dark cinereous tint, with a strong gloss of green throughout; tail blackish, edged with rufous; quills beneath cinereous. Irides blood-red: the bill blackish red beneath (at the base), also at the gape and internally; feet reddish." A third he describes as of "the same glossy green colour above, with the exception of the rump, which is a lighter cinereous without any green,

* The sole objection to this identification is, that the bill is stated to be orange.

and the forehead—which also is nearly devoid of the green; chin and throat cinereous; breast the same but darker, banded with rufous and white; the belly pale cinereous, faintly marked with pale rufous and white; under tail-coverts and tail as in the first." One procured near Calcutta, from which the admeasurements here given were taken, agrees nearly with the last, and exactly with a specimen sent by Mr. Jerdon: irides brownish-red, the orbits dusky; bill also dusky, with merely a dull yellowish tinge at the base of the lower mandible; inside of the mouth carneous deeply tinged with coral; feet olivaceous, tinged with yellow underneath. Upper-parts wholly dusky-cinereous, with a greenish gloss, except on the head and rump; throat, breast and belly, somewhat lighter cinereous; the vent, under tail-coverts, and greater part of the exterior webs of the outermost upper tail-coverts, white; tail blackish, its outer feathers successively more broadly tipped with white, and the inner webs of the two outermost feathers on each side barred with the same. A specimen casting off the nestling livery has the new growing feathers of its under-parts a dull ruddy-brown colour without markings, including the belly and under tail-coverts, while those of the head and back are greenish-glossed dusky-cinereous, as in the last preceding adults. The gloss of the upper-parts of this young bird, as also the colour of the irides of the glossed Bengal specimen before described, together with the analogy of *C. micropterus*, (the second brownish plumage of which is much bronzed, while little or no trace of this exists in dark ash-coloured specimens,) indicates that the glossless uniform dark ashy examples of the present species are also in fully mature plumage, the glossed being younger birds. A specimen, which I infer to be an old female, agrees in dimensions: all the upper-parts are bright rufous, barred with broader dusky bands than in younger birds, having a greenish shine, and which are obsolete on the occiput and rump, and nearly so on the upper tail-coverts; primaries wholly dusky-brown, with slight rufous edges towards their base only, these being more developed on the secondaries; tail rufous, its medial feathers marked along the shaft with dusky, and the rest shewing fragments of dark bars, and a broader subterminal dusky band, with a white spot at the tip; sides of the neck rufous, the throat, fore-neck, and breast, much stained with the same, and more or less crossed with un-

dulating dusky bars; belly, flanks, and under tail-coverts, white, with similar cross-bars more scanty on the last; some of the tibial feathers shewing traces of rufous, but otherwise white barred with dusky: the legs appear to have been dusky-yellowish. Two other presumed females agree better with General Hardwicke's figure, except that their colouring is not so rufous, but more ferruginous, and their markings generally somewhat finer: both have the entire under-parts deeply tinged with dingy ferruginous, a little albescent on the belly and lower tail-coverts; their upper tail-coverts and rump have very numerous cross-bands, as likewise the occiput; and the tail has as many as fifteen bars, the same as in the female Coël. The immature plumage of the young male before noticed, as killed while in moult, has the barring of the upper-parts of a more mottled character, the ferruginous tint paler, and the nestling feathers retained on the under-parts are banded pretty much as in the last described females; its new tail-feathers resemble those of the adult male, while the only one left of the nestling series (being the penultimate) is rufous, crossed with twelve or thirteen dusky bars.

The points of resemblance between this bird and the common large Coël (*Eudynamys orientalis*) are worthy of being noticed; viz. 1. the crimson irides,—2. the sexual diversity of plumage, which I suspect to be constant,—3. the uniform dark colouring of the male,—and 4. the nakedness of the tarse, wherein it differs from all the foregoing species; while the number of caudal bars in, at least, the younger females is a further token of this affinity, and *C. honoratus* would seem to be intermediate. Latham's description of his male *C. niger* is sufficiently accurate, except that he assigns an orange colour to the bill; but his female does not accord with any specimen which I have seen. This is described by him as having "a pale bill; is brown above, spotted with white; head striped white and brown, over the eye a white streak; under-parts white, with irregular brown spots; thigh-feathers long, barred with brown; tail cuneiform, brown, *crossed with fourteen or fifteen* whitish bars, the tip fringed with white; legs pale blue."

From what I can learn, this Cuckoo appears to be not a rare bird in Bengal, though I have hitherto succeeded in procuring but one

recent specimen* ; and Mr. Jerdon remarks that " the Plaintive Cuckoo, as it may be appropriately named, is an inhabitant of the western coast of the peninsula, being found alike in thick jungle, and in the more open spaces, and even in gardens and avenues. It occurs at all levels from that of the sea, to the top of the Neilghierries, about Coonoor and Kotagherry, where it is found in thick bushy ground. [I have been informed by this naturalist, that he has since ascertained it to be much more generally diffused than he formerly supposed.] Like the other Cuckoos it is found single or in pairs. It has a most sweet and plaintive note, which is often heard, and which sounds something like the last syllable, being *whe-whew, whe-whe-ē-w*, much lengthened out, and very plaintive. I found its food to consist chiefly of caterpillars."†

* I have since obtained others, among which is a female that had nearly acquired the adult garb of its sex, similar to that described above,—also two males, quite similar to each other, but in a phase of plumage different from any described in the text, and one of them incompletely moulted into this livery, retaining a few unshed secondaries and wing-coverts, together with some scattered feathers upon the nape, belonging to the first or mottled dress common to both sexes. These have the back and wings dark grey, glossed with green, the head, neck, rump, throat, and breast, pure ashy, the last being tinged with rufous, while the rest of the lower-parts, from the shoulders of the wings to the lower tail-coverts inclusive, with also the fore-part of the inner surface of the wings, and the axillaries, are uniform bright rufous-buff; irides comparatively dull red. A specimen described in the text was also moulting out of its first or mottled livery, and throwing out rufous feathers on the under-parts, but these are considerably duller than in the two now noticed, and they equally appear on the throat and breast, which in the present specimens are grey; moreover the upper-parts were coming much darker than in the latter, and equally so on the crown and back. The man who shot one of the rufous-breasted males here described, informed me that he saw it follow a butterfly on the wing, which it endeavoured to capture with its feet in the manner of a Hawk; a trial that has already been recorded of the European Cuckoo. I may add that the average size of the present species exceeds the dimensions given in the text, the males commonly measuring about nine inches and a half long, by thirteen inches and a half across; and the females nine quarter by twelve inches and three quarters.

† The Javanese *C. rufovittatus* and *C. pyrogaster* (habitat not given) of Drapiez *(Dict. Class. d'Hist. Nat.*, Art. *Coucou)*, may be varieties of this or the preceding species.

" *C. rufovittatus*. Taille, sept pouces. Parties superiéures d'un brun noirâtre, rayées de roux vif; plumes du front blanches à leur base; rémiges brunes, dentelées de roux à leur bords; rectrices largement bordées de roux, avec l'extrémité blanche, d'un roux fauve en dessous; gorge, devant et côtes du cou, et poitrine blancs, finement rayés de noirâtre; parties inferiéures d'un blanc roussâtre; bec noir, brun en dessous à sa base; pieds d'un jaune rougeâtre. La femelle a fauve tout ce qui est d'un roux

8. *C. flavus*, Gmelin: *le petit Coucou de l'Isle Panay*, Sonnerat, *Voyage a la Nouvelle Guinée*, p. 122; *le petit Coucou à tête grise, et ventre jaune*, Buffon, *Hist. Nat., Ois.* VI, 382. So far as an opinion can be formed from Sonnerat's figure of this species, I incline to regard it as nearly allied to the preceding one; but the tarsi are doubtless represented much too long, and they are figured to be naked, as in *C. niger*. Length (apud Buffon) about nine inches, of which the tail measures more than half, and is of a wedge shape. Upper part of the head and throat light grey; the nape, back and wings, pale umbre-brown; belly, thighs, and lower tail-coverts, pale yellow tinged with russet; and the tail black, barred with white. Bill and feet light yellow, the former tipped with black. A female is described by Sir Stamford Raffles to have "the tail barred with brownish-yellow instead of white, and the grey extending to the breast. The nostrils are perfectly round and tubular, their edge forming a prominent ring. Found at Pulo Penang:" also in the island of Panay, and very abundant in Java, and doubtless in the Malay countries generally; frequenting the plains and cultivated tracts, where, in Java (according to Dr. Horsfield), "it is heard in the morning from almost every tall tree. It has three distinct notes, which it repeats in great regularity with a loud but not unpleasant voice, although by many natives it is considered ominous of evil."

9. *C. (Eudynamys?) honoratus*, Lin; *Cuil*, v. *Coucou tachété de Malabar*, Buffon, and figured in Shaw's *Zoology*, IX, 104: identified, according to Levaillant, with his African *Coucou Tachirou, Oiseaux d'Afrique*, pl. 216, apud *Dict. Class. d'Hist. Nat.*, IV, 569. This manifestly appertains to the Coël section, differing from the common Coël in being much smaller, in having a still more graduated tail, &c.: what is probably the livery of the female and young appears to be the only one described in the books to which I have access.

vif chez le mâle; elle a le sommet de la tête cendré, la gorge et les côtés du cou teints de fauve, et toutes les parties inferiéures rayées de noirâtre. De Java.

"*C. pyrogaster*, Vieillot. Taille huit pouces, six lignes. Parties superiéures d'un brun bronzé, rayées transversalement de fauve; sommet de la tête tirant sur le cendré; rémiges intermédiares dentelées de fauve, les latérales de blanc; toutes étagées et terminées de blanc; gorge, dessous du cou, poitrine et ventre d'un fauve pâle, rayés transversalement de brun et de blanc; bec noir, brunâtre à sa base en dessous; pieds rougeâtres."

Length above a foot, the tail about six inches, and very much graduated, its outermost feathers scarcely more than half the length of the middle ones. All the upper-parts blackish-ash, marked with two points of white on each feather; the throat and under-parts white, with ash-coloured cross-rays; quills cinereous, and also marked with transverse macular bars. This bird is stated to inhabit Malabar, but much requires to be verified as an inhabitant of India. It is apparently intermediate to the common large Coël and diminutive *C. niger*.

10. *C. (Eudinamys*, Vigors and Horsfield, *Lin. Trans.* XV, 304,*) orientalis*, Lin.; *C. Indicus*, Latham, *Ind. Orn.* III, 285; and the female—*C. Mindanensis, scolopaceus, crassirostris, punctatus*, and *maculatus*, Auctorum. (Common Coël.) Length fifteen and a half to sixteen inches, by twenty-three inches in extent; wing seven inches and a half, and tail the same; bill an inch and a quarter to forehead (through the feathers), and nearly one and a half to gape; the tips of the mandibles opening to two inches and a quarter from the hooked extremity of the upper one; tarse an inch one-eighth, and bare of feathers except close to the joint: irides bright crimson, affording a very conspicuous character in the living bird, and quite relieving the sombre uniform greenish-glossed black colour of the plumage of the mature male: bill pale greenish, and inside of the mouth flesh-coloured: legs somewhat bluish-slaty, or in younger individuals dull greenish lead-colour. Average size of both sexes alike, or nearly so, though it may be that the females are more commonly somewhat the larger. Too well known in India to require a further description. This bird is very common in Bengal, as also in the Malay countries, extending even to Australia (*Lin. Trans.* XV, 304), where, however, it is understood to be rare.* Mr. Jerdon notices it as "common in the Carnatic in groves, gardens and avenues, and also on the west coast; but rare on the bare table-land. It feeds entirely on fruit, and is remarkably fond of the fig of the banyan tree." During the time these figs are ripe, which is early in the cold season in Bengal, the trees are quite alive with Barbets (*Bucco*), Coëls, and other less abundant visitants. Col. Sykes remarks, of the Coël, that "its sin-

* The *Cuc. crassirostris*, currently identified with this species, is described as African.

gularly loud notes are not at all like those of a Cuckoo" (*P. Z. S.* 1832, 97): assuredly they do not resemble that "note of fear, unpleasing" to particular parties, but those who are acquainted with the melodious liquid shaking note which the European Cuckoo frequently utters as it takes wing, will immediately recognise the Coël's cry as thoroughly *cuculine;* at least I did so, before I knew what bird it proceeded from. The Coël is very commonly kept caged by the native inhabitants of Calcutta, becoming quite fearless and familiar, and frequently uttering its loud cry (*koyo-koyo-koyo*, with variations,) adverted to by Col. Sykes, as well as another note, which truly corresponds to the sound *cuckoo* emitted by the bird of Europe, and which sounds like *ho-whee-yo,* delivered at intervals as the *C. canorus* utters its well-known cry, often for a long while together, and not unfrequently in moonlight nights. The Coël is remarked by Mr. Jerdon to be parasitic,* and here as with him usually selects the nest of the common Indian Crow (*Corvus splendens*) to deposit its egg (or, as I am told, generally two eggs) in; and I am further assured, that it is no unfrequent occurrence for the Crow to turn out the young Coël at the age when it has begun to put forth its spotted feathers. This remains to be certified by further observation. The Coël is very good eating; and the same is stated of the European Cuckoo. As compared with the allied species, its robustness of form would seem to be exceptional, rather than normally characteristic of its subgenus, and its relation to some of them may be compared to that of *Gracula* (or *Eulabes*, Cuv.,) *religiosa* to *Pastor tristis* and the other thick-built smaller Mynahs.

I shall not venture to introduce, as an established species, different from the Coël, the *C. Panayus*, Latham, *Ind. Orn.* I., 210, *Gen. Hist.*, III., 281,—founded on the *Coucou tachété de Panay* of Sonnerat: which appears to differ only from the female *orientalis* in wanting the rufous on the ear-coverts (not always present in the young of the latter), and in having an ungraduated tail: the throat and upper part of the front of the neck are also figured and described as black, spotted like the back, and abruptly defined. It is said to inhabit the island of Panay, but needs verification.

* Vide also *J. A. S.* VIII. 684.

Subgenus *Pseudornis*, Hodgson, *J. A. S.* VIII. 136.* (Drongo Cuckoos.) Essential structure that of the other Cuckoos with feathered tarsi, but the tail even or forked, except that the outermost feathers are much shorter than the rest, and the two lateral halves of the tail curve outwards towards the extremity, as in the Drongos. The size, colouring, and general aspect, also, so closely resemble those of the Drongos (*Edolius*, subgenus *Dicrurus*), that an ordinary observer might readily mistake one for the other, whence Mr. Hodgson's apt designation of *false bird* (*Pseudornis*), i. e. 'disguised Cuckoo.' Mr. Jerdon, indeed, suggests, of one of them,—"Does this Drongo Cuckoo select the nest of the *Dicrurus* to deposit its eggs in? If so, the foster-parents would hardly be undeceived even when their progeny were arrived at maturity." The sexes are similar, but whether the young also resemble the adults I am unaware. These birds inhabit upland forests.

11. *C. (Pseudornis) dicruroides*, Hodgson, *J. A. S.* VIII. 136—*Madr. Journ.* XI., 221. (Fork-tailed Drongo Cuckoo.) Length ten inches to ten and a half, of wing five and a quarter to five and a half inches, and of penultimate tail-feathers five inches and a half to five and three-quarters, the outermost an inch and a quarter less, and the medial three-eighths of to half an inch less than the penultimate; bill to forehead (through the feathers) an inch, and to gape rather more; tarse three-quarters of an inch. Irides hoary-brown; bill black, the palate red; legs and feet blue. Colour black, with a changeable blue and green gloss, brighter on the upper-parts: head subcrested: the outer webs of some of the long tibial feathers white, as also those on the tarse, and the under tibial feathers which are of downy texture; a minute speck of this also near the tips of the outer principal wing-coverts, but often obsolete; the same occasionally on the tips of the upper tail-coverts, and a series of such on the lower tail-coverts; the outermost tail-feather obliquely barred with white, the bars in some contracted into spots, and finally an oblique streak of white on the inner surface of the wing, and a round spot of it on the inner web of the short outermost primary.

*Erroneously identified with *Oxylophus*, Swainson, by Mr. G. R. Gray, *List of the Genera of Birds*, &c. 1st edit. p. 57.

In Nepâl, according to Mr. Hodgson, this species is confined exclusively to the mountain forests; and I am informed that it occurs rarely at Darjeeling. A single specimen has been obtained by Mr. Jerdon in Southern India, near Manantoddy, in the Wynaad; in this individual the irides are stated by him to have been reddish-brown, and the legs reddish.

12. *C. (Pseudornis) lugubris*, Horsfield, *Lin. Trans.* XIII. 179, and *Jav. Res.*, with a coloured figure; *C. albopunctulatus*, Drapiez, *Dict. Class. d'Hist. Nat.* IV, 570. (Square-tailed Drongo Cuckoo.) This so very much resembles the last as to require some consideration as to the propriety of admitting them as distinct; but on minute comparison I am satisfied that they are distinct, although the plumage absolutely resembles, to every white speck and marking on the greenish-glossed black ground; the example of *C. lugubris* before me has, however, an occipital spot composed of three or four wholly white feathers, which I do not perceive in the preceding species, though both specimens of the latter which I have for comparison are unfortunately somewhat defective of feathers just at that part; there are also a few scattered white specks upon the crown and on the breast of *C. lugubris*, which however may occur in some specimens of the other: the more distinctive differences consist in the present being a smaller bird, with shorter wings and tail, the latter square, or merely exhibiting a furcate tendency from the decided curvature outward of each lateral half, besides which the outermost pair of tail-feathers are in a greater degree shorter than the rest than in *C. dicruroides*. Length about nine inches, of wing four inches and seven-eighths, and tail four inches and a half, its outermost feathers an inch and a half shorter than the rest, whereas in *C. dicruroides* these are but an inch and a quarter shorter than the more elongated penultimate tail-feathers; bill to forehead (through the feathers) fifteen-sixteenths of an inch, and to gape an inch; tarse under five-eighths of an inch. Bill and feet black, according to Dr. Horsfield, but the latter seem to have had a yellowish tinge in the Society's specimen: irides, according to the same authority, dark-coloured.

"The *C. lugubris*," writes Dr. Horsfield, "is found in districts of secondary elevation, which are diversified with extended ranges of hills and covered with luxuriant forests. The southern and wes-

tern parts of Java are generally of this description. In the extensive central plains intervening between abrupt, conical, and elevated mountains, and which are generally in a high state of culture and covered with flourishing towns and villages, I have rarely observed it. This bird retires into the deepest coverts, and having a dark plumage, it is with difficulty surprised. Its peculiarities, both as to voice and habits, have not, as far as known to me, been observed. Its habits are very different from those of *C. (Eudynamys) orientalis* and the *C. flavus*, both of which are very abundant in Java." The specimen here described was brought from Singapore.

Subgenus *Chrysococcyx*, Boié (1826), v. *Lampromorpha*, Vigors, v. *Chalcites*, Swainson. (Metalline Cuckoos.) The members of this group absolutely resemble the first or typical Cuckoos in structure, being merely characterized, in addition to their very small size, by the resplendent metallic hues of their plumage.

At least three inhabit the Malay countries, two of which are described by Dr. Horsfield in *Lin. Trans.* XIII., 179, and one of them more elaborately in his 'Zoological Researches in Java'; besides which the next appears to be not uncommon in the Malay peninsula, if not also in the Tenasserim provinces.

13. *C. lucidus*, Gmelin; *C. Malayanus*, Raffles, *Lin. Trans.* XIII. 286,—the female; *C. metallicus*, Vigors, *Ibid.* XV. 303,—the young, as satisfactorily shewn by specimens in transitional plumage. (Banded Emerald Cuckoo.) What are evidently the male, female, and young, of a species which appears to be referrable to the foregoing, are clearly identical with one another, the intervention of the female livery assisting to demonstrate the necessity of bringing the above synonyms together. Length of a splendid male fully seven inches, of wing four inches and a quarter, and tail three inches, its outermost feathers half an inch shorter; of bill to forehead (through the feathers) five-eighths of an inch, and tarse half an inch. Bill, in the dry specimen, translucent pale straw-yellow, both mandibles tipped with dusky. All the upper-parts, with the breast, brilliant dark emerald-green, the feathers silky in texture, and having a rich and slightly aureous silken gloss; belly, sides, and under tail-coverts, with the inside of the wings anteriorly, white, transversely barred with shining green; tail like the back, a pair of unmoulted old feathers, next to the uropy-

gials or central pair, of a duller or more bronzed green, with dusky tip and slight rufous edge, and one of the outermost pair, also unmoulted, having a pale tip and deep rufous barrings, but the corresponding outermost feather on the other side, which has been moulted, having smaller bars of white, almost confined to the outer web; rest of the tail streakless, and equally bright on both webs as the uropygials, the penultimate feather only being slightly tipped with white; such of the large wing-feathers, also, as have been renewed, are bright-green like those of the back, the old being dusky with merely a faint gloss of green, and the old coverts a more bronzed green, slightly tipped with rufous. A presumed old female is smaller, or barely six inches and a half long; wing from bend four inches and one-eighth, and tail two inches and three-quarters: dusky tips of the mandibles rather more developed than in the male: this specimen also is moulting, and the new feathers of its wings and tail resemble those of the other sex; but the rest of the upper-parts are much more bronzed, especially on the head and neck, and the feathers of the crown have each a well defined narrow whitish bar; throat, front of neck, and breast, also bronzed shining green, with white cross-bars; and rest of the under-parts resembling those of the male, but the transverse green markings more bronzed. Three specimens of the young differ from the young of the subgenerically restricted Cuckoos in having no transverse bars on the upper parts: crown, nape, and interscapularies, a rather faintly bronzed dull-brown, the last also more or less of a shining green, which prevails on the scapularies, tertiaries, and on the wing and tail-coverts; under-parts whitish, barred throughout with faintly bronzed brown; primaries and secondaries, with the coverts of the former, and the winglet, dull brown, the primaries marked at the basal half of their inner webs underneath with white, as is also the case in the adults; tail brown, with a faint green gloss and subterminal dusky band, all but the uropygials having a white spot at the tip of their inner webs, and the outermost feathers having both webs barred with white, and more of this than in the adult, and the rest with two or three rufescent bars on the inner web only: bill wholly dusky.

The *C. lucidus* was originally discovered in New Zealand, and is also known as an inhabitant of Australia, from which continent the specimen described as *C. metallicus* was obtained. The *C. Malayanus*

of Sir Stamford Raffles, is mentioned as a "native of the Malay peninsula"; and the specimens here described are from that country and (I believe) Tenasserim.

14. *C. chalcites*, Temminck, *Pl. Col.* CII, fig. 2; *C. basalis*, Horsfield, *Lin. Trans.* XIII., 179. I copy the following description from Shaw's Zoology, XIV., 209. "Length rather more than five inches and half [six inches, Horsfield], the male having the top of the head red, with a bronzed gloss; the back and wings plain metallic green, the tail above red at its base, a little shaded with green in the middle, and white at its tips, the two lateral feathers having large oval white spots on their inner webs: the fore-part of the neck and the breast are whitish, varied with brown; the belly is white; the under tail-coverts whitish spotted with bronzed green; the tarse long and naked [?]. The female is reddish above, very slightly shaded with bronze, and white beneath."

From analogy I should judge that the female and young, rather than the mature male and female, are here described. This species) inhabits Java and Australia. The identity of *C. basalis* and *C. chalcites* is stated by Dr. Horsfield in the 'General Catalogue of Javanese Birds,' prefixed to his Zoological Researches in Java, where also we are informed that *C. pravata*, Horsf., briefly described in *Lin. Trans.* XIII., 179, is "to be cancelled."

15. *C. xanthorhynchos*, Horsfield, *Lin. Trans.* XIII, 179,—*Jav. Res.*, with a coloured figure. (Amethystine Cuckoo.) Length six inches and half, of wing four inches, and tail three inches, its outermost feather half an inch shorter; bill to forehead (through the feathers eleven-sixteenths of an inch, and tarse half an inch. Colour of the upper-parts and breast brilliant amethystine-violet, with dull dark margins to the body-feathers slightly glossed with green; beneath white, barred across with dark green; outermost caudal feathers having five white bars, the last terminal, and the two basal not extending to the inner web; the next two feathers on each side are tipped with white, and the penultimate have rudiments of other white bars; rest of the same splendid colour as the back: bill wholly yellow, and much less thick than represented in Dr. Horsfield's plate; and feet apparently dusky: the crown is very slightly crested. Inhabits Java, where stated to be rare and very shy. Dr. Helfer mentions its existence, also, in the

Tenasserim provinces, and it is probable that the Asiatic Society's specimen was thence obtained.

Subgenus *Oxylophus*, Swainson. (Crested Cuckoos.) These have bare tarsi, and the occipital feathers lengthened to form a considerable crest: the wings shorter and less pointed than in the preceding, having the fourth primary (instead of the third) more or less the longest: they are never barred or mottled at any age; and are mostly green-glossed black above, and whitish beneath, sometimes varied with other colours. I know of nothing peculiar in their habits.

16. *C. Coromandus*, Auctorum. I can hardly reconcile the conflicting descriptions of this species without some suspicion that two have been confounded under the name. That with which I am acquainted, as occurring in Bengal, Nepâl, Tenasserim, and which is also the *C. Coromandus* of Mr. Jerdon's list (*Madr. Journ.* XI, 222), is well described by Latham, *Gen. Hist.* III, 292, and may be distinctively termed the Red-winged Crested Cuckoo. A male I procured measured fourteen inches and a half long, by eighteen inches and a half in spread of wing; the latter from bend six inches and three-eighths, and middle tail-feathers eight inches and a half, the outermost four inches and a half shorter; but the tail is generally somewhat longer than this, its middle feathers not uncommonly measuring ten inches and a half; bill to forehead (through the feathers) an inch one-eighth, and to gape an inch and a quarter; tarse an inch, being a little feathered towards the knee. Irides dark hazel: orbits dusky; bill black; the inside of the mouth dull coral-red; feet lead-coloured. Upper-parts, comprising the scapularies and tertiaries, with the tail, black glossed with green, paler on the tertiaries, and less glossed on the head; the longest occipital feathers exceeding an inch and a half: a conspicuous half collar of white encircles the nape: wings invariably deep ferruginous, the tips of the primaries and secondaries dusky: under-parts white, a little tinged with fulvous, excepting the lower tail-coverts which are green-black, and the throat and fore-neck, which in some are deep ochreous-fulvous, in others (probably females) a very light fulvous, deepening laterally. The wings of the presumed females are scarcely less deep in colour than in the males.

Dr. Latham remarks, that "the above is found not only on the coast of Coromandel, but also on the south coast of Africa, where

M. Levaillant met with it, near the rivers Swarte-kop and Sondag. Many also have been brought from Senegal." In the vicinity of Calcutta it is certainly rare, as the specimen above noticed was the only recent one ever seen by the Society's taxidermists, who were unaware of its existence in this part; and it does not appear to be commoner in peninsular India, but on the eastern side of the Bay of Bengal it is more numerous, as likewise, I have reason to suspect, in Nepâl. With its note I am wholly unacquainted.

The definition by Linnæus of *C. Coromandus* is merely "*caudâ cuneiformi, corpore nigro, subtus albô, torque candidô*; saying nothing of the very conspicuous character of the rufous wings, nor of the hardly less conspicuous fulvous throat of especially the male: various other authors assign a small, round, grey spot on each side of the head behind the eye, no trace of which is perceptible in six specimens before me; and likewise assert, that the throat as well as the thighs are blackish, the latter only being more or less dusky in the specimens I have seen. Analogy with *C. edolius* renders it probable, however, that the young are here adverted to.

The *Ceylon Cuckoo* of Latham (*Gen. Hist.* III, 291,) must be nearly allied. Length seventeen inches. Bill curved, black; general colour above, and of the tail, fine blue black; the head much crested; chin and throat dull yellow-ochre; from this the rest of the under-parts are white; thighs pale ash-colour; tail cuneiform, blue-black; its two middle feathers nine inches long, the others gradually much shorter; legs blue, the hind claws curved, neither of them straight nor subulated. Inhabits Ceylon. Mr. S. Daniell."

17. C. *edolius*, Cuvier; *C. ater* and *melanoleucos*, Gmelin,—*serratus*, Sparrman; *le Coucou Edolio*, Levaillant; *Le Jacobin huppé de Coromandel*, Buffon. (Pied Crested Cuckoo.) Length thirteen inches, by seventeen inches and a half in extent of wings; the latter from bend five inches and three-quarters; and middle tail-feathers seven inches, the outermost three inches less: bill to forehead (through the feathers) an inch and one-eighth, and to gape a trifle more; tarse fifteen-sixteenths of an inch. Irides dark-coloured; bill black; and legs bluish-leaden. Colour of the upper-parts uniform black, not very intense, with a greenish shine, except the bases of the primaries which are pure white, forming a conspicuous wing-spot: all the tail-feathers,

except the middle pair, rather largely tipped with dull white: crest-feathers an inch in length: under-parts dull white, or faintly tinged with fulvescent, more especially in the female, which presents no other difference of plumage from the male. A full-grown young bird measured twelve inches and a half long, by sixteen inches and a half across: upper mandible of the bill dusky, with a slight yellowish tinge; the sides of its base, and nearly all the lower mandible, bright-yellow: irides dark hazel, with greenish-yellow orbits: feet greenish lead-colour. Upper plumage as in the adult, but much less deeply coloured, and the coronal feathers scarcely elongated, and rounded like the dorsal plumage at their tips; the throat ashy, passing downward on each side, and separated by a whitish streak from the dark ear-coverts; the rest of the under-parts, and tips of the tail-feathers, rather deeply tinged with fulvous, as also the greater portion of the wing-spot; coverts of the primaries slightly tipped with fulvous-white.

This is a common Bengalee species, and appears to be found also in South Africa, where, however, it must not be confounded with the *Oxylophus Levaillantii* of Swainson's 'Illustrations' (2nd series, Vol. I, pl. XIII), the *Varieté de Coucou Edolio* of Levaillant, or *C. Afer* of Leach and Shaw, which is nearly allied, but larger, and at once distinguished by the sagittal black spots on its throat and fore-neck. The present species was strangely referred to *Leptosomus Afer* by Major Franklin and Colonel Sykes; and Mr. Jerdon remarks of it — "The *Popeya* is distributed all over India, but cannot be said to be a common bird anywhere [here, in Bengal, it certainly is tolerably common]. It is of course most numerous in the more wooded districts. I have seen it in the Carnatic, Malabar Coast, and even on the bare Deccan, in low jungle or among gardens. It hunts single or in pairs, and feeds chiefly on various soft insects, &c. On the Neilgherries, I have seen it occasionally about the edges of the hills, frequenting the thick bushy ground there." From what I have observed of this species, it is not one which much affects concealment, but frequently sits exposed on a dead or bare branch. I have never heard from it any note resembling the sound *Popeya*, which is here also the common name of the species; but only a continuously reiterated simple cry, by no means loud. It is also designated *Koloo Bulbul*, allusive probably to its crest; for native classification is not better than popular classification in England,

where the *Accentor modularis*, for example, is styled 'Hedge *Sparrow*.' Dr. Latham informs us, that it is said to lay its eggs in the nest of the Chattoreah *(Malacocercus Chatarœa)*, and that they are plain greenish in colour; the Cuckoo said generally to destroy those of the Thrush, when it deposits its own": this at least is true of the European Cuckoo *(C. canorus)*, whence any eggs that may be found in the same nest with the Cuckoo's egg, have been laid subsequently to the introduction of the latter. The *C. Vaillantii* before noticed, according to Latham, inhabits India, a figure of it being among the drawings of Gen. Hardwicke; but I greatly suspect there must be some mistake in this.

In the Pied Crested Cuckoo, it may be remarked that the third primary is very nearly equal to the fourth, and exceeds the fifth; whereas in the Red-winged species *(Coromandus)*, the third is considerably shorter than the fifth. With the Crested Cuckoos terminates the genus *Cuculus*, in its most extended signification, agreeable to modern notions of arrangement; and I next pass to the consideration of the Malkohas *(Phœnicophœus)*, an extensive group generally characterized by having a somewhat large, green-coloured bill, having the nostrils basal, and placed near the edge of the upper mandible,—a coloured bare space round the eye, more or less developed,—distinct eye-lashes, in general, but rudimental only in the subgenus *Rhinortha*,—a longer tarse than in the Cuckoos, but the toes similarly formed for arboreal habits,—short and rounded wings, of which the sixth primary is usually longest, the fifth, sixth, and seventh being nearly equal—and a broad and much graduated tail, sometimes of great length.

Among them, the most distinct subgenus is that of

Rhinortha, Vigors, (1830), v. *Anadœnus*, Swainson, (1837): Straight-billed Malkohas:—wherein the clothing plumage has disunited webs, and the bill is straight, tapering regularly to the end, where the tip of the upper mandible curves somewhat abruptly to overhang that of the lower one. The size of these birds is inferior to that of most of the others; and I am not aware that any occur to the westward of the Bay of Bengal.

18. *Rh. rufescens (?); Anadœnus rufescens (?)*, Swainson, mentioned in *Class. Birds*, II., 324; *Phœnicophœus viridirostris*, Eyton,

P. Z. S. 1839, p. 105; *Bubutus Isidorei*, Lesson, figured in one of the plates to Bellinger's Voyage, as I am informed by Mr. Jerdon. Length twelve inches and a half, of wing four inches and a half, and middle tail-feathers seven inches, the outermost three inches and a half less; bill to forehead an inch and one-eighth, and to gape an inch and three-eighths; tarse fifteen-sixteenths of an inch. Colour of the upper-parts bright rufous-chestnut, except the head and neck which are pure light grey, together with the breast; the rest of the lower parts tinged with ferruginous, the flanks and lower tail-coverts coloured as above; volar feathers of the wings tipped with dusky, more developed on the primaries, and all the tail feathers tipped with white and subterminally with black; the legs appear to have been bluish. I am unaware whence the Society's specimen of this bird was obtained, but the species is included in Mr. Eyton's catalogue of a collection of birds from the Malay Peninsula, under the denomination cited.*

19. *Rh. chlorophœa: Cuculus chlorophœus*, Raffles, *Lin. Trans.* XIII, pt. II, p. 228; probably cited as *C. chlorocephalus*, Raffles, *P. Z. S.* 1839, 105; *Coccyzus badius*, J. E. Gray, and *Anadœnus rufus*, Swainson, apud G. R. Gray (*List of the Genera of Birds*, first edit., p. 56). Length, of the largest specimen before me, thirteen inches and a half, of wing four inches and a half, and middle tail-feathers seven inches, the outermost three inches and three-quarters less; bill to forehead an inch and three-sixteenths, and to gape an inch and three-eighths; and tarse an inch. Colour of the upper-parts bright rufous-chestnut, as in the preceding species, and the volar feathers of the wings similarly tipped with dusky; but the head, neck and breast, are bright ferruginous, paler on the throat, the belly tinged with fuscous, and under tail-coverts blackish: tail and its upper coverts wholly dusky-black, the former tipped with white, and both crossed with numerous rays of a paler colour. The legs, according to Raffles, are bluish; and the naked space round the eyes of the

* The *Cuculus melanogaster*, Vieillot, *Dict. Class. d'Hist. Nat.* IV, 570, would seem to be allied. "Taille, quinze-pounces. Parties superieures ferrugineuses; sommet de la tête cendré; rectrices longues, etagées, noires et terminées de blanc; gorge, devant du cou, et poitrine, roussâtres; parties inferieures noires: de Java." The plumage would thus appear to be intermediate to that of *Rh. rufescens (?)* and of *Rh. chlorophœa*.

same green colour as the bill, which is doubtless also the case with the preceding species. This bird, observes Sir Stamford Raffles, "inhabits the forests of Sumatra, but is not common. It feeds on insects, like the rest of the genus." The Society's specimens are from Singapore.

The more restricted Malkohas have been divided by Mr. Swainson into *Phœnicophæus and Dasylophus.*

Dasylophus is defined by him to have the "bill rather large, compressed in its whole length. Gonys angulated. Culmen convex, gradually arched. Frontal feathers incumbent, and concealing the nostrils. Feathers before the eye erect, forming a double crest."

20. *Ph. superciliosus*, Cuvier. (Red-eyebrowed Malkoha). Two specimens in the Society's Museum may, I believe, be referred to this species, though but partially agreeing with the description in the *Dictionnaire Classique*, which is the only one to which I have access. Length about sixteen inches, of which the middle tail-feathers measure eight inches and a half, the outermost being three inches and a half less; wing six inches; bill to forehead (in a straight line) an inch and five-sixteenths, and to gape an inch and three-quarters; tarse an inch and three-eighths. General colour dusky, brightly glossed on the upper-parts with greenish-blue, the tail-feathers white-tipped; the bare orbital skin not papillose, bounded above to beyond the eye with a white streak, and fringed above throughout its length with a singular erect range of rigid and glistening, narrow and discomposed, red feathers, the longest nearly an inch in length; bill apparently yellow at base, then shewing a sinuous deep green zone, and the rest pale green; in form more evenly compressed throughout its length than in the subgenerically restricted *Phœnicophæi.* A young bird is generally similar but less brightly glossed, the posterior portion of the red eyebrows much less developed, and the anterior portion yellowish in colour. The *Malkoha á sourcils rouges* described by M. Drapiez as *Ph. superciliosus*, Cuv., however, is stated to be but from ten to eleven inches (French) in length, having the under-parts of a dull white, but agreeing in all other respects. Should that here described prove different, it might be termed *Ph. ornatus.* M. Drapiez's bird is stated to inhabit the Philippines.

21. *Ph. Cumingi*, Fraser, *P. Z. S.*, 1839, p. 112. (Laminated Malkoha.) Length sixteen inches and a half, of wing six inches, tail

eight inches, bill an inch and a half, and tarse an inch and a quarter. This is at once distinguished from all other known species of *Cuculidæ*, " by the singular structure of the feathers of its crest and throat, the shafts of these being expanded at their extremities into laminæ, which may be compared to the shavings of whalebone; and in this respect they resemble the crest feathers of the Toucan to which Mr. Gould, in his Monograph, applies the name *Pteroglossus ulocomus*, but which is the *Ph. Beauharnesii* of Wagler, only they are not curled as in that species. The feathers above the nostrils, of the crest and chin, and along the middle of the throat, are grey at the base, have a decided white spot towards the middle, and are terminated by a broad expansion of the shaft, which is of a glossy black colour, and exhibits blue or greenish reflections; the external edge of this expanded portion of the shaft is minutely pectinated: the occiput and sides of the head are grey, passing into dirty-white on the cheeks and sides of the throat: the hinder part and sides of the neck, with the breast, are of a deep chestnut colour: the back, wings and tail, deep shining green: all the tail-feathers are broadly tipped with white: the vent, thighs, and under tail-coverts are dusky-brown, tinged with green: the bill is of a brown colour, and the feet are olive: irides red."

This beautiful species was obtained in the Island of Luçonia, of the Philippines, being termed *Ansic En Bicol* in the language of Albay. It is referred by Mr. Fraser to the present subgenus, though apparently devoid of the last character assigned to this by Mr. Swainson; and it would also seem, from the description, to want the usual naked space surrounding the eyes.

The subgenus *Phœnicophæus* is restricted by Mr. Swainson to such as have the " bill large, very thick, smooth, resembling that of a Toucan in miniature [the nostrils, however, very differently placed]. Face naked [and papillose]. Nostrils basal, oval, close to the rictus; placed in a groove of the bill [not always perceptible], and defended by stiff erect bristles." Ridge of the bill more or less convex, in some obtusely angulated; its terminal half more compressed than the basal half.

Among these, Cuvier distinguishes, as having the naral apertures narrow and placed near the edge of the bill:—

22. *Ph. pyrrhocephalus; Cuculus pyrrhocephalus,* Gmelin; *Ph. leucogaster,* Dumeril. (White-bellied Malkoha.) I quote the following description from Latham. "The length of this bird is sixteen inches; weight four oz. Bill strong, very thick at the base, and bending downward; its colour greenish-yellow: top and hind-part of the head and neck, under the jaws, greenish-black, with a slender white streak down the shafts of the feathers, appearing, from the narrowness of those about the head, as numerous specks: sides of the head, and round the eyes, wholly bare of feathers, appearing rough or granulated, and of a reddish-orange colour [crimson in the living bird?], bounded beneath with white: the middle of the crown feathered: fore-part of the neck, back, and wings, greenish-black, with a gloss of green on the last: tail very long, cuneiform, greenish-black, appearing glossy in some lights, the feathers white for nearly one-third from the end: breast and belly white: the legs brown, with yellowish scales: wings reaching a little beyond the middle of the tail [an extraordinary elongation in this genus, and perhaps owing to the manner in which the skin described had been prepared]. Inhabits Ceylon, where it is called *Malkoha.* A specimen, in Mr. Daniell's drawings, was fully eighteen inches long, and named *Maal-Kenda-Ettah.*" Also said to inhabit Africa.

Others have round nostrils placed basally.

23. *Ph. viridis,* Lavaillant: *le Rouverdin,* Id.; *Ph. curvirostris,* Shaw, *Nat. Misc.* pl. 905; *Ph. tricolor,* Id., *Zool.* IX, 61; *Ph. melanognathus,* Horsfield, *Lin. Trans.* XIII, pt. I, p. 178, and *Cuculus melanognathus,* Raffles, Ibid. pt. II, p. 287. (Red-breasted Malkoha.) About eighteen inches long, of which the middle tail-feathers measure ten inches and a half, and the outermost four inches and a half less; wing six inches and a half; bill to forehead (in a straight line) an inch and a half, and an inch and three-quarters to gape; tarse an inch and a half. The bare skin around the eye less developed than in the last species, but still large and extending forward to the bill, being of a bright red colour in the living bird; the irides dark; and feet lead-coloured. Back and wings dark and glossy bluish-green, continued along the rump and two-thirds of the tail in one specimen before me, while in another the entire central pair of tail-feathers is of this hue, and there is more of it on the rest

of the tail-feathers than in the other; head dark ashy, as also the chin and feathers bordering the lower part of the orbital skin in the second specimen above mentioned; the rest of the under-parts deep chestnut-rufous, more or less paler on the throat, and darkening to maronne on the belly and lower tail-coverts: in the first specimen mentioned, the outermost tail-feathers are almost wholly maronne, and the rest successively more so to the middle pair, which have only their terminal third of that colour: bill glaucous-green, the basal half of the lower mandible coral-red towards the middle.

Sir Stamford Raffles states that this bird "feeds on insects, and not, as has been reported, on fruits. It is found on the hills of Sumatra and the neighbouring [peninsula and] islands, but is not easily procured, as it commonly perches on the summits of the highest trees." It is described also to inhabit Africa.

24. *Ph. tristis: Melias tristis*, Lesson; *Cuculus Sumatranus*, Raffles, *Lin. Trans.* XIII, pt. 2, p. 287. (Little Malkoha.) Length of a fine specimen fifteen inches, of which the tail is nine inches, its outermost feathers four inches and a quarter less; wing five inches; bill to forehead (in a straight line) an inch and one-sixteenth, and an inch and three-eighths to gape; tarse an inch and one-eighth. Entire upper-parts closely resembling those of the preceding species (*Ph. viridis*), except that the tail-feathers are wholly greenish and white-tipped: under-parts of a dark ash-colour: orbital skin tolerably large, and bordered above with a slight streak of white: some have a tinge of rufous about the breast. Inhabits Sumatra and the adjacent peninsula and islands, where it lives (according to Raffles) upon insects; and it was also obtained by Dr. McClelland in Assam.

In *Ph. tristis*, the bill is more compressed than in *Ph. viridis*, and the ridge of the upper mandible is obtusely angulated throughout, instead of being quite rounded and bulged towards the base, as in that species; the inferior margin of the upper mandible also curves much further downward, overlapping the base of the lower mandible. In the next two species, the bill is still more compressed and proportionally smaller, asuming nearly the same form as in *Xanclostomus*, wherein Mr. Jerdon has even placed one of them. It is possible that either the *Taccocua* of Lesson, or the *Calobates* of Temminck, may refer to this form.

(To be continued.)

Notes, principally Geological, on the Tract between Bellary and Bijapore. By *Capt.* Newbold, *F. R. S. &c. Madras Army.*

No. 1.

The notes, of which the following paper is an abstract, were taken during a survey ordered by Government of that line of Post Road, connecting Bombay and Madras, which lies between Bellary and the ancient Mahomedan capital Bijapore. They commence from Bellary, comprising a line of 164 miles extending in a north-westerly direction through part of the Ceded Districts, the Nizam's dominions, and the Southern Mahratta country, crossing at right angles the courses of the Tumbuddra and Kistnah rivers as they hasten across the Peninsula from west to east, to add their tribute to the Indian ocean. The route chiefly lay over a vast undulating plain, constituting a considerable portion of the great plateau that is elevated on the shoulders of the Eastern and Western Ghats, and intersected by a few subordinate spurs, running nearly at right angles with the great lines of dislocation.

Ceded Districts from Bellary to Yailbenchi.

From Bellary to Courtney, a distance of eleven miles, extends a plain based on granite and gneiss, penetrated by numerous greenstone dykes. From Courtney to Yailbenchi, four miles, the plain continues, as before, covered with a superstratum of *règur*, or the black cotton soil of India, to a depth of from one to eighteen feet, in many places resting immediately on the gneiss and granite; in others on an intervening bed of a calcareous deposit, somewhat resembling the travertin of Italy, though more nodular, and called by the natives *kanker*. It is burnt by them for lime. Like rows of flints in chalk, it is seen also in the lower layers of the *règur*, often with sharp projecting spiculæ of carb. of lime, which would have been broken off had the nodules been drift pebbles. Here and there, on the surface, and partly imbedded in the soil, greenstone occurs *en boules*, indicative generally of a subjacent dyke. Angular fragments of both yellowish and reddish quartz in many places literally strew the surface of the ground, which close to Yailbenchi, changes to a red clayey soil; and, on examination, proved to be the result of the disintegration of a bed of micaceous hornblende schist, with gneiss here rising to the surface. Granite, greenstone, and a rock composed principally of a reddish foliated felspar, pierced by veins of the same mineral in a more compact form,

and tinged of a delicate green by actynolite, are seen in the walls of the small fort here. The produce of the soil is principally cotton, and juari, (Holcus sorghum).

Ceded Districts from Yailbenchi to the Southern bank of the Tumbuddra.

From Yailbenchi to Devasamudrum, the *règur* continues covering the surface of the plain, mingled, in greater or less proportion, with the angular debris of the subjacent rocks just alluded to; except near the village of Soganhully, where it is interrupted by a bed of a rich red alluvial soil, deposited apparently in this low situation by a number of rivulets flowing easterly from the great tank, or artificial lake of Daroji. This rich soil deriving additional fertility from the water to which it owes its locality, produces rice and wheat in addition to other grain; and also sugar cane. In some places, however, it is impregnated with muriate of soda. A few native salt manufactories, indicated by small mounds on the banks of the rivulets, are visible on the left of the road.

From Devasamudrum, gneiss with its associated schists, mica, hornblende and chlorite, constitutes the prevailing rock to the bed of the Tumbuddra. Veins of quartz and felspar cross it in various directions, in which thin seams of an actynolitic felspar, of a lively green, not unfrequently occur. Near Hulhully, on the south bank of the river, a few dykes of greenstone and basaltic trap, containing augite, cut the gneiss in an easterly direction. Calcareous deposits, in the form of a nodular *kanker*, are seen in the rivulets running down the slopes of the plain to the river bed. The soil is *règur*, lying upon the gravelly detritus of the subjacent gneiss, &c., with here and there a thin stratum of *kanker* interposed. The cultivated vegetable products the same as before. The plants growing wild on the plain are principally the cassia auriculata mimosas, asclepias gigantea, and the jatropha glandulifera. The last named plant is almost confined to the black soil. The banks of the Tumbuddra at this point, are formed by an accumulation of silt, clay, and sand, brought down by the freshes. The bed is covered with a fine red quartzy sand.

Nizam's country from the North bank of the Tumbuddra by Tawurghirry to Cundigul.

The Tumbuddra is crossed by basket boats to Mustoor, the first village in the Nizam's dominions. The plain rises gently as the traveller proceeds northwards to Umaluti, a walled village about twenty-four and a half miles from Mustoor. Between this place and Tawurghirry, its

surface is broken by the protrusion of a bed of milky quartz, rising into a broken ridge of small hills; from which a gradual, but stony, descent leads to the decayed town and fort of Tawurghirry. Springs of fine water abound, and with numerous rivulets, maintain an almost unfailing supply of water. The latter feed the Tumbuddra, the bed of which constitutes the drainage line in this part of the Nizam's territories. Judging from the quantity of *kanker* found on the banks of these tributaries, a large proportion of lime must be conveyed by their means to the Tumbuddra, and thence to the ocean. The *règur* continues to cover the surface of the plain, with but few breaks, from the Tumbuddra to Umaluti, a distance of upwards of twenty-four and a half miles, though not perhaps to the depth seen in many parts of the Ceded Districts. This circumstance might probably be accounted for by the slopes here having a greater angle of inclination, rendering the superincumbent soil more liable to the denuding effects of floods, streams, and the heavy monsoon rains. The *règur* thus becomes blended with the alluvium washed down, and is seen as a stiff greyish mixed clay. Both the alluvial red soil and *règur* are impregnated with muriate of soda and natron. Salt manufactories are seen scattered over the country on the banks of the rivulets. Beyond Umaluti to Tawurghirry, the soil consists of the debris of granitic rocks; and is sandy, gravelly, or stony, according to situation, and state of disintegration. Near the bed of the Tumbuddra, I have before remarked, that the subjacent rock is gneiss and its associated schists. Quitting the bed, these rocks are less seen, while granite and greenstone constitute the prevailing rocks from Chuloor to Umaluti; the former occurs in bosses, knolls, and detached hills, with tors and logging stones, the latter in dykes and loose *boules*. From Umaluti to Tawurghirry, the granite rises in a more decided manner from the surface, taking a south-easterly direction. One of the most considerable of these elevations, is a range of hills a little south of the Tawurghirry road, called the "*Caradi Guddi,*" from being infested by a number of bears, which are attracted to this neighbourhood by the fruit of the dwarf date, that luxuriates in the low moist valley. A bed of white and red quartz assumes the form of a low ridge, covered with jungle, and over which the road passes, called by natives, from its white appearance, "*Pilla Guddi;*" and running S.S.E. Some of

the quartz veins intersecting the granite, pass into hornstone with a splintery fracture. The granite is crystalline, and contains dark mica in scales; hornblende in small crystals; foliated reddish felspar; and greyish quartz in minute angular fragments. Hematitic iron ore exists largely near the bed of quartz: the slope of the ridge towards Umaluti is strewn with the slag and scoriæ of the furnaces formerly used for smelting it. The Hindus, I am informed, gave them up many years ago, owing to the exactions of their Mahomedan rulers. The agricultural produce of the soil is chiefly juari, cotton, and a little wheat; being at a distance from the river, it is indifferently watered; depending on the dews, springs, and the periodical rains. The majority of the springs about Tawurghirry are brackish—the formation granite, with reddish felspar, in clustered blocks, generally not rising above twenty or thirty feet from the surface. The soil around the town is reddish, arising from alluvium brought down the slopes of the ridge, and the disintegration of the granite rocks in the vicinity. It produces good crops of juari.

A little more than a mile N.W. from Tawurghirry, chlorite slate occurs in the bed of a rivulet in nearly vertical laminæ, interseamed with a reddish subcrystalline felspar, having a general direction of E. 10 S. though contorted and waving at various points: the general dip is to the N. About two miles farther on, a trap dyke intersects the schistose beds, running nearly East and West, and decomposes into a reddish brown soil. Three miles farther, near Idlapur, the chlorite, mica, and micaceous hornblende schists appear in the form of low hills, having an irregular direction; but which approaches that of the laminæ of the schists themselves. The chlorite schist predominates, and losing its chlorite, passes into both a ferruginous and a soft purplish shale, or slate clay, containing much felspar in a decomposing state. The summits of two or three of these hills were crested with a jaspery clay ironstone, with cherty quartz in parallel laminæ. A smoke-coloured vesicular quartz is found veining the chloritic slate, and a reddish tough subcrystalline *kanker* is seen in the hollows and sides of the hills. Large masses occur in the road side, imbedding small nodules of hematitic iron ore, which is profusely scattered in the bed of the rivulets. At Sassenhal, in the bed of a nullah, I found an angular block of a compact rock of a light ochreous yellow colour, having cavities lined with minute

yellowish pyramidal quartz crystals. Passing still north-westerly from Idlapur, the hills subside into long wavy swells to Moodianur. The chlorite slate is seen penetrated by a rock of reddish felspar and quartz, in which chlorite is scattered in thin lamellæ, which passes into eurite imbedding minute green crystals of tourmaline. Actynolite occurs in thin veins with quartz, and imparts a fibrous and radiated character to the rock. The direction of the laminæ of the chlorite slate was found to be N. 55° W.; dip 58½°, S. 45° W.; general direction of joints N. 10° E.; dip 85°, E. 10 S. The larger beds of quartz conform in direction and dip to the laminæ or strike.

Ramtar River.

About half a mile beyond Moodianur, the left bank of the Ramtar river, running towards the Kistnah, presents a small section of the rock composing the hill, the base of which it washes. It proved to be quartz rock, irregularly tinged with oxide of iron in almost tabular masses, separated by fissures, having the appearance of stratification, dipping to the N. E. at an angle of 13°. As I could discover no interstratified bed of any other rock, I hesitate to pronounce these the lines of stratification. Globular masses of a porphiritic greenstone imbedding reddish crystals of felspar occur on the surface. This bed of quartz rock lies between the chloritic schist and felspathic gneiss, the latter of which is observed about a mile further on, with a similar direction and dip as the former. Veins and beds of a jaspery clay iron ore, with calcareous incrustations, occur in parallel laminæ to the gneiss, which extends into the Southern Mahratta country to Cundigul.

S. Mahratta country from Cundigul to Danoor, on the S. bank of the Kistnah.

Near Cundigul the chloritic slate again rises to the surface as a cluster of hills, having the same smooth contour as those of Idlapur, and crested with a similar jaspery rock. Kanker and calcareous spar occur in the seams; and the surface is strewn with nodular hematite. Many of the specimens of the slate effervesced with dilute muriatic acid, impregnated with lime, probably from infiltration of water, charged with this mineral. The dip is to the N. 45° E. at an angle of 70°, the strike N. 45° W. Passing over the plain at the foot of these hills, about quarter of a mile from the village of Cundigul, a dyke of basaltic greenstone, running E. and W. is traversed. The green chloritic slate in its vicinity acquires a dull blue hue; becomes hard and compact, and

splits into prisms having smooth planes. The contortions of the strata observed at some distance from the dyke, may be perhaps attributed to the intrusion of this rock. Gneiss is again seen in the beds of the Nundawarghi nullahs, alternating with mica, hornblende, and chlorite schist. It is red, felspathic, and contains veins of quartz, felspar, and actynolite. The last mineral often occurs in the seams with a compact siliceous felspar, having a lively green colour, sometimes in drusy crystals, and lining the interior of vesicular cavities. A dyke of basaltic trap crosses the plain in a West by Northerly direction. At the village of Nundawarghi, I remarked a number of millstones composed of a fine white and red granular sandstone, the grains of quartz cemented together by a felspathic paste imbedding angular and rolled bits of a dark flinty slate, derived from the slate associated with the gneiss and of a ferruginous rock. These stones I was informed were quarried at Badami and Jalihal, the price from $\frac{1}{2}$ to 1 rupee each. The red felspathic gneiss and associated crystalline schists are seen at intervals as far as Cumblihal, where I encamped in the plain. Here the gneiss becomes granitoidal, the red felspar still continuing six furlongs beyond Cumblihal; at the Muddi nullah it is seen alternating with micaceous schist. Dip 60°, E. 20° N. Nodular *kanker* of a faint red, and hematitic iron ore, strew the beds of the rivulets. Near Caradi, the granite loses much of its mica, consisting almost wholly of red felspar and greyish quartz, and assumes the character of a pegmatite and graphic granite. The green actynolitic felspar continues to intersect the rock in thin seams. At Coujaganur the Kistnah river is first seen: thence to Danoor, the tappal village near the ferry, the route lies along its right bank, to which the plain declines with a gentle slope that increases however near the river bed. Numerous streams cut the bank in their progress to the Kistnah, leaving intervening swells of ground, and rendering the road, which crosses them at right angles, uneven and difficult to traverse during the rains, when this tract is partially inundated by the river. In consequence of the thick superstratum of mixed alluvial and *règur* soil, few opportunities occurred of observing the subjacent rocks. Gneiss, however, was the one most frequently met with.

Right bank of the Kistnah.

On the ascent of a low hill a little beyond the small fort of Haverighi,

a dyke of basaltic greenstone cuts the gneiss, running nearly due East and West, and slightly distorting the laminæ of the latter rock. Several ramifications are thrown off, one of which has a South-westerly direction. The trap here may be remarked splitting into prismatic fragments with smooth planes. The natives take advantage of this circumstance, and employ the stones thus ready formed in building.

Bed of the Kistnah.

In the bed of the river lie nodules of a reddish brown and white cornelian, chert, jasper, calcedony, cacholong, semi-opal with linear curved and angular delineations, and mocha stones. The pellucid pebbles are sometimes surrounded with an opaque *enduit* which adheres to the tongue, mealy externally, but hardening as it approaches the nucleus. The fracture of the inner part is semi-conchoidal, hardness from six to seven of Mohs' scale. Fragments of a dark coloured basaltic rock still adhere to these pebbles; which, together with their water-worn rolled exterior, indicate them to have been transported from the trap amygdaloids to the West. The swollen state of the river prevented any observation which the section of its banks might have afforded. The sides of the ravines, however, presented gneiss, with both white and red felspar, interstratified with micaceous hornblende schists. The latter has a fine and almost slaty structure, brilliant lustre, is easily worked, and split by the natives into long slabs for the purposes of building. Iron pyrites are disseminated. A trap dyke running to the East is crossed a little beyond Muddur. The strike of the gneiss, &c. though contorted in some places, runs E. 30 S. and dips at an angle of 60° to N. 35 E. The surface of the left bank is much the same as that of the right, it is covered with pebbles brought down by the river; among them I observed a water-worn bit of a grey limestone, probably brought down by the Kistnah from the plain at the base of the Western Ghauts.

Remarks on the Kistnah.

It may be remarked, *passim*, that the Kistnah is one of the most considerable rivers of India. It rises among the Mahavaleshwar hills, near the western coast, a little to the S. W. of Satara, and after crossing the peninsula in an East by Southerly direction, falls into the Bay of Bengal at Sippelar Point, a little to the S. of Masulipatam. During a course of about 700 miles, it receives the waters of the Yairli, the Warda, the Gutpurba, the Malpurba, the Bima, the Tumbuddra, and the Hydrabad or Mussy

rivers. Its breadth from bank to bank at Danoor, previous to its junction with the three last streams, as taken by trigonometrical measurement by my friend Lieut. Kinkead of the Artillery, and myself, was found to be 1918 feet. The current was running rapidly, carrying the round wicker basket boats, in which we crossed, a considerable distance down the stream, in spite of all the efforts of the boatmen.

Accumulations of mud, silt, and sand are daily progressing on the banks, entombing the remains of alligators, fish, and fluviatile shells. This river is thought to be richer in gems than any other stream in India. As it flows through the Palnad Circar, diamonds, cat's eyes, onyxes, and calcedonies occur in its alluvium; also a small portion of gold dust at Paugtoor, in the Nizam's dominions. Near the frontier of the Ceded Districts, beautiful agates are found. Not far from its mouth are some of the diamond mines for which Golconda is celebrated, and at Paugtoor, it abounds with amethystine quartz.

S. Mahratta Country, from the North bank of the Kistnah to Gurdinny.

After leaving the bed of the Kistnah, the plain rises gradually to the North. On the slope lie some scattered blocks of a fine grained granite, composed of crystals of reddish felspar, quartz, and a black glittering mica in minute plates. The superstratum of soil beyond the alluvium of the river is red and quartzose. Passing in a West by Northerly direction, we reach a long low descent, which slopes gently to the west, to the bed of the Hirri, one of the tributaries to the Kistnah: from this the ground again rises with an almost imperceptible ascent to the west, forming a shallow valley running almost due north. The Hirri river follows its course from Bagwari, flowing southerly to the Kistnah, into which it debouches a little above its junction at Capila Sungum, with the Malpurba. It forms the principal line of drainage of an extensive and fertile tract. Our route lay on the left bank of the stream. In the lower, or more southerly part of the valley, a felspathic zone, extending in an easterly direction and several miles broad, is crossed. This rock varies in lithological character, in some places assuming the form of a pegmatite, at others that of a protogine, being combined with quartz and chlorite. A few loose and imbedded blocks of a granite, similar to that found on the north bank of the Kistnah occur, rarely without rising to any considerable height above the surface. The felspathic rock observed in sections presented by the deep nullahs run-

ning down the slope of the plain, has a pseudo stratiform appearance, arising from nearly horizontal joints, which might be mistaken for the lines of stratification. It continues as the surface rock as far as the village of Gurdinny, near which it is overlaid by beds of a friable trap, approaching wacke, with an obscurely schistose structure, and penetrated by veins of an earthy carbonate of lime, calc spar, and quartz in crystals. It rises near the village into a small knoll, down whose declivity runs a rivulet, in the bed of which the first section of the great overlying trap formation of the Deccan met my eye. Depositions of *kanker*, both in beds on the surface, and veins penetrating the fissures in both rocks, occur in abundance; it is found in a pulverulent and concrete state: the nodules are not so crystalline as those that are seen in the vicinity of the older trap dykes, which penetrate the granite and gneiss of the Carnatic, the Ceded Districts, and Mysore.

S. W. limit of the great overlying Trap formation.

About two miles to the north, on the rising ground on which stands the little fort of Beylhal, the road is literally paved with the *boules* of trap, which, exfoliating in concentric lamellæ, leave circular and oval nuclei, the latter in their turn, however hard and compact, evince a tendency to a similar process of disintegration. This gives a singular appearance to the surface of the road where the rock is uncovered by dust; presenting a surface paved, as it were, with mere pebbles of compact basalt set in concentric rings of wacke. The nuclei remain prominent from their superior hardness. Calc spar of various shades of white, green, and pink, calcedony in perforated nodules, and in geodes exhibiting concentric annular delineations, and lined with minute crystals of quartz, semi-opal and jasper occur in veins imbedded in wacke.

S. Mahratta Country from Gurdinny to Bagwari.

At Umblanur, a walled village in the jaghire of the Mahratta chief Punt Pritti Niddhi, about three miles north from Beylhal, I found the nuclei to consist of a hypersthenic felspar, imbedding crystals of augite, fracture small grained uneven; streak greyish white. Bits of a dark flesh-coloured eurite, and a porphyritic rock composed of crystals of dark dull green hornblende, imbedded in a paste of a faint bluish green felspar, exceedingly tough under the hammer, occur in the plain. I searched, but in vain, for these rocks in sitû; although judging from

the sharp angles of some of the fragments, their proper locality cannot be far distant.

From Umblanur, still proceeding northerly, to within three furlongs from the town of Bagwari, the route continues along the left bank of the Hirri. The trap is observed in the nullah beds to undergo many changes in texture and colour, even in the space of a few yards, from a compact heavy basalt to a friable wacke ; from globular to schistose; from black to red and a light brownish speckled grey. The laminæ of the schistose variety are often intersected by transverse fissures, which divide the rock into rectangular and rhomboidal prisms, similar to those observed in clay slate near the line of contact with a basaltic dyke. These again, by the agency of the mysterious law of crystallization, which is manifested in a greater or less degree, in both ancient and modern trappean rocks, from the microscopic atoms of augite and hornblende to the prodigious pillars of Staffa and the Giant's Causeway, often assume a pentagonal and hexagonal shape by exfoliation. By process of farther exfoliation the angles are worn away, and the prisms assume a globular appearance, which has led some observers to imagine them to have been erratic boulders subjected to the rolling action of water, or from their abundance, and the augite often found in them, to have been showered down on the surface by volcanic agency. Near Bagwari, the beds of the streams abound with *kanker*, indurated ferruginous clay, fragments of red and yellow jasper, trap, amygdaloid, and a few nodules of calcedony; the concave surface of the botryoidal varieties of this mineral not unfrequently exhibit a succession of pentagons and hexagons.

S. Mahratta country from Bagwari to Bijapore.

From Bagwari to Mangoli, the route lies over plains, the lowest stratum of which, as seen in wells, to the depth of twenty to fifty feet below the surface and beds of nullahs, is the overlying trap. About two miles N.W. from the former place, it is overlaid by a sheet of a conglomerate composed of a nodular and pisiform iron ore, and fragments of ferruginous clay imbedded in a travertine-like paste of carbonate of lime, coloured of a light ochre brown by oxide of iron. The bed of a nullah presented the only section (of this stratum) ; it was here four feet thick covered by a layer of black cotton soil or *règur*, and resting immediately on the concentric exfoliating trap which was penetrated by seams

of a whiter and more earthy carbonate of lime, as shewn in the right hand corner of the plan.

Large masses of a lateritic rock, cemented together by calcareous and ferruginous matter, and having a smooth shining *enduit*, which imparts a glazed appearance to the surface, occur in the calcareous conglomerate. The extent of the latter, owing to the thickly covered nature of the soil, I was unable to trace; but it is met with at various places between Bagwari and Mangoli, and most probably continues, almost uninterruptedly, overlying the trap for the greater part of the distance; viz. twelve and half miles. Near Mangoli, the trap again appears as the surface rock, seamed however, and almost broken up, by the immense quantity of calcareous matter penetrating between the laminæ. The lime is seen to take up some of the colouring matter of the augite or hornblende of the trap, and is stained of a mottled green and brown. The trap exhibits superficial dendritic appearances, generally dark brown, with a yellow or brownish ground on the smooth surface into which it readily divides on being struck with the hammer. This facility of division arises from natural microscopic fissures pre-existing in the substance of the rock, sometimes visible to the naked eye. The fragments are of different shapes, but almost invariably angular, and frequently prismatic. The trap varies from a compact black and phonolitic basalt, to a loose light greywacke, speckled with minute ferruginous spots, and still preserves both the laminar and globular forms described above. Veins of a reddish colour, without any definite direction, are observed intersecting it. Their composition does not appear to vary much from the dull brown grey rock that forms the prevailing colour of the trap in this vicinity, except in being more ferruginous. Deep and nearly vertical fissures dipping generally to the W. 70° S. cleave its tables in a direction N. 25° W. A number of small vesicular cavities pervade its structure, the axis of whose longest diameter is generally N. and S., may be received as indications of the course here taken by this great *coulée* of trap.

City of Bijapore.

The view of the city of Bijapore, as the traveller approaches it from Mangoli, is truly striking, and peculiarly oriental. As in the distant view of Istambul from the sea of Marmora, spires, minarets and cupolas, some of which are topped by the crescent still glittering, the *donec impleat orbem* of Mahomedan

ambition, now all crumbling into dust by the Almighty fiat, rapidly shoot up in succession to the view in the distant horizon. I entered the city by the Futteh gate, near which is the breach in the wall made by Aurungzebe's batteries, and rode through a heap of ruins, gardens, and tombs, (literally a city of sepulchres,) which extends nearly to the Shahpur gate, where there is a small bazaar. Beyond it, the elegant mausoleum of Ibrahim Ali Adil Shah, stands at a little distance from the city walls, nearly opposite the western, or Mecca gate, having an extensive garden in the rear. The tall and graceful minarets of this harmonious structure contrasted in their whiteness with dark masses of foliage in the back ground, throw a lightness and airiness over the whole, altogether enchanting. The gilded arabesque work, comprising sentences from the Koran, into which the screen of the mausoleum has been carved, is rudely shattered by the balls fired from the city walls to dislodge Aurungzebe, who had established himself in the mosque behind the tombs. Fascinated by the beauty of the place, I directed the camel drivers to ease their animals of their canvass load, and fixed on a spot shaded by some fine old trees as the site of my little encampment.

The staple articles of cultivation are red and yellow juari, (Holcus Sorghum); bajra, (Holcus spicatus); culti, (Glycine tomentosa); moong, (Phaseolus mungo); thoor, (Cytisus cajan); bullur, (Dolichos lablab); and white lobey, (Dolichos catiang). These are comprised in the Mungari, or early crops, and are generally sown in June and July after the early showers of the S. W. monsoon, and are reaped about the end of December. Cotton, wheat, white juari, the castor oil plant, and chenna, (Cicer arietinum,) are the staple articles of the late, or Hingari crops, and are almost invariably sown in *règur*, during the months of September and October, and cut about February or March. A quantity of caradi and kusum, (Carthamus tinctorius,) are sown with the Hingari crops, from which the staple oil of the country is chiefly produced. Cocoanut trees are but seldom seen. In consequence of the almost total absence of tanks, and other sources of artificial irrigation from which a constant supply of water can be kept up, but little rice is sown; the subsistence of the peasantry therefore is chiefly on cholam and wheat cakes. After reaping, the ryots have a custom of heaping up the straw in the fields, and covering the stacks over with a thick


Section of Nullah 15 f.
Regur
Kunkur
trap
veined
with
Kunkur
Red
felspathic
Granite
Bijapur
Yellanhully
Hukli
Mugsabinahal
Manigoli
Thurri river
Great Trap formation
Talicota
Blue & buff Lithographic
Limestone
Bagwari
Sackur
Umblanur
Alcopa
Sandstone
Gurdanur
Mudibhal
Southern Boundary
North boundary of Plutonic & Metamorphic Rocks
Kistnah River
Caligh
Capila Sungum
Confluence of
Kistnah and
Malpurba
Granite
Tungragh
Malpurba River
Goyaganur
Caradi
Cuddawal
Metamorphic
Cumbla
Ramdar River
Schists basing devated plains
& penetrated by
Greenstone dykes
overlain by large
patches of black
Regur & Red
alluvial Soils
Raichoor
Sandstone
Cundigul
Badami
Mudianur
Yepulparry
Burnoo beds
having often intervening
of fresh water Calcareous
deposits. Saline Springs
Sandstone
Sassenahal
Talopur
Gujandier Ghur
Nundapur
Tawurghirri
Manadhal
Umaluti
Hulihadre
Sunkanahal
Adoni
Kanighirri
Chuboor
Tumbudra River
Kasarhuthy
Granite
Mustoor
Hulhally
Hagri River
Devasamudrum
Schists
dykes
Ruins of Annagundi
Bijanagger
Copaldroog
Yadbenchi
Courtney
Metamorphic Schists
penetrated by Greenstone
Granite
Bellary
Metamorphic Schists
broken up by Granite
& penetrated by
Greenstone dykes
Regur 3ft
Conglomerate 4ft
Calcareous
Trap 5ft
Sketch referred to
between Bajwari & Mangoli.
Route Sketch
from
Bellary to Bijapur
by Capt Newbold M.N.I.
Scale
English Miles

layer of the black soil, which is said to preserve it effectually from the ravages of animals and insects. In the Ceded Districts, it is generally carried off to the villages and there stacked. This custom of heaping it up in the fields is ascribable to the almost total absence of carts and bandies in the South Mahratta country and the Nizam's dominions.

The principal trees growing wild in the plains from Bellary to Bijapore, are the Acacia arabica, the Melia azadirachta, Butea frondosa, Ficus indica, Ficus religiosa, Spondias mangifera, and a tree called the "*Jummi*," held sacred by the Mahrattas.

The principal wild shrubs of the plain are the Cassia auriculata, the Asclepias gigantea, Indigofera cærulea, and several species of Mimosa. The Webera tetranda, Cassia fistula, the Zizyphus jujuba, Ixora parviflora, the Carissa spinarum, Carissa carandas, the Bander and Hingar, are generally found in the red soils, while the Jatropha glandulifera, as before stated, is almost confined to the *règur*. On the declivities of the granite hills, bushes of Euphorbia, Cacti, the Annona squamosa, and less frequently the Agave vivipara. That delicious flower, the Nerium odoratum, grows in abundance on the banks of the Tumbuddra. The tamarind and mango trees are seen planted in a few scattered groups or topes. The Solanum lycopersicum, the Calyptranthes caryophyllifolia, the Musa paradisiaca, and the Feronia elephantum, are seen in orchards near the villages.

Notes principally Geological, from Bijapore to Bellary, via Kannighirri. By Capt. Newbold, *F. R. S. &c., Madras Army.*

No. 2.

Geology of the plain of Bijapore.

The city of Bijapore stands on an immense sheet of overlying trap, with an undulating surface, though here and there small step-like descents, characteristic of trappean formations may be observed; but none of sufficient altitude to disturb, to any great extent, the generally level appearance of the surrounding country. As far as the eye can reach, on the north-west horizon are seen, from some of the higher points of the city, low, wall-like, ranges of sandstone. The almost unbroken extent of the plain of Bijapore affords but little scope for the geological examination

of the strata subjacent: the observer must therefore dive into wells, pass up the beds of rivulets that water the surface, search for quarries, and descend into the fosses that surround fortified places. In failure of all these, the walls of forts and other buildings present a mineralogical collection on the large scale which usually affords a clue to the petrographical nature of the surrounding formations, as natives seldom trouble themselves to bring building-stones from any distance, preferring mud if the former material be not at hand. The surface of the plain is in general strewed with fragments of trap, amygdaloid, quartz, calcedony, opal, cacholong, calc spar and zeolites, kanker, nodular iron ore, and a conglomerate of ferruginous clay and iron ore imbedded in compact kanker. These decomposing together in unequal proportions, form a superstratum of a light brown soil, in which small crystals of a pearly calc spar and zeolite glitter like particles of silvery mica or talc, in soils formed by the decomposition of gneiss and granite. This light-brown soil is extremely fertile, producing abundant crops of wheat, chenna, bajra and juari: it is very different in colour and appearance from the *règur*, which I have seen covering with its black crust, rocks of all formations, at heights above the present drainage level of the surrounding country, the granite and gneiss of Bellary, a small part of Mysore, the limestone and sandstone of Cuddapah, and the states at the foot of the Nulla Mulla hills. Beneath this soil the trap, in public roads and other places liable to abrasion, is often seen in the state of the concentric decomposition alluded to in speaking of Beylhal, and also in a schistose form. In deep sections, such as wells and quarries, the rock assumes a tabular appearance, splitting almost horizontally into thick stratiform masses, which are again intersected, at right angles, by almost vertical fissures, imparting a columnar structure. At Turvi, a village about four and a half miles from the Mecca gate of Bijapore, beyond the ruined palace of Aurungzebe, the basalt rests conformably upon a bed of amygdaloid into which it passes. Large beds of the amygdaloid occur in the trap, rising above its surface, as seen near the Allahpur gate of Bijapore.

Fissures and joints.

The fissures, though nearly vertical, do not appear to indicate any axis of disturbance, dipping irregularly. At the bottom of a well at Tangoli, about fifteen miles south of Bijapore, the direction of the fissures was N. 25 W., dip W. 20

S., joints horizontal. At the quarries of Bijapore, the fissures took a direction N. 20 E., joints dipping 5° to E. 20 S. Calc spar occurs in thin discoloured seams, lining the fissures. A number of empty vesicular cavities pervade the rock, which appear never to have contained any mineral substance, and probably were occasioned by the evolution of gases while the rock was in a liquid state. Their direction is not uniform, but it will be found generally south-westerly, conforming to the axis of the trap's direction.

Petrographical structure of rocks.

The petrographical structure varies often in the space of a few feet, from a compact greyish black basalt, having a granular structure and conchoidal fracture, with streak of ash grey, to a soft wacké speckled with brownish decaying crystals of augite and amphibole. The trap in this vicinity has a blush of red traceable in the darker portions, and becoming stronger in the wacke and amygdaloid; the latter has for its basis, a fine red clay. The dark compact variety melts into a black glass, and is faintly translucent at its edges, exhibiting a dull green; the rest are opaque, and melt with difficulty into a greenish black glass. Some varieties, which appear to contain much silicious matter, are infusible. The less compact trap has an uneven fracture. When reduced to a coarse powder, a few of the fragments are taken up by the magnet; the fine powder is of dull greenish grey. It does not gelatinize when treated with acids. Its specific gravity I found to be 3.35.

The variety used in building the splendid palaces, mosques, and mausoleums of Bijapore is of a deep reddish brown opaque, and of a granular fracture, approaching earthy. This rich colour adds much to the appearance of the ruins. The rock is by no means uniform in texture, being more or less vesicular, amygdaloidal, or clayey, and subject to exfoliation: consequently, when the stone has not been carefully selected, it gives way under the superincumbent pressure; many of the structures are rapidly falling into decay on this account. The variable nature of the trap is perhaps most strikingly seen in making the circuit of the city walls, which are built upon the rocks from which their materials have been quarried. Not only is the disintegration seen in the walls themselves, but wherever they rest on an amygdaloidal foundation; which, exfoliating, splitting, and giving way, causes whole masses of masonry to be precipitated piece-meal into the fosse. Vertical

fissures in the walls commencing at the base, and proceeding upwards, mark the site of future and extensive ravages. The masonry on the firmer parts of the rock is in excellent preservation : if well selected, it would make a good building stone, and is capable of receiving a fine polish, as shewn in the bas relief round the Sijdeh recess in that little gem of Moorish architecture, the Mecca Mosque within the citadel, which is constructed of the more compact variety of the purplish amygdaloid just mentioned.

The basis of the rock is felspar, with amphibole and augite in various proportions. The latter mineral (augite) is not much seen in the red amygdaloid rock. Olivine is of rare occurrence. Vesicles are seen in all varieties, both empty and containing green earth, which becomes brown or black on long exposure, calcedony, cacholong, calc spar, quartz, zeolites chiefly radiated, stilbite, heulandite, and mesotype, when it assumes an amygdaloidal stamp. These minerals also occur in veins, and are most abundant in the red amygdaloid, to which they impart a reticulated or porphyritic appearance, as they chance to occur in veins or crystals. Geodes of calcedony are seen also containing drusy crystals of quartz and of zeolite, enclosing crystals of carbonate of lime. I have seen veins of crystalline quartz splitting in the centre, in a direction parallel to the sides, containing all these minerals on their inner surfaces. Agates are sometimes, but rarely, found imbedded; greyish crystals of glass of felspar are met with in the semi-compact varieties; also small nodules of a compact cream coloured opaque zeolite with a faint tinge of buff, and marked with concentric annular delineations, resembling in shape those in orbicular granite.*

From Bijapore to Bagwari.

Marched this morning, (July 9th,) on the new route to Hukli, a place about twelve miles S. E. from Bijapore. The brown soil, arising from the disintegration of the subjacent trap continued about a mile, when it was succeeded by the *règur*, strewed with abundance of grey kanker in small nodules.

* Some of these nodules are earthy, and have a powerful argillaceous odour. The most compact have a hardness about seven (Moh's) fracture semi-conchoidal, inclined to splintery—opaque. Before the blowpipe they intumesce, and phosphoresce slightly. They gelatinize when treated with nitric and muriatic acids. Some of them inclined acicular, microscopic and minute crystals of a mineral resembling chabasite.

At about three miles from Bijapore, the kanker and iron ore conglomerate occur in masses: the latter is used as a revêtment to a small well into which I descended, and found the water percolating through layers of kanker, dark earth, and iron ore. The fissures were nearly vertical; direction N. 5 E., dip S. E. by E. Trap, generally covered by a bed of reddish kanker, on which rests the cotton soil, passing into a reddish amygdaloid, reticular and porphyritic, containing calc spar and zeolites, continues to Hukli. Portions of its red clay basis intumesce, and curl up before the blowpipe, indicating the existence of numberless minute particles of zeolite disseminated throughout its substance. With muriatic acid, it formed a gelatinous mass; in this respect resembling the Silesian variety of basalt analyzed by M. Löwe of Vienna. Wells of fresh water are of frequent occurrence. The same formation continues to Bagwari. Between Hukli and Bagwari, a branch of the Doni is crossed, having black steep banks of cotton soil; this stream is a treacherous bed of saline and sluggish water, unfit for the use of man or beast. The earth of its banks is highly impregnated with muriate of soda, as shewn by the efflorescence on the surface, and by the adjacent salt works. About seven miles from Hukli, between Musibinahal and Bagwari, I observed a flat topped hill, about a mile from the left of the road. It was composed from base to summit of a tabular lateritic rock. Cuboidal masses of the same crowned the summit, exactly resembling the masses on the tops of the smooth laterite hills of Malabar and Canara. Farther east, about a mile, runs a low ridge of hills with a N. E. and S. W. direction; the flat contour, and waving direction of which powerfully reminded me of the laterite hills on the Western Coast. I examined the end of the range, and found it to be of the lateritic rock just alluded to; the rest also appear to be of the same rock. About twelve miles to the south of these, rise two other flat topped hills at Nagarwar, which I am assured by the natives, are of the same rock. The small hill of Hori Math, near Ingliswar, celebrated as being the site of the miraculous birth of the founder of the Jungum sect, is entirely composed of the lateritic rock. These lateritic hills are remarkable, as rising above the low trap elevations amid which they are situated, and are the only hills of any height to be seen for miles around. This circumstance, which is not of rare occurrence in other parts of India, is evidently the result of the denudation of the subjacent trap,

the beds of laterite being once probably continuous over its surface. The trap is seen in the vallies and nullahs at their base, on which the lateritic rock rests in tabular, horizontal masses. A siliceous porphyritic rock, having cavities lined with minute brown crystals, is associated with this rock, and is found in loose blocks on the surface. The imbedding paste is a light coloured highly indurated jaspideous clay. Before the blowpipe *per se*, the crystals lose their colouring matter, but fuse with carbonate of soda into a white enamel.

Quarries of Bagwari.

Went about two and a half miles to the east of Bagwari, to see the quarries whence the compact blackish trap is dug, used in building the walls of that town; found the quarry to be nothing more than a large assemblage of basalt *en boules*, lying partly on, and partly imbedded in, the soil covering a long swell, probably a basaltic dyke, through the surrounding trap. I searched in vain for an excavation affording a section of the intrusion of the former. The basalt is different in mineral structure from that seen passing through the granite, gneiss, and slate of the Ceded Districts, the Nizam's dominions, Mysore, Malabar, and Canara. It is now amygdaloidal and vesicular, and contains small globules of calcareous spar, zeolites, and calcedony. The vesicles, however, are more usually empty: some of them contain a brownish yellow earth into which I have observed the zeolite to decay, and also calcareous spar, coloured with the peroxidation of iron, which exists plentifully as the black protoxide and carbonate. The fracture is conchoidal, fragments faintly translucent at the edges; streak, greyish white; melts before the blowpipe into an intense green glass. It contains little amphibole, and appears to be composed almost entirely of augite and felspar.

Lateritic rock of Hori Math.

The lateritic rock in the vicinity of Hori Math appears, generally, to contain more iron than the rock of Malabar and Canara, and is consequently of greater specific gravity. The specimens I obtained did not contain lithomargic earth, nor so much quartz as the latter; the tubular sinuosities are frequently lined, like those of the Malabar variety, with an ochreous earth arising from the decomposition of quartz and felspar, and tinged of various shades of brown and yellow by the oxide of iron; this earth forms a compact paste, cementing more firmly the component parts of the rock together: it exactly resembles in this respect, portions of the Malabar

laterite. It is not so soft interiorly. This paste adheres to the tongue, and gives out an argillaceous odour when breathed on. The more compact parts of the rock, forming the coating of the tubular cavities, become magnetic before the blowpipe, and are converted into a dark grey slag.

From Bagwari to Alcopa.

Proceeding in a S. E. diretion by Jawannaghi and Narsinghi, to Alcopa, a village east of Umblanur, the road lies diagonally across the low trap swells which have generally a S. W. direction, though their lines sometimes intersect each other at obtuse and acute angles. The tops of the swells are mostly slightly convex, though often terrace-like, and are composed of the more compact and globular trap. In the banks of nullahs, the trap and amygdaloid may be observed alternating, and passing into each other: when they occur horizontally, the trap is generally the surface rock; this may be owing to its superior hardness, and capability of withstanding the abrasions caused by the elements. The amygdaloid contains irregular bits of decaying felspar and numberless vesicles, often filled with green earth and crystals of carbonate of lime. The former mineral, in moist situations, assumes a black or deep brown colour in decomposition, giving a speckled appearance to the rock, resembling that of the toadstone of England. Before the blowpipe, these dark spots are converted into black slag. In the bed of a stream, a few hundred yards N. W. from the village of Kunkal, I found slender prismatic crystals of carbonate of lime fasciculated in sheaf-like forms, with dark pieces of chert in a friable mass of the amygdaloid; the radii of the calcareous crystals were three inches in length, and of a faint amethystine hue.

About two miles to the north of this village, indications of a change in the formation were seen in the angular bits of red pegmatitic and quartz rock, that occur on the plain and in the beds of nullahs, which become more frequent as the villages of Kunkal and Alcopa are approached. A few hundred yards south of the latter, I found these indications confirmed, and the quartz rock in situ, in tabular masses in the bed of a nullah. Alcopa is situated near the south-eastern foot of a slope, on the top of which the trap has the usual compact and globular form; while at the base it is tabular, schistose, and amygdaloidal. A few hundred yards to the south of this village, the trap formation ceases at the foot of a low range of flat-topped hills of sandstone. In the hope

of discovering the line of termination, I spent several hours in searching the beds of streams, and visiting the quarries in the neighbourhood, and at last discovered it in the bed of a nullah, about three hundred yards south of the village: here, after clearing away the gravel and detritus composing the bed, I distinctly saw the trap overlying the sandstone, and penetrating some of the numerous fissures that cleave the latter. I had anticipated this fact from the circumstance of the little disturbance in the latter rock, which occurs in tabular horizontal masses, having a rhomboidal shape from being intersected by fissures with a varied direction, but generally N. 65 W., crossed by others trending S. 20 W. Where the trap had penetrated them, I did not find the two rocks adherent, or passing into each other; but perfectly distinct and separate, and occasionally a thin calcareous seam intervening. Both the trap and sandstone seem to be slightly altered by contact, the former becoming less crystalline and more earthy, but often extremely tough, and splitting into small fragments, with numerous microscopic fissures intersecting its structure. The colour of the sandstone, from a few lines to several inches distant from the contact, is generally reddish, passing into a deep reddish brown. There was no appearance of semi-fusion, or intermixture, nor entangled masses of sandstone in the trap, a circumstance coinciding with the observations of Lord Greenock, in his account of the phenomena displayed by the igneous rocks in the neighbourhood of Edinburgh, in their relations to the secondary rocks: nor did I observe any solidification in the former, as noticed by Professor Hausmann, in the sandstone altered by heat near the blast furnaces at the Steinrennerhutte in the Harz: on the contrary it was of a looser texture than ordinary. In structure, from a loose and variegated grit, it approaches a compact quartz rock, containing disseminated portions of decomposed felspar, which falling out, leave a number of minute oval cavities. This stone is much used in building by the villagers in preference to the trap. I saw no veins penetrating the sandstone; pegmatite occurs in scattered blocks: the situs of this rock cannot be far distant, judging from the sharpness of the angles of these fragments.

From Alcopa to Talicota.

Proceeding in an easterly directions towards Talicota, the trap formation extends to the village of Mudkeysur, three coss from Alcopa, when it is succeeded by a bluish grey compact limestone, which I first observed in the bed of a

nullah. No section occurred, shewing its contact with the sandstone ; the surface of the country being covered with a thick stratum of soil, but from the easterly dip of both rocks, it is evident that the limestone is the uppermost. It continues the surface rock to the most easterly point of my observation ; viz. Talicota. In a deep well at Munjghi, a coss west from Talicota, the bed of the Doni river and the plain in front of the Talicota fort gate, it occurs in stratified masses, with a very slight dip, varying according to the rise of the plain. In the well, the dip was only $2\frac{1}{2}°$ E. 5 S. Dividing the limestone from the surface to the bottom of the well was a fissure, a foot wide, direction S. 5 W., filled with a buff-coloured earthy kanker and angular fragments of the limestone rock. The latter in mineral character resembles the Cuddapah limestone, but is generally lighter in colour, varying from dark blue to pale buff or cream, and has few traces of pyrites.

The minerals associated with it, are hematite in small nodules, often occurring disseminated like strings of beads through its structure, which falling out, leave regular lines of small holes that resemble the perforations of boring insects, and the tubular sinuosities in laterite. Angular fragments of a buff-coloured jasper are strewed among those of the limestone, and from their variolated exterior, appear to have been in contact with the basalt, possibly limestone passing into jasper. I have often noted the Cuddapah limestone passing into chert, from contact with basaltic dykes. The softer and finer varieties of the cream-coloured limestone found in the vicinity of Talicota, are well adapted for lithographic purposes. Some of the specimens which I brought hence, were sent down to the lithographic establishment at St. Thomas's Mount, and found to answer. There is also a fine laminar limestone found in the bed of the river, with beautiful dendritic appearances between the plates.* The plain of Talicota is averred by Ferishta to have been the theatre of the overthrow of the Hindu empire of Bijanugger in A. D. 1564 ; where Ram Raj, its sovereign, was totally defeated

* A specimen of this dendritic limestone was examined for me, by Dr. Wight, who kindly afford me the following note: "The arborescent appearance in the slate I think an organic remain. At least I find, when under a high magnifying power, that the black lines can, with the point of a needle, be picked off without touching the stone, as if the carbonaceous matter of the plant was still there. I feel uncertain, however, whether to call the original a *moss* or a *fucus*, but think the latter."

and slain by the combined armies of the four Mahomedan kings of the Deccan; viz. those of Bijapore, Golconda, Bider, and Ahmednugger. Few, if any, of the present Hindu inhabitants of the place, however, had any tradition of this having been the site of the battle; and even Mahomedan historians differ, placing it farther south. Talicota is now, (1838,) the capital of a small territory held in jaghire from the British, by a Mahratta chief of the Rastia family, named Bala Sahib. It is situated in a plain on the left bank of the Doni river, which flows into the Kistnah, and separates the jaghire from the Mudibhat talook. The river is about 150 yards broad, and was easily fordable when I crossed it in the month of July. The banks are steep and clayey; the bed, as before mentioned, consists of great slabs of laminar limestone. Talicota is erroneously placed in some maps on the right bank of the stream. Besides the town walls, which are of stone, it possesses an inner fort, or citadel, in which the palace of the Rastia, a high stone house with small windows and loopholes, is situated. The palace has nothing but a guarded gateway to distinguish it from the substantial dwellings of the Bunnias and Lingayet merchants of the place. Near it, is the holy and celebrated Mahomedan shrine of the Five Saints, "*Durgah-i-punj-Pir.*" The pettah is large and spacious, and has a broad street, in which are the shops of the Jain venders of brass-ware, numerous calico printers, dyers, &c., for whom the place is noted. There is a small private Jaina shrine here, into which I was shewn by the Jaina merchant who accompanied me. It contained several white marble images of the principal *Tirthunkars*, brought from the north, (*Uttara Dés,*) together with the *Pancha Purmestri* in brass. There was also a brazen bas-relief of all the twenty-four *Tirthunkars*, the gigantic *Ardeswara* standing naked in the midst of the saintly group. The following is an approximative statement of the population of the town :—

Mussulmans, principally weavers and soldiers, ...	1,500
Vaisya Comptis, grain and provision sellers, ...	125
Mahratta dyers and cloth printers, ...	500
Lingayet cloth merchants, ...	1,000
,, weavers, ...	250
,, oil-makers, ...	50
Kunbis, agriculturists, ...	1,000
Carried over, ...	4,425

Brought over, ...	4,425
Mahratta tailors, ...	250
,, saddlers, ...	50
Brahmins of the Smarta and Vaishnavam sects, ...	500
Jains of the Vaisya sect, ...	15
,, ,, Chsetriya sect, ...	25
,, ,, Suryonsh Chsetriya sect, ...	25
Jain Upadi, or inferior priest, ...	1
Total, ...	5,291

Besides the above, there is a body of one hundred Mahratta horse and sibundies, maintained by Rastia; and a floating population of that wandering class of grain merchants, the Brinjaris, with whom the bazar was crowded. The revenue of the jaghire is estimated at about 10,000 rupees per annum. At the time I visited the place, Talicota was in charge of Nana Sahib Rastia. Bala Shahib, his elder brother, was engaged in a religious pilgrimage to Gungapur, on the banks of the Bima.

I observed the limestone to the S. W. of Talicota nearly five miles.

From Talicota to Mudibhal.

About two miles farther in the same direction, the overlying trap occurs in the bed of a nullah, a little to the E. of the village of Gonahal, and continues for about a mile, when sandstone, in isomorphous masses, forms the surface rock, and is also seen in the bed of a nullah, in which lay angular blocks of both the above-mentioned rocks and fragments of the red pegmatitic stone. Trap prevails between Gonahal and Contogi: it is seen a little to the west of the latter village, overlying the sandstone in the bed of a nullah. The latter rock is here observed to separate into contorted laminar flakes of a reddish hue and friable structure near the line of junction: the former is earthy in texture, as before observed. A few feet from the junction, the sandstone resumes its usual texture and colour. Between the flakes calcareous incrustations have taken place. Between Contogi and Mudibhal, trap and amygdaloid are the surface rocks. Immediately to the west of the latter place, rises a low ridge of finely grained sandstone, where the quarries for millstones, for which Mudibhal has long been known in this quarter, are situated. The rock lies immediately under a stratum of *règur*, in tabular masses, in-

tersected by vertical fissures running E. and W., and crossed by others at right angles : horizontal fissures also occur, dipping at about one and half to the E., these afford great facilities to the *Wudras* in excavating masses for pillars. A sort of pickaxe, wedge, heavy hammers, and levers are the only implements used : blasting is had recourse to, to split the larger blocks into pieces for the millstones. The masses of rock, though red, and variegated near the surface, are generally white and crystalline in the centre, having decaying portions of felspar disseminated. The millstones are shaped on the spot, and exported to the surrounding districts and to the Nizam's territories. They fetch from four to sixteen annas each ; fire is not used to separate the masses, as in granitic rocks.

From Mudibhal to the north bank of the Kistnah.

A little west from the sandstone hills, the red felspar rock, with mica interspersed, occurs in unstratified knolls and masses. This continues to Hallighirry, whence the formation to the Kistnah is gneiss, with a few blocks of the granite protruding. A dyke of the crystalline greenstone occurs between Lepghirri and Hallighi, E. and W. direction. The Hindus rarely employ the overlying trap for building, preferring to bring sandstone or granite from a considerable distance. This is shewn in the old Hindu temple in Bijapore and villages in the vicinity of Contogi. East of Mudibhal the Idgah hill affords a good specimen of the globular trap ; it resembles the greenstone dykes of the Ceded Districts, at a distance, in colour and contour ; but the mineral character of the rock differs in containing little hornblende : it is tough, much less crystalline, and contains zeolite and calcedony imbedded in nodules. It decays into a deep red earth.

The Capila Sungum, or confluence of the Kistnah and Malpurba.

Crossed the Kistnah on the 15th July to Danoor and halted. Went to see the junction of the Malpurba and Kistnah on the 16th, about two and half miles west from Danoor. Crossed the Malpurba, about 200 yards broad, in a basket boat to the Delta, on the apex of which is situated the celebrated temple to the Lingum, in which Baswapa, the founder of the Jungum sect, finally disappeared, according to the version of his priests. The temple is evidently of great antiquity, small and not remarkable for beauty. I have a strong impression, that it was built by the Jains, from some peculiar symbols that have escaped the

mutilating hands of their opponents, such as the two elephants with elevated trunks over Lachmi, &c. The temple faces the east, and the sacred Ling is covered by a hollow silvered head of Mahadeo, which was taken off for my inspection: expanded behind it, rises the silvered hood of a *Cobra de capello*, forming a canopy to the whole. There is nothing remarkable about the Ling, which is a small one blackened by libations of oil, milk, &c. I was not near enough to see the depression, or mark, said to have been left on it at the place Baswana was absorbed. Facing the Ling, in the ante-room, are two Baswanas, or sacred bulls. At the point of the Delta stands an Acacia tree. The two rivers were flowing with considerable rapidity, and their turbid waters mingled in curling eddies near a small temple, almost submerged in the waves, containing a Ling. The three Maths of the three Swamis here are in a dilapidated condition; that of Sencri Bharti is in the best state of repair. A brahmin performing *tapas* on a tiger skin, sat in a state of religious abstraction in one of the cells. The *Sthalla Puranam* of the place is in the hands of Ragovindra Achari, one of the three *Matha-mudras* whom I saw here; the names of the others are Sencri Bhat and Binda Achari. There are two *Sassanams*, one in the N. wall of the enclosure, the other near the ferry of the Malpurba in Hala Canara.

Rode from Cuddywal to Hunnagund, about five miles westerly.

Jain temple at Hunnagund.

There is a Jain temple situated in the S. E. extremity of a short and low range of hills; it is in ruins; the Gopar had been prostrated, and the sculptures considerably defaced. The temple fronts the east, and the doorways are flanked by mace-bearers in relief, with female figures on either side. The walls are decorated exteriorly with various sculptures: bayadéres, lions, elephants, &c. in alto relievo, and present a mass of elaborate carving. Bas reliefs of naked *Tirthunkars* are interspersed, the larger in a standing, the smaller in a sitting, posture. The extreme length of the arms of the former, which hang loosely down by their sides reaching below the knees, reminded me of the description of those of Rob Roy. The sanctum had been rifled of its idols, but I observed a large one reared up in one of the entrances, which possibly had been abstracted thence, as it has evidently suffered displacement. It is an erect naked figure in high relief, executed on a block of fine sandstone, with the short curly locks, (resembling a Welsh wig,) elongat-

ed ears, and peculiar contour, that characterize the Jaina saints: from the hood of the *Cobra* extended like a canopy over his head, I judge the image to be that of *Purswanath*. The features and other parts have suffered mutilation. The interior of the place, fouled by bats and other animals, is supported by massive stone pillars, generally square, with tori: the ends of the architraves are carved into lion's heads, &c. The whole is of a light red sandstone brought from Himallya, few coss off. There is an inscription in the wall of the doorway; another slab bearing an inscription in Hala Canara lies broken near the threshold. The earth and rubbish have accumulated up to the knee of some of the images. The range on which the temple stands, is a bed of elevated jaspery rock with contorted laminæ, and similar in appearance to that forming the copper-mountain ridge of Bellary. Direction N. W., dip 60 to 70 N. E.

From Sassenhal to the Tumbuddra.

From Sassenhal and Jumlapur to Nundapur, the road passes over the N. W. extremity of the Idlapur schistose elevations, before noticed. From Jumlapur, where the chlorite slate is seen at the usual angle of elevation, the ground rises for about a mile, when a narrow greenstone dyke is crossed, running E. 10 S. About 40 yards farther, the main dyke is traversed, running in an almost similar direction, which covers the summit and descent of the elevation with globular and angular fragments, almost as far as Nundapur, a distance of three miles. At the base of the elevation on which this village is situated, the slate is seen in the bed of the nullah, dipping at an angle of 60 N. 45 E., *i. e.* from the dyke. The schists on the western side of the dyke, observed yesterday at Sassenhal, dip at an angle of 72 to the S. W., *i. e.* from the dyke. The greenstone differs not from that usually seen in the Ceded Districts, being crystalline or porphyritic near the centre, imbedding crystals of a greenish felspar, and becoming more compact as it approaches the edges: amphibole and felspar intimately mixed, are its chief constituents. Near its eastern flank these minerals separate, and it passes into a sienite, which is exceedingly tough under the hammer: the felspar crystals fast decomposing, form a compact paste. The chlorite slate, in the immediate vicinity of these plutonic rocks, loses its fine slaty character, becomes thick-bedded, compact, and of darker colour, and is penetrated in every direction by contorted quartzose veins, the

planes of which seem almost as various as their flexures. At the distance of a furlong and 100 yards S. E. from Nundapur, a red felspathic dyke occurs in the gneiss, almost concealed by a superincumbent mass of friable kanker: small crystals of a scaly graphite, with a shining steel-like lustre, occur disseminated in this vein. The gneiss alternates with chloritic slate and beds of a red felspar rock: its laminæ are much contorted, and have here an easterly direction. One mile and a furlong in the same direction from Nundapur, the bed of a stream is crossed, where a dyke of a compact reddish felspar rock (Eurite ?) cuts the gneiss in a direction of N. 60 E., flanked by a thick bed of reddish felspathic granite, containing both mica and chlorite in lamellæ, and a little quartz. This rock and the gneiss are much weathered. Six furlongs hence, the gneiss assumes a granitoidal form, appearing in rounded blocks with concentric exfoliations. Three miles from Nundapur, a trap dyke crosses the gneiss, running westerly; and another, at four miles five furlongs, having a similar direction. A furlong from this, a large dyke of the red euritic rock, about 200 yards broad, occurs in the same direction, flanked by a bed of the red felspathic rock, large beds of kanker accompanying the intrusion of the dyke. I saw an immense bed of this calcareous rock, lying as a flat table on the gneiss near Manadhal. From this place to Kannaghirry, a distance of eleven miles one furlong, gneiss, granitoidal gneiss, forming gentle elevations, and scattered surface blocks occur; the associated schists of chlorite and mica are less seen. A trap dyke occurs at the distance of five miles five furlongs from the former village; direction W. 15 N.

In the bed of the stream, forming in part the fosse of the fort of Kannaghirry, gneiss is seen alternating with mica and hornblende schists, both thick bedded and laminar. On the N. E. flank of the fort, a dyke of pegmatite, with a close small grained sub-crystalline structure, is seen passing through the gneiss, and in a direction parallel with that of the laminæ. In the latter rock, a vein, (five inches broad,) of large crystals of felspar and quartz running N. 25 E., exhibits a dislocation to the E. of seven inches. A fissure traverses it for some distance longitudinally, running also into the schist. The walls of the fissure are lined by quartz passing into hornstone.

About four miles North by West from this, near the village of Hanumanhal, I saw on the road side a monument of a Hirlu, or a hero

slain in battle, evidently of high antiquity. It consisted of a slab of gneiss placed in a slanting position, on the surface of which a male and female figure were rudely sculptured in bas relief: the former was armed and in the attitude of combat; the latter, with uplifted hands, seemed in the act of throwing herself into his arms for protection. The relations and descendants place flowers and offerings of oil and milk, as offerings to the manes of the brave: the pious passenger deposits a stone, of which a large heap at the foot threatens to overwhelm the monument and the hero altogether. It is probable, many of the tumuli of loose stones observed in many parts of India, cover similar antiques.

Concluding Remarks.

I shall conclude these notes, with a few observations on what I term the great overlying trap formation of Central and Western India, the southern limit of which has been just described, in contra-distinction to the hills and dykes of greenstone associated with the granite, gneiss, and metamorphic schists of Southern India, which I take to be a distinct and more ancient rock.* The overlying trap formation has a south-westerly course; its southern margin terminating, according to Mr. Fraser, near Malwan, in latitude 15° 53′ N. and longitude 73° 47′ E. on the Western Coast of the Peninsula, and its northern limit between Bulsar and Gundavie below Surat, between the 20th and 21st degrees of North latitude. Its boundaries at Gundavie, according to Dr. Lush, are strata of clay containing kanker. Proceeding southerly on the sea coast between Bassein and Surat, horizontal strata of sandstone are seen resting upon it, supposed to be identical with the fossiliferous rock of Kattywar, and which may be accounted as the newest sandstone formation of India. Still farther south at Bombay, it is fringed by a recent formation of coral and shells; and N. of Malwan, it meets with the greenstone, granite and sienite of Southern India. Thus the western extremity of this formation occupies in its breadth, an extent of sea coast approaching five degrees of latitude. Proceeding inland in a N. E. direction from the vicinity of Malwan, its southern boundary may be described by a line drawn thence through

* This opinion is chiefly grounded on the relative position, age of associated rocks, and mineralogical distinctions, which are very striking. The zeolites, chalcedonies, green earth, olivine and calc spars so abundant in the formation just described, are never or rarely seen in the trap a little to the S. of the Kistnah. The latter is never seen overlying fossiliferous rocks in continuous sheets, but occurs as dykes in granite and the older stratified formations.

Merritch and Gurdinny, a village about 40 miles S. E. from the city of Bijapore to Bider; thence north of Hydrabad to Nagpore; and from Nagpore north-easterly towards Sohagepore and Sagur to the 82d degree of East longitude, as observed by Franklin and Coulthard. At Gurdinny it rests on granite, a broad pegmatitic zone intervening. A little to the east of Gurdinny, at Mudibhal, on a crystalline sandstone; and at Nagpore on granite. Its north-eastern limit has not been accurately defined; straggling *coulées* of a similar trap, (containing olivine, calcedonies and agates,) have however been traced by the Rev. Mr. Everest as high as Gwalior, which lies in lat. 26° 15′ N. and lon. 78° 1′ E. It is said to extend still farther toward the east up to the Rajmahal hills: though it would appear that its continuity here becomes broken up. Assuming Gwalior as its north-east corner, we will return towards the Western Coast by the northern limit, passing from Gwalior in a south-westerly direction to Neemuch; whence taking a direction more southerly to Dohud, as traced by Captain Dangerfield, it passes by the east of Baroda to the sea near Bulsar, a little to the south of Surat. On this last line the trap was found, at Sagur, to rest on shell limestone, and on the limestone, greenstone, quartz, argillaceous, and talcose rocks of Oodipore. At Bulsar, as before stated, it is bounded by strata of clay and kanker.*

Such is the unparalleled extent of this vast sheet of trap, covering a space, with some interruption, of 250,000 square miles.

Since writing the above, I have had the pleasure of perusing Col. Sykes's admirable paper on this great trappean region, and perceive that he assigns to it an area of from 200,000 to 250,000 square miles only; but adds, however, that it appears to him that the above are not the absolute limits of the trap. My own observations, taken during journies to Bijapore, Bider and Culberga, will have served to trace its S. W. boundaries more distinctly than has hitherto been done.

* It is probable that the amygdaloidal trap found overlying a bed of limestone, containing oysters, limnæ, small melaniæ, &c. at Peddapungali near Rajahmundry, and discovered by Col. Cullen, is an outlier of the great overlying trap formation.

Ancient Inscription found at Aden. Communicated to the Asiatic Society by the Government of India. With a plate.

No. 29 of 1842.

From Captain S. B. Haines, *Political Agent at Aden,*
To J. P. Willoughby, Esq.
Secretary to Government of Bombay, dated 29th September, 1842.

Political Department.

Sir,—I have the pleasure to forward to you the accompanying copy of an ancient inscription recently discovered in Aden, by the work-people employed in excavating the new road leading up from the Custom House.

2d. It is an interesting fact, that though Aden in its most flourishing era was the principal sea-port of the ancient Hymyari kings, that no Hymyaritic inscriptions previous to this have ever been discovered, either in the ruins of the ancient town, or its immediate vicinity; though on the shores of Hadramaut, and inland as far as Sana, many beautifully executed inscriptions have been found, and transmitted to Bombay. In every other case, however, the characters have been found on oblong marble blocks, generally forming part of a gateway, as at Nukbel Hajar, on the Hadramaut Coast; whereas, in the specimen now brought to light from a depth of twenty feet beneath the present surface of Aden, we have a circular slab of pure, and very compact white marble, with a raised rim round it, and apparently forming part of an altar. The inscription is not so well executed as many others that I have seen, but it is perfectly clear, without flaw or injury. In removing the stone, part was unfortunately broken off by the work people.

3d. The antiquity of this specimen may very safely be dated from the first year of the Hijera, when the last of the Hymyari princes reigned in Yemen. After the conversion of the Sabeeans to the Moslem faith, the altars erected to their gods were overthrown, and the religion of Islam universally prevailed. The character gradually became lost, as the Kufic writing spread over the southern and hitherto unconquered country of Yemen and Nedjran, and is now extinct. The learned professor, Gesenius of Germany, has succeeded in decyphering

Impression from the Stone
Sd S.B.Haines.
Political Agent

26th Septr 1842

Copied by G.T.Ribeiro
Asst Secl and Pol Dept

and translating a small part of one inscription found by the officers of the " Palinurus,' during the survey of the South Coast, and it is only to be hoped, that this specimen may afford an additional clue to assist him in his valuable and highly interesting researches, regarding a nation that has been so utterly swept away.

4th. The inscription, it will be perceived, is a fac-simile, being an impression from the stone, and its accuracy therefore may be depended upon.

I have the honour to be, &c.

Political Agent's Office, Aden,
29th September, 1842.

(Signed) S. B. Haines,
Political Agent.

(True Copy.)
(Signed) J. P. Willoughby,
Secretary to Government.

(True Copy.)
P. Melvill,
Assistant Secretary to the Government of India.

Meteors observed at Allahabad on the 10th of August, 1842. *By Capt.* Shortrede, 1*st Assistant, Grand Trigonometrical Survey of India.*

The following observations were made at Allahabad, for the purpose of comparing them with corresponding observations to be made at Agra, but the gentleman at whose suggestion the observations were undertaken, was unable, from sickness, to take an active part in the business. Though the primary object was thus frustrated, it may be worth while to record these observations, with a view of calling the attention of those who may have opportunities of making similar observations about the 10th of August and 13th of November next.

The first step towards a knowledge of these meteors is a large collection of facts, and it is not to be overlooked, that in this country we have advantages for such observations which are scarcely equalled in any other part of the world, owing to the general clearness of our sky, the extent over which observations can be made, and the facility of intercourse by our common language, and the post routes everywhere.

The observations themselves are very easily made when a person knows exactly what he has to do, and does not allow himself to be distracted by attempting too much. Besides general attention, the most useful qualification I believe to be, the ability readily to estimate altitudes at sight. I know by experience, that persons in the habit of such observations, may train themselves to estimate altitudes at sight within 2° of the truth, for I have practised it along with another person, proving our estimates by an altitude and azimuth instrument. In the present observations, the altitudes I believe to be within 5° of the truth, and the azimuths within 15°. But as the meteors come sometimes very quickly after each other, there is no time for deliberation, and it becomes necessary to write down at once whatever is to be recorded, so as to be ready for the next.

In order to judge of the azimuths, I had my cot put in an open place, and laid duly East and West, because I had a straight road, with well marked objects in that direction. I lay on my back, and had a faint oil light on the ground, just sufficient to let me see my watch and what I was writing. I wrote lying on my back, and holding the paper over my head, and in this way saw several meteors which otherwise would have passed unnoticed.

It is an obvious fact, to whatever conclusions it may ultimately lead, that a considerable majority of these meteors have a Westerly course in or near to the Zodiac. Such being the case, it is desirable that some observers should be situated as nearly as may be at right angles to the Zodiac, and at considerable distances from each other, in order that the errors in estimating the altitudes have the least possible effect on the computed heights from the surface of the Earth.

In order that meteors observed at distant places may be readily identified, it is desirable that observers should set their watches either to mean or to apparent time, by means of an astronomical observation, or by a well-set sundial. Provided it be distinctly stated, whether the watch shews mean or apparent time, it is of no great importance which is used; though as a general rule, apparent time is the most convenient for meteorological observations, because the tides, &c. of the atmosphere, like those of the ocean, have a direct relation to the apparent, rather than to the mean course of the sun.

Appt. Time of Obser.	Origin. Alt.	Origin. Az.	Course.	Length.	Remarks.
h. m.					
11·18	70°	S. W.	Nearly vertical.	25°	Faint.
11·23	40	S. W.	Vertical.	10	Very faint.
11·34	45	S. W.	..	15	Faint.
12·20	70	S.	..	..	Splendid from meridian 20° S. of Zenith towards 20° S. of Jupiter, train visible for one or two seconds.
12·23	..	..	..	5	Very small; from 20° S. of Zen. towards Jupiter.
12·27	..	..	..	8	From 15° N. of Zenith towards Jupiter, faint
12·39	45	N.	West	10	Small.
12·41	70	..	W. 20 N.	6	Faint, ended at 10° S. of α Cygni.
12·42	..	..	N.	10	From Milky Way between α Cygni, and α Pegasi. Sky clear, 25° above horizon.
12 50	90	..	N.	8	Faint.
12·54	45	N.	..	..	Very faint, towards α Cygni.
12·58	..	..	Westerly	..	From 10° E. of α Pegasi.
12·59	32	N.	..	..	From 8° above Pole-star : faint.
13·00	..	..	Westerly	..	From 20° N. of α Pegasi : faint.
13·04	30	W. 20 S.	W. 35 S.	..	
13·08	50	W. 15 N.	W. 25 S.	10	
13·15	80	S.	S. W.	15	Faint: cloudy towards N. and heavy E.
13·19	24	N. 5 W.	N. W.	5	Faint
13·22	..	..	W.N.W.	5	Faint: from 5° N. of Altair.
13·25	40	N.	W.	15	
13·28	65	N.	N.	10	Faint.
13·30	60	S. W.	S. W.	10	Very faint.
13·30½	70	S.	W. 20 S.	45	Brilliant.
13·39	20	W.	W.	..	Rather bright, but short.
13·48	35	W. 20 N.	..	..	From 8° S. of α Cygni.
13.49	..	..	..	..	Faint from near Zenith towards S. W.
13·56	..	..	..	..	From 15° S. of α Cass., cross meridian from 10° E. of Zen. to 40° below Zen. towards 40° S. of Jupiter.
13·57	60	S.	S. 20 W.	..	Towards Fomalhaut.
14·01	75	N.	..	..	Towards 30° W. of Fomalhaut.

Appt. Time of Obser.	Origin. Alt.	Origin. Az.	Course.	Length.	Remarks.
h. m.					
14·02	..	S. W.	..	..	Another? uncertain.
14·04	90	..	..	..	Two from near Zenith, towards 20° W. of Fomalhaut: both faint.
14·04¼	..	..	..	..	
14·08	..	..	..	..	Three within 20°s; 1st and 3d from 10° W. of Zen. towards Jupiter, length 20° 2d Northwesterly.
14·09	45	S. W.	..	..	Towards 5° S. of Fomalhaut.
14·12	..	..	..	..	From 15° S. of Altair to 10 S. of Jupiter.
14·13	40	S. 60 W.	S. W.	..	
14·14½	..	..	..	..	Three; two of them S. W., the other N. N. W., generally altitude about 40° at origin.
14·17	60	S.	S. W.	25	
14·18	..	S. W.	..	..	One S. W.; direction S. W. oblique.
14·18½	..	N. W.	..	..	One N. W., nearly vertical.
14·19½	40	..	W.	..	10° N. of Altair, direction West, vertical. Sky clear towards N., cloudy in E. horizon.
14·22	45	S.	S. W.	..	
14·23	60	S.	..	..	Bright from 30° S. of Zenith towards 15° E. of Fomalhaut.
14·24	..	..	W.	..	In Milky Way near α Pegasi.
14.26	70	S.	..	..	Two, 20° S. of Zenith, direction S. W.
14·26¼	70	S.	..	..	
14·27½	..	..	..	..	One N. W.; somewhat uncertain.
14·28½	..	..	S. W.	..	From α Arietis.
14·31	75	S.	..	..	From 15° S. of Zenith towards α Ceti.
14·32	45	S. W.	S. W.	..	From alt. 45° S. W. to 2° N. of Fomalhaut.
14·34	90	..	..	..	Brilliant from Zenith to between Fomalhaut and α Ceti; train luminous for about 10 seconds.
14·35	50	N. W.	..	..	In Milky Way at 40° N. W. from Zenith, direction in Milky Way Westward.
14·39	50	S. S. W.	..	..	Towards Fomalhaut.
14·42	..	..	..	..	Small, at 35° about α Cygni in Milky Way.
14·44	..	..	N. E.	..	Corruscating in Zenith, direction N. E.
14·44½	80	S.	S. W.	..	From 10° S. of Zenith.
14·48	..	..	W. 35 S.	..	From 10° S. of α Cass. direction W. 35° S.
14·49¼	..	..	..	..	From N. of Zenith towards Ceti. Cloudy and heavy all around, except to N., Left off observing.

Memorandum on the "Bora Chung," of Bootan. *By* A. Campbell, Esq., *Superintendent, Darjeeling.*

Fukeergunge, right bank of the Teesta, January 25, 1843.

The announcement of any extraordinary fact connected with the habits of men or the lower animals, produces three states of mind in the mass of those addressed; 1st, an unenquiring and implicit credence; 2nd, wonder, without any lasting attention to the matter narrated; and 3rd, sceptical disbelief. I have no doubt that the notice of the "Bora Chung", by Dr. Pearson, in Vol. VIII. of the *Journal of the Asiatic Society*, p. 551, produced all these states, in a great number of readers, for I have heard many express themselves to this effect; and I confess, that although I did not disbelieve the account of this fish's habits, I have been very anxious to make further inquiry into them. When in Bootan last year, it was out of my power to do so, but this year I have been more fortunate; and the following is the substance of the information I have gained:—The "Bora Chung" is not found on the right bank, or Rungpoor side, of the Teesta; it is confined to the Bootan side. It inhabits jheels and slow running streams near the hills, living principally in the banks, into which it penetrates from one foot to five or six. The tubes leading from the water into the banks are generally a few inches *below* the surface of the water, and consequently filled with water; they are sometimes of no greater diameter than sufficient to receive the fish, sometimes they are a foot wide; when of the smaller size, they terminate in a basin where the fish remains, returning to the water at pleasure. The usual mode of catching them is by introducing the hand under water into these recesses; two fish are generally found together, and they lie coiled up horizontally, resembling a wheel. They are eaten by the people of the Bootan Dooars, and are quite wholesome. It is not believed that they bore their own holes, or form their resting basins, but that they occupy the abandoned locations of land crabs. When in the waterpool or streams, they always remain close to the margin, and constantly move out and in, of their holes. They never leave the water, nor can they move on the grass more than any other fish. They are supposed to breed in the recesses described.

I have not as yet succeeded in getting specimens of the "Bora Chung," but expect to do so. I saw those sent from Darjeeling to Calcutta for Dr. M'Clelland. They were each about twelve inches long, of a dark brown colour, and scaly. If Dr. M'Clelland described them, they must be sufficiently known to Naturalists; but they may not have reached that gentleman; or, if so, their fate has been similar to that of fourteen species of fish collected in the Bootan Dooars last year, and forwarded by me to Calcutta for Dr. M. I have not had any acknowledgment of their receipt, and I conclude, therefore, that they never reached him.

Proceedings of the Asiatic Society.

(Friday Evening, 7th October, 1842.)

Dr. J. Hæberlin in the chair.

W. H. Elliott, Esq., C. S., proposed at the former Meeting, was ballotted for, and unanimously elected a Member of the Society.

Ordered,—That the usual communication of his election be made to Mr. Elliott, and that he be furnished with the rules of the Society for his guidance.

Library.

The following Books were presented:—

Books received for the Meeting of the Asiatic Society, on the 7th October, 1842.

The Calcutta Christian Observer, September and October, 1842. New series, Vol. iii. Nos. 33 and 34. Presented by the editors.

The Calcutta Christian Spectator, July 1842. Vol. iii. No. 7. Presented by the editors.

The Calcutta Literary Gleaner, October 1842. Vol. i. No. 8. Presented by the editors.

Proceedings of the London Electrical Society, 1841-42. Part iv. Presented by the Society.

Wilson's Antiquities and Coins of Afghanistan. London, 1841, 4to. (7 copies.) Presented by the author.

Wilson's Sanskrit Grammar. London, 1841, 8vo. (4 copies.) Presented by the author.

Ibraheem's Grammar of the Persian Language. London, 1841, 4to.

Ballantyne's Grammar of the Marhatta Language. London, 1839, 4to.

Ballantyne's Elements of Hindi and Braj Bhákhá Grammar. London, 1839, 4to.

Ferishta, (in Persian), fol. 2 vols.

Read letter from Moulvie Abdoollah, of 6th instant, submitting a copy of reprint of the 2nd Volume of the "Futawa Alumgiri," for inspection, and soliciting orders for the delivery of the copies to the Mohafiz of the Asiatic Society.

The vol. made over to the Moulvie of the Society for examination and report.

Read a letter of 31st March, 1842, from Chas. V. Walker, Esq. Honorary Secy. Electrical Society, presenting a copy of part 4th of the Proceedings of the Society, and requesting notice of its safe arrival, and of any regular channel through which to receive the future numbers.

Ordered,—That the thanks of the Society be communicated to the Electrical Society, and that Messrs. Allen & Co. of London, be named to Mr. Walker, as the channel for the receipt and transmission of all future numbers to the Asiatic Society.

Read letter from Mr. V. Tregear, of 8th September last, suggesting with reference to a Report of a Committee of Scientific Men appointed to consider the weights and measures at London, who recommend the decimal system, that a similar reform be proposed in Indian Coins, &c. ; also suggesting the change of title of the Society from that of the Asiatic Society of Bengal to the Asiatic Society of India.

Ordered,—That the first suggestion be referred to a Member of the Society competent to the task, to report on the feasibility or otherwise of the proposed introduction in India, to enable the Society to judge if it could go up to the Government with the proposal ; and that as regards the second, the Society is of opinion, that the change was not desirable.

Read letter from Dr. J. Hæberlin, of 7th instant, intimating that according to the request of the President, he had examined the MS. work prepared by Dr. Wise, entitled "A Commentary on the Hindu System of Medicine," that the publication would form a most valuable addition to our store of knowledge, and might become a very useful auxiliary in many respects in the Researches of India ; but that he was of opinion the Society should not publish the work at its own expence, but rather subscribe as liberally as it may think right for a certain number of copies.

Referred to the Committee of Papers.

Read the following letter of 7th instant, and enclosures from Major W. Hough.

To H. Torrens, Esq., *Secretary to the Asiatic Society.*

Sir—I do myself the honor to request you will submit a "Chinese Life Preserver," to the President and Members of the Asiatic Society, to meet this evening, together with the accompanying drawing, and explanatory paper. I shall be glad if it meets with the approbation of the Society, and that it may, by its public notice, be brought into general use.

I have the honor, to be, Sir,

Calcutta, Spence's Hotel,
7th October, 1842.

Your obedient servant,
(Signed) W. Hough, *Major.*

Report* of a Special Board of Officers assembled at Barrackpoor on the 23rd September 1842, by order of Major General Littler, Commanding, to test and report upon two Bamboo Floats, or Life Preservers, submitted by Major W. Hough, with a view to their being used, under the sanction of Government, in fleets of Troop-boats, when proceeding on the river, for the preservation of lives, in case of wrecks, or other accidents.

President.
Captain R. Smith, 28th Regt. N. I.
Members.
Captain Powell, M. B. and Capt. Tierney, 28th Regt. N. I.

The Committee have duly tested the Bamboo Floats submitted to them, and are of opinion, that in the event of a wreck or other accident, the use of the small one would save the life of any man who was unable to swim, "if properly fastened on," as it is sufficiently buoyant to keep the head and part of the neck above water, without any exertion on his part.

The large Float is capable of supporting four people by merely placing their hands on it, which causes it to sink six inches, and will bear the weight of three persons sitting upon it; but this plan appears objectionable, as it tilts up in every direction and throws them off, which would be very dangerous to those who could not swim; but were there two or three practised swimmers to guide and keep it steady, it might be capable of saving women and children.

These floats ought to be made of very dry kaguzee bamboos, each piece to have two or more knots, according to the size, which will make them the more buoyant.

A small "Jhalee," or Frame-work, introduced over the centre square of the large floats, upon which women and children might be placed, would tend to the preservation of life.

(Signed) Ralph. Smith, Capt. and President.
John Powell, Capt. and Member.
E. T. Tierney, Capt. and Member.

(Signed) J. H. Littler, *M. General,*
Commanding at Barrackpoor.
(True Copy,) W. Hough, *Major.*

Note from C. B. Greenlaw, *Esq.*
Secretary to the Marine Board.

My dear Hough,—Many thanks for the Life Float. I think it the most admirable I ever saw. No ship ought to go to sea from any place where bamboos are procurable, without a quantity of them on board. Yours &c.

(Signed) C. B. Greenlaw.
(True Copy.) W. Hough, *Major.*

Government House, 7th October, 1842.

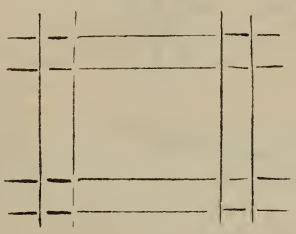
[*Extract.*] Dear Sir,—"I am directed by the Hon'ble the Deputy Governor of Bengal, to thank you for the inspection of the Life Preserver, of which he highly approves.

* A copy sent by the General to the Commander-in-Chief.

If you will have the goodness to forward it with an official letter to the Secretary to Government, it will be adopted by Government." (Signed) H. SPOTTISWOODE,
To Major W. HOUGH, Calcutta. *Military Secretary.*
(True Copy.) W. HOUGH.

Origin of the use.

"In the year 1730, I was passenger in a ship from Batavia to China, 400 tons, (the Pridaæ, Francisco Xavier, Commander,) freighted by English, Chinese, and Portuguese. Near the Coast of China we met with a Tyfoon, (Taufong), which carried away all our masts, bowsprit, and rudder; six feet water in the hold — expecting every moment the ship would founder. The English and Portuguese stood in their shirts only, ready to be thrown off; but the Chinese-merchants came upon deck in a bamboo habit, which had lain ready in their chests against such dangers, and it was thus constructed; four bamboos, two before and two behind their bodies, were placed horizontally, and projected about twenty-eight inches. These were crossed on each side by two others, and the whole properly secured, leaving a space for their bodies; so that they had only to put it over their heads, and tie the same securely, which was done in two minutes, and we were satisfied they could not possibly sink. The shape is given below."—*From a letter to the Author of the Seaman's Preservative. Annual Register, vol. iv.* 1761, *p.* 141.—"*Useful Products.*" (True Copy.) W. HOUGH.



In 1834, the above was published by me, but not in a form to attract general attention. It occurred to me that I might save the two minutes, above noticed, by forming the "Life Preserver," at once, into two squares, ready for immediate use.

It seems to be adapted for use by fleets of Troop-boats, proceeding up or down any river, or in the case of Troop-transports, or indeed, for ships generally, for either boats or ships wrecked in the middle of a river, or at sea, or coast, or ashore, it will render safe many valuable lives. The soldier or sailor, may place it under his cot or hammock. If made on a larger scale, it might be the means of saving boxes, containing valuables or papers, now, often lost in boats proceeding up the Ganges, &c.

The loss last month of two officers, sixty-eight men, six women, twelve children, of H. M's. 50th and 62nd Regiments, and a great number of natives, suggested to me to request Major General Littler, commanding the Division, to test its use before a Committee, which assembled in his presence. I since submitted it to Government for immediate adoption, a division of the 9th Lancers being on the eve of departure from Calcutta to Allahabad by water. I had often tested its utility myself, but I thought

that a formal report would be more satisfactory; and it has been reported to His Excellency Sir Jasper Nicolls, Commander-in-Chief in India.

W. Hough, *Major.*

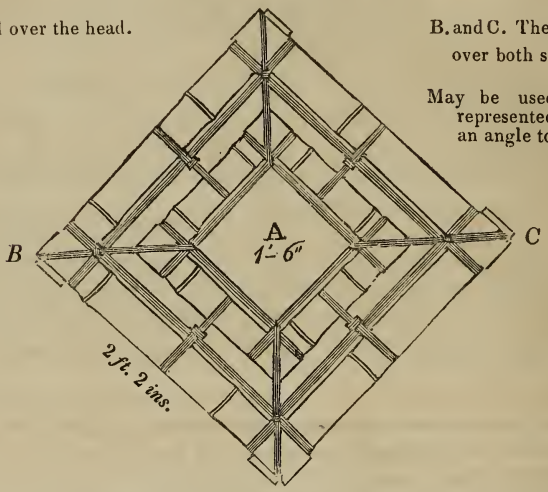
Calcutta, 7th October, 1842.

The Chinese "Life Preserver," as modified by Major Hough. *First known to the English in* 1730, *vide Annual Register, Vol.* 4, 1761, *p.* 141.—"*Useful Projects.*"

A Placed over the head.

B. and C. The arms thrown over both squares.

May be used as above represented; or with an angle to the front.



To be made of kaguzee bamboos. The knots to be cut just at the ends; if in the middle between two knots, water would get in and make them less buoyant. The frame of eight bamboos is fastened by string at the angles, and in the centre of the sides, and should be tarred, or dammered over, to prevent the string becoming rotten. There should be a strong wooden pin to fasten the bamboos at the angles. The above is made with two knots in the inner square, of large bamboos, the outer may be of common bamboo. Those of three knots would support three or four men. Smaller might be made for children. By fastening a rope to the float, and then to the arm, or round the body, it never can drift away.

W. Hough, *Major.*

Calcutta, 7th October, 1842.

Read the following letter addressed to the Secretary by M. Garcin de Tassy.

Monsieur, *Paris*, 53 *Rue St. André des Arts, ce* 9, *Juillet* 1842.

Sous les auspices de mon honorable ami M. J. B. Tassin, qui m'a fait l'èloge de votre caractère serviable, je prends la liberté de m'addresser à vous pour vous exprimer le desir que j'ai d'obtenir une *Biographie originale des Poëtes Hindous*, si un pareil ouvrage existe. Le *Bhakta mâl*, dont M. W. Price a publie de nombreux extraits, peut jusqu'a un certain point remplacer cet ouvrage, puisque la plupart des chefs des sectes Hindous dont il y est questions ont auteurs de poësies Hindous. Mais je n'ai pas cet ouvrage complet; s'il existait à Calcutta et qu'on peut en avoir une copie, je vous serais bien obligé de me la procurer. Pourriez-vous aussi me procurer quel-

ques poësies de Kerbir accompagniès d'une traduction en *Urdû*, ou du moins de quelques notes, interlineaires, ou marginales, soit en *Urdu*, soit en Hindi ou en Persan? Vous n'ignorez pas que ces poësies, tres remarquables du reste, sont fort difficiles à entendre. J'ai un MS. complet du *Bijak* qui en est la collection, mais une commentaire ou une traduction me serait souvent fort utile. Y aurait-il enfin moyen d'avoir un commentaire Hindi, ou une traduction Urdû du célèbre Ramâyâun de Tulsidas qui a ete imprimé plusieurs fois à Calcutta? J'acquitterais de la manière que vous voudriez bien m'indiquer les frais que vous feriez pour moi, si vous avez la bonté de vous charger de ces recherches, ainsi que je l'ai fait dans le temps envers l'excellent M. J. Prinsep qui eut la bontè de faire copier pour moi plusieurs MSS. de la Société Asiatique. A cette occasion je dois vous dire qu'il y en a un, je crois, dont on ne m'a jamais reclamé les frais de copie. Si vous en avez connaissance, je serais bien aise de m'acquitter et je m'empresserais de la faire au premier avis.

Les renseigments que je prends la liberte de vous demander et les nouvelles copies que je solicite sont destinies à augmenter les materiaux du 2d volume de mon Histoire de la Literature Hindouis et Hindoustâni. La partie Hindoui est sans nul doute la plus interessante. Malheureusement c'est surtout celle qui laisse le plus a desirer. Vous contribuerez a rendre mon ouvrage plus complet sous ce point de vue si vous voulez bien continuer d'avoir pour moi la meme bienveillance dont m'honorait M. J. Prinsep.

De mon côté je m'estimerais heureux de vous être bon a quelque chose, tant a vous en particulier, qu'a tous les membres de la Société Asiatique de Calcutta, dans vos rapports avec l'Institut de France, ou avec la Société Asiatique que dont je suis Vice President. J'ai l'honneur d'etre

Monsieur,

Votre bien dévoué serviteur,

GARCIN DE TASSY.

Read the following Report from the Curator:—

SIR,—On the present occasion, I have little to Report to the Meeting.

A fine, nearly full-grown, male of the white-browed Gibbon, or Hoolock, (*Hylobates hoolock*, Harlan,) has been received from Barrackpore, its skin has been mounted, and the entire skeleton has been set up. The deep black colour of this specimen contrasts strikingly with that of the mingled brown and blackish female noticed in the Society's Journal, Vol. X, 838, while the latter is much darker than in that styled *H. choromandus* by Mr. Ogilby, as this, in its turn, is deep-coloured in comparison with the pale skin obtained by Dr. Walker, which I exhibited at a former Meeting of the Society.

By C. S. Gullevie, Esq., the Society has been presented with a small collection of very interesting mammalia and birds, procured upon the Munipore Hills, on the eastern frontier of Bengal. The following species are comprised, of which those new to us I mark, as usual, by prefixing an asterisk.

Sciurus bicolor; an individual renewing its coat, and acquiring its hyemal dress, the hairs of which are longer, finer and less glistening, and of a considerably paler colour, than those of its summer garb, insomuch that the animal assumes a variegated appearance during the period of transition, the change commencing on the croup.

**Sc. erythrogaster (?)*, Nobis, *N. S.*? Size of the British Squirrel, or a little larger, and having a much longer tail. Entire upper-surface glistening deep reddish-black, minutely grizzled with light fulvous or yellowish-brown, each hair having thus two small annulations: the whole under-parts, from the throat, and inside of the limbs, a rather dark, but not intense, reddish-maronne: feet black with little trace of annulation; the fulvous predominating most about the head: tail similar to the back for the basal third, then gradually less grizzled, and the terminal half black, almost without grizzling; moderately bushy: whiskers black: ears not pencillated. Length nine or ten inches; the tail without its hair as much more, and with it upwards of two inches additional; tarsus, to end of claw of longest toe, two inches and a quarter.

* *Buceros Nipalensis*, Hodgson, *As. Res.* XVIII, 178: a magnificent pair, male and female, of this splendid species, — the male having the head, neck, and breast, uniform rust-colour, paling on the crown, and the belly and thighs deep reddish bay.

Picus strictus (?), Horsfield, *Lin. Trans.* XIII, 176; *P. Sultaneus*, Hodgson; *P. Strenuus* (?) Gould. I have doubtfully followed Mr. Jerdon in referring this species to *P. strictus*, Horsfield, which is very briefly described *(loc. cit.)*, and although the latter part of the statement "*Pileus* maris coccineus, fœminæ aurantius," does not apply, inasmuch as the female of this Indian bird (which I have obtained in the vicinity of Calcutta) has the occiput black with round white spots. I am tolerably confident of its being the *strenuus* of Gould, included by Dr. Horsfield in his Catalogue of Assamese birds procured by Dr. McClelland; and there is a figure of it among the latter naturalist's drawings of his specimens.

Polyplectron chinquis.

From Dr. Spry,

Four specimens of a *Draco*, from Tenasserim.

From Mr. Peter Virre,

Hemidactylus: a species new to the collection, taken in Calcutta; the individual having a double tail.

Numerous specimens of various kinds have also been collected and set up, but not any requiring particular notice.

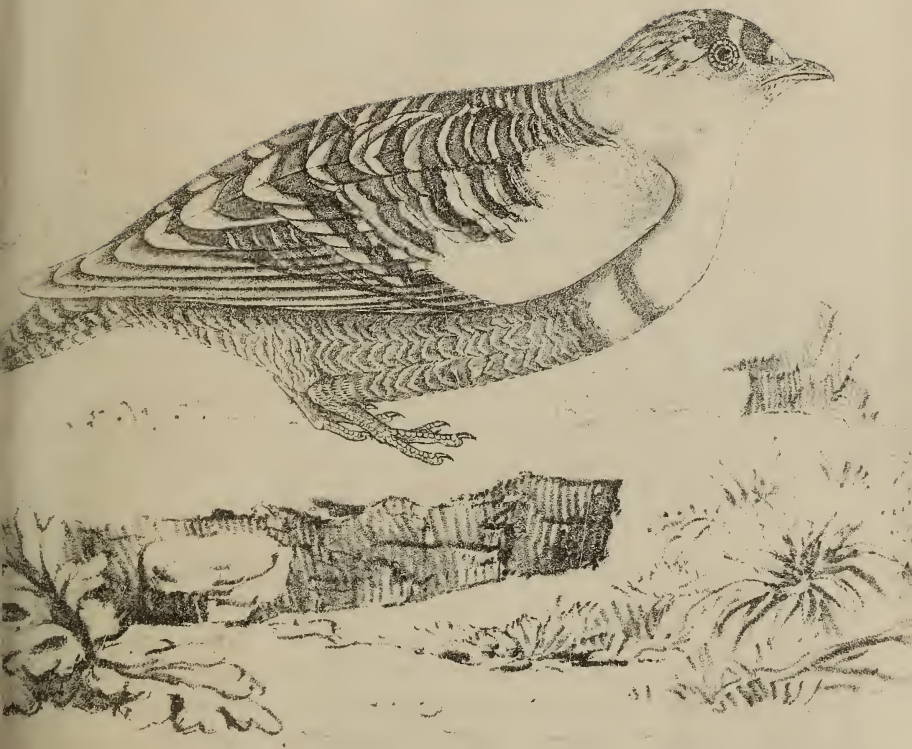
I am, Sir,

Yours obediently,

EDWARD BLYTH.

P. S.—The Mungoose from the Neilghierries, noticed in my last Report (p. 880), appears to be the *Herpestes fusca*, Waterhouse, *P. Z. S.* 1838, p. 55: it is less allied to Mr. Hodgson's *H. auropunctata* (which I have just received from that naturalist), than I had anticipated.—E. B.

The President forwarded for the Museum of the Society, two specimens of *Ornithorynchus Paradoxus*, received by Mr. C. R. PRINSEP, from Van Diemen's Land.



Pterocles quadricinctus,

JOURNAL

OF THE

ASIATIC SOCIETY.

A Seventh *Memoir on the Law of Storms in India; being* The Calcutta Hurricane *of 3rd and 4th June* 1842. By Henry Piddington, Esq.

On the 3rd June 1842, Calcutta was visited by a tremendous hurricane, of which the centre passed over the city. It came from the South-east, and seems to have reached, with interruptions and divisions, as far inland as Dinagepore, Purneah, Monghyr, Purulia and Midnapore; beyond which we can trace only irregularities, such as we may suppose, to occur by the last efforts of the impetus of a storm.

The damage done in Calcutta alone, and to the shipping on the river, very few of which escaped some injury, was immense. Ships were blown and drifted from Calcutta to Cossipore, where two or three were sunk; many were sunk or driven on shore at Calcutta; and near Kedgeree, the *Globe* and *Symmetry* were totally lost.

The opportunity was not one to be neglected, and I made every effort to procure information by a public request in the papers, and by every other means I could think of. I am happy to say I was most cordially seconded by all classes, and have thus collected a highly valuable mass of documents, which we may perhaps pronounce by far the completest record of the course of a storm, which has yet been published. I beg to tender my best thanks to the gentlemen who have so kindly assisted the enquiry. I believe I have acknowledged, individually, every report which reached me; but

should I in any one instance have omitted to do so, I request the party to believe that this is wholly unintentional, and arises from my having no other time than the intervals of business, and hours of rest or relaxation, to devote to the research.

I now give the different documents, observing that I have invariably abridged them by retrenching all matter, and even phrases and words, which do not strictly relate to our subject. The Logs of ships from Ceylon and the Andamans to the Sand Heads, are naturally the first class, as tracing the storm from seaward, and shewing the state of the weather in the Bay.

SECTION I.

SHIPS IN THE BAY OF BENGAL.

Extract from the Log of the Barque JOHN CRAIG, *Captain G. Pettingall, from Algoa Bay to Calcutta, reduced to civil time.*

30*th May*, 1842.—At 10 A. M. a heavy squall, wind W. S. W. Noon latitude 5° 49′ N., long. 84° 42′ E., P. M. strong gales W. S. W., Thermometer 80°, Barometer 29.5.

31*st May*.—Throughout strong and hard gale W. S. W. Noon latitude 9° 7′ N., longitude 85° 5′ E. Thermometer 84, Barometer 29.4.

1*st June*.—Heavy gales W. S. W. and hazy weather throughout. Noon latitude 11° 45′ N., longitude 84° 23′ E. Thermometer 85°, Barometer 29.3.

2*nd June*.—Heavy gales W. S. W. Towards midnight S. W. for a few hours. Noon latitude 14° 17′ N., longitude 83° 34′ E. Thermometer 85°, Barometer 29.2. Under close-reefed top sails for the last two or three days.

3*rd June*.—Fresh gales W. S. W. and S. W. Latitude 16° 34′ N. longitude 82° 53′ E. 4 P. M. made land about Coringa, wind South.

4*th June*.—Steady breezes. Latitude noon 17° 50′ N., longitude 84° 0′ E.

Abridged Log of the Ship Mark Palmer, *Capt. Blenkinsop, bound to Calcutta, reduced to civil time.*

Wednesday, 1st June.—She was at Noon in 3° 49′ N., longitude 82° 25′ E., with a strong S. W. by W. breeze and clear weather, with all sail set. To midnight the same, wind S. W. by S.

2d June.—The same fair monsoon at S. W. with hazy weather from noon; latitude 6° 39′ N., longitude 85° 14′ E. continuing till midnight.

3d June.—A. M. the same. Noon latitude 10° 8′ N., longitude 85° 42′ East; arrived off *Jaggernath* by 7 P. M. carrying fine monsoon throughout.

Abridged Log of the Ship Jessie Logan, *towards Calcutta, reduced to civil time.*

31st May.—At noon latitude 2° 48′ N., Barometer 29.84, Thermometer 84. P. M. fine clear weather, wind W. S. W., 8 knot breeze.

1st June.—Fresh and squally, wind W. S. W., latitude 6° 14′, Barometer 29.62. Thermometer 85. P. M. strong breeze S. W. preparing for bad weather, heavy cross sea. Midnight finer, made more sail.

2nd June.—A. M. light winds to noon. Latitude 7° 55′. Barometer 29.75. Thermometer 87°. P. M. variable, and S. W. at 10 P. M. when squally and blowing fresh.

3d *June.*—A. M. to noon strong breezes S. W. Noon latitude 10° 60′ N. Barometer 29.60.

I was unable to obtain the longitudes to this vessel's log, but they are of little importance, as she was doubtless about on the usual track.

Abridged Log of the Bark Juliet, *bound to Calcutta, reduced to civil time.*

1st June.—Strong breeze W. S. W. (8 and 9 knots,) and fine weather. Noon latitude 4° 26′ N., longitude 85° 0′, the same till midnight.

2*d June.*—A. M. the same wind W. S. W. and fine, 8 and 9 knots. Noon latitude 89° 57′ N. longitude 85° 12′ E. P. M. the same.

3*d June.*—The same. Noon latitude 13° 21′ N. longitude 84° 40′.

4*th June.*—The same, latitude 16° 48′ N. longitude 85° 0′.

Abridged Log of the Bark AUGUSTUS, *Captain G. Purchase, from Mauritius to Calcutta, reduced to civil time.*

27*th May.*—Noon latitude 18° 45′ N. longitude 85° 35′ E. Moderate breezes, 2 and 3 knots and cloudy. Barometer* 29.54, Thermometer 89°. P. M. to midnight light and variable winds. S. W. to S. E.

28*th May.*—9 A. M. wind Easterly and light. Noon latitude 19° 16′ N., longitude chronometer 85° 53′ E. Barometer 29.58. S. Westerly current. P. M. variable E. by S. to S. E. at 7, but then increasing a little. 5 P. M. saw Manickapatam Pagoda bearing N. W. by N. Midnight light airs.

29*th May.*—4 A. M. calm, saw Black Pagoda N. N. W. five leagues. Noon light breezes and clear, latitude 19° 39′, longitude chronometer 86° 18′, Barometer 29.57; slight Northerly current. P. M. moderate N. E. to E. by N. and N. E. winds. 8 P. M. cloudy, lightning to Southward and N. N. W. Midnight light winds and clear.

30*th May.*—4 A. M. moderate N. N. E. breezes and clear, increasing to five knots at noon, very cloudy to the S. E. with thunder. Latitude 19° 1′, longitude chron. 86° 39′ E. Barom. 29.34, strong S. Westerly current. 1 A. M. squally N. N. E. At 5, North, at 9, N. E. heavy squalls and showers towards midnight.

31*st May.*—4 A. M. the same weather; 6 A. M. fresh gales; close reefing. *Noon more moderate.* Wind from 5 A. M. to noon N. N. E. to N. E. Latitude 18° 38′ N., longitude chron. 87° 17′ East, Barometer 29.23. P. M. wind N. E. veering to E. by N. At 7 A. M. strong breezes, heavy squalls and much lightning.

1*st June.*—A. M. wind E. by N. and weather as before. At 11, wind N. N. W. strong breezes and cloudy. Latitude 19° 18′ N. longitude

* Captain Purchase having favoured me with a comparison, his Barometer is corrected to that of the Surveyor General's Office by subtracing 0° 16′ from its indications.

86° 23′ E. Barometer 29.19′ P. M. fresh gales and heavy squalls N. N. W. At 11 P. M. N. W. by N. strong gales, much lightning, and heavy rain.

2*d June*.—6 A. M. wind N. W. At 9 and to noon W. by N. dark cloudy weather, strong gales and much rain. No observations. Barometer 29.24. P. M. the same; under close reefed top-sails. 1 P. M. wind West. At 7 P. M. wind W. S. W. to S. W. at midnight, when fresh gales and cloudy.

3*d June*.—4 A. M. the same soundings, 26 fathoms mud; 6, saw the Black Pagoda N. W. Noon False Point Light House N. W. 4 or 5 miles. Barometer 29.30. P. M. wind W. S. W. Fresh breezes and fine to the Pilot.

Abridged Log of the Barque PANTHEA, *Captain Marman, bound to Calcutta, reduced to civil time.*

Sunday, 29th May.—3 A. M. to noon calm. Latitude 18° 54′ N. P. M. to midnight light Northerly winds.

30*th May*.—A. M. to noon, light Northerly winds. Latitude 18° 57′. N. P. M. Northerly breezes with hazy weather, and some lightning.

31*st May*.—N. N. E. winds freshening. Noon no observations. P. M. freshening to a heavy gale from N. N. E. 2 P. M. hove to under close reefed main top-sail, heavy sea *from the Eastward*.

1*st June*.—Gale continuing from midnight. Noon no observations. P. M. wind veered round to the Westward. Blowing hard at West.

2*d June*.—A. M. moderated; daylight bore up and made all sail. Wind W. S. W. course N. by W. P. M. wind S. W. course, N. E. by E., moderate breeze, 5h. 30m. P. M. saw Ganjam bearing W. N. W; 10, a heavy squall from N. W.

3*d June*.—A. M. fine. Noon latitude 20° 8′ N.

Abridged Log of the Barque JOHN WILLIAM DARE, *Captain Ross, from Calcutta bound to Penang, reduced to civil time.*

26*th May* 1842.—The *John William Dare* left the Pilot at 2 P. M. on the 26th May. At 8 P. M. the outer light bore N. W. $\frac{3}{4}$ N. working to windward with light variable breezes.

27*th May.*—Light airs to noon, when latitude 20° 38′ N. P. M. light one and two knot breezes S. S. E., S. by E., and S. E. to midnight.

28*th May.*—Calms and clear weather, current to the N. E. at the rate of two miles per hour. Noon latitude 20° 32′ N. P. M. light airs to midnight with cloudy weather.

29*th May.*—Light breeze from N. E. at 8 A. M. Noon latitude 29° 46′ N. Barometer 29.50. P. M. moderate breeze N. E. by E. freshening to midnight, when going six knots.

30*th May.*—Moderate 6 knot breeze, N. E. by E. to noon and squally; latitude 17° 56′, Barometer 29.50 and falling. P. M. fresh breezes N. E. and squally, increasing to a gale at S. E. by E. at 6 P. M. At 12, S. S. E. heavy cross sea. Barometer at 6 P. M. 29.30; at 8, hove to.

31*st May.*—2 A. M. wind about South, 6 A. M. a little more moderate, 10 increasing again. Noon no observations, wind about South. No observation, Barometer 29.20. 1 P. M. wind S. W. by S. 11 P. M. S. by W. 7 P. M. more moderate, heavy cross swell from W. S. W. to midnight.

1*st June.*—2 P. M. heavy squalls and heavy S. W. swell. 10 A. M. bore up; ship being leaky and lascars worn out. Noon no observations, Barometer 29.10 and falling. P. M. wind W. N. W. increasing gale, hove to again. Midnight heavy weather. Barometer 28.80.

2*d June.*—A. M. wind W. N. W. fresh gales and heavy squalls. No observation; current (or drift) three miles per hour. Barometer 29.0. P. M. fresh gales W. N. W. and dark hazy weather to midnight. Barometer 29.00.

3*d June.*—A. M. made a little sail. At 7, wind S. S. W. Noon no observations. P. M. fresh gales S. W. and cloudy.

4*th June.*—A. M. to noon the same weather, wind about S. W. by S. latitude 19° 12′ N. longitude 90° 33′ E. Barometer 29.10. P. M. wind S. S. W. to midnight.

5*th June.*—Noon latitude 20° 0′ N. longitude 89° 3′ E. reached the Pilot station at 10 A. M. on the 6th.*

* The Brig *Moulmein*, Captain Pratt, from Singapore to Madras, had light winds and fine weather in latitude 4° 24′ N. to the East of Acheen Head on the 29th May. On the 30th, a heavy North-westerly swell with Diamond Point W. N. W. Variable winds and calms on the 31st, and from 1st June, beat through the Bengal passage against a strong S. W. Monsoon, which lasted through the 2nd and 3rd June.

Letter from Captain Buckton, commanding Brig "ALGERINE."

SIR,—Upon perusal of the "*Englishman*" of the 6th instant, I observe your request, "for any information respecting the late storm," that this city has been visited with.

Should my observations upon the extraordinary weather, which I encountered in the Bay of Bengal, between the 19th May and 4th June, tend to throw any further light upon the Law of Storms than is at present known, I shall feel glad that the constant attention which I paid to the signs of the weather, and the indications of a most excellent Marine Barometer (by Troughton and Sons,) will have slightly availed the interests of science.

The 18th May, in latitude 8° 5′ N. longitude 97° 50′ E. commenced with light Westerly winds, increasing towards midnight with thick cloudy weather. At 9h. 30m. A. M. experienced a very heavy squall from the N. W., with torrents of rain, loud peals of thunder and vivid forked lightning; the electric fluid struck on the wet deck, hissing as it bounded forward and over to leeward; and the force of the wind so great, that, although every sail was furled, we lay lee gunwale under. This squall lasted until near noon, and was succeeded by a fresh breeze from the Westward, and which continued with thick cloudy weather until noon of the 23rd, when, in latitude 6° 16′ N. longitude 97° 20′ East, the wind gradually veered round to S. W. and W. S. W. increasing to a double reefed topsail breeze, carrying us into latitude 8° 50′ North, longitude 93° 35′ East; during the whole of the time the Barometer ranged between 29.20 down to 29.0 At 3 A. M. of the 26th, the wind drew round to W. by S., blowing strong, with a high confused sea. Barometer down to 28.80, latitude 9° 20′ N., longitude 93° 11′ East; at 2 A. M. 27th, the wind suddenly veered round in a heavy squall to N. W., then to N. E., and back again to N. N. W., with very heavy rain, little thunder, but most vivid and constant lightning; the Barometer falling to 28.70, latitude 9° 26′ N., longitude 92° 35′ E.

On 28th, in latitude 10° 0′ N., longitude 92° 26′ East, the sky became a perfect dense mass of black clouds with the scud flying rapidly past from N. E., S. E., and W. S. W., the wind light, and

the sea rising in bubbles, as if the wind was blowing from every point of the compass, hissing and rising up in bubble like a boiling cauldron. Here the Barometer fell to 28.60; this being excessively low for so low a latitude, induced us to make every preparation for severe weather. From this time until the 1st June, latitude 15° 25′ N., longitude 87° 58′ E. experienced an increasing gale steady from S. S. W. to S. W. by W. with much lightning, and a very heavy appearance all round. The Barometer rising and falling according to the strength of the squalls, or the preponderance of rain from 28° 70′ to 28° 56′. On the 2nd, (civil time,) the gale increased so as to oblige us to lay to, the Barometer having fallen to 28.45, (latitude 17° 20′ N., longitude 87° 6′ E.) At 9 A. M. experienced a cross sea, setting in from S. W., N. W., and N. E., the former preponderating; the rain pouring down in torrents, the gale increasing, and the squalls blowing with fearful violence from W. S. W. and shifting suddenly from that to N. W., N. N. W., and as far as North; the Barometer gradually falling until it came down to 28.18; at midnight more moderate, the Barometer up to 28.36. Steady gale from S. W. by W. decreasing towards noon. 3 P. M. when latitude 19° 10′, longitude 86° 42′, so as to enable us to make sail until 11h. 30m. P. M. of Friday, when the Barometer again fell to 28.20 during a most severe squall from N. W. False Point was then bearing about N. W. 12 miles; here we were obliged to stand to the S. Eastward for two hours, when we again made sail, and on the following night, at 10 P. M. we were anchored off the tail of Saugor Sand, the wind very steady from S. Westward and decreasing, the Barometer having risen to 28.50. From this time until our arrival at Calcutta, on the morning of the 7th, we had fresh breezes from S. W. mostly; the Barometer rising to 28.85.

CHARLES BUCKTON,
Commander of the Brig Algerine.

Abridged Log of the Barque ARIEL, *Captain Burt, from Singapore bound to Calcutta, reduced to civil time.*

The *Ariel* passed the Nicobars on the 21st and 22d May, working against a strong monsoon until the 26th May, when she was at noon

in latitude 10° 49′ N. longitude per chron. 90° 30′ E. Barometer 29.69*. Thermometer 85°. Increasing S. W. breezes and cloudy weather. P. M. strong monsoon. At midnight increasing breeze S. W. and very squally.

27*th May.*—7 A. M. steady breeze S. W. Noon strong monsoon and cloudy. Latitude account 12° 47′ N. longitude 89° 07′ E. Barometer 29.56. Thermometer 89°. P. M. moderate breezes W. by S. but squally appearances. At 8 P. M. light breezes, and cloudy at midnight.

28*th May.*—Daylight fresh breezes and cloudy, wind variable. At 8 A. M. a severe squall, and the wind shifting suddenly from N. E. to West, ship was taken aback and thrown on her beam ends. Lost the gig and several sails. At 10, squall abated. Noon, continued heavy squalls, with thunder, lightning and heavy rain. *Wind continually veering,* (it is not noted between what points,) and a troubled sea on. No observation. Latitude account 13° 57′ N. longitude 89° 42′ E. Barometer 29.49. Thermometer 89. P. M. severe, heavy, continued squalls, with thunder, lightning and rain. Barometer from 29.49 to 29.59, wind veering from N. E. to N. W. and West, preparing for bad weather; sunset more moderate; midnight strong winds and variable, as before.

29*th May.*—Daylight strong gales with heavy rains and a heavy sea; noon the same, with continued squalls, thunder, lightning and rain; wind marked as variable from North to West. Latitude account 13° 59′ N. longitude account 90° 7′ E. Barometer 29.44. Thermometer 88° P. M. the same, moderating at intervals, but increasing again; wind from West to W. by S. and W. S. W. at midnight.

30*th May.*—Daylight hard gales W. S. W. and heavy rain; noon more moderate. Latitude observation 13° 39′ N. longitude 88° 58′ E. Barometer 29.41. Thermometer 86. P. M. lying to under storm staysails; wind W. S. W.; midnight more moderate, and sea considerably fallen.

31*st May.*—Daylight moderate W. S. W. At 8, a severe squall. Noon strong gale. Latitude account 14° 01′ N. longitude account 89° 13′. Barometer 29° 38′. Thermometer 86°. P. M. strong gale and very heavy squalls at times. Barometer still at 29° 38′, lying to under storm staysails. Midnight clearing a little.

* Corrected by comparison with that of the Surveyor General's Office.

1*st June.*—Daylight strong steady gales S. S. W.; 9, severe squalls. Noon strong gales. Latitude account 14° 37′ N. longitude 89° 18′ East. Barometer 29.41. Thermometer 85°. P. M. strong gale to midnight, wind about S. S. W.

2*d June.*—Daylight weather as before; wind apparently West to S. S. W. Noon moderating. Latitude observation 15° 03′ N. longitude 89° 02′ E. Barometer 29.38. Thermometer 84°. P. M. to midnight strong gales S. W., but less sea.

3*d June.*—Daylight the same, more sea. Noon latitude 16° 21′ N. longitude 87° 29′ E. Barometer 29.31. Thermometer 89½ 7′. P. M. to midnight strong gales S. W. going from 5 to 8 knots N. W.

4*th June.*—Noon latitude 18° 44′ N. longitude 85° 56′ E. Barometer 29.34. Thermometer 92. Fine weather. At 4 P. M. saw Ganjam, and hence had the usual variations in the monsoon at this season to the Pilot.

Abridged Log of the Brig ARETHUSA, *Captain Jas. Clarke, from Calcutta towards Madras, reduced to civil time. Forwarded by Captain Biden.*

30*th May.*—P. M. strong breezes from the S. W. and cloudy weather, with a heavy swell are noted, increasing at sunset, and at 11 P. M. "experienced a heavy fall in the Barometer" is stated, though how much is not said, nor is the Barometer height given.

31*st May.*—Increasing gales S. W. by W., high sea breaking over the Brig. Daylight strong gales. 10 A. M. more moderate. Noon brisk breezes and strong gales. Latitude observation 14° 20′ N., longitude 84° 29′ E. P. M. strong gales S. W. by W. and high sea. At 6, wore ship to the W. N. W. having hitherto been standing to the S. S. E. Midnight the same weather, wind S. S. E.

1*st June.*—8 A. M. weather the same. Noon latitude by observation 13° 49′ N., longitude 84° 5′ E., wind W. S. W. from 2 A. M. P. M. strong gales and high sea. Wind S. W. by W. and S. S. W. to midnight.

2*nd June.*—The same weather to noon, with wind S. W. Latitude 14° 22′ N. longitude 83° 24′ E. moderating a little. Midnight varying to South.

3rd June.—Same weather, wind from S. S. W. to S. W. at noon, Latitude 14° 21′ N. 82° 53′ E.

This vessel's log is given for 4th, 5th and 6th, but it is evident, as by the foregoing extracts, that she had only a heavy monsoon.

Abridged Log of the Barque NORFOLK, *Captain ——— from Calcutta to Mauritius, civil time.*

27th May.—Noon latitude 20° 15′ N. longitude 88° 54′ E.

28th May.—At noon latitude 19° 40′ N. longitude 88° 5′ E. Light winds, and fine till midnight.

29th May.—At 8 A. M. increasing winds N. E. Noon latitude 18° 82′ N. longitude 87° 15′ E. Steady breeze N. by E. to midnight, when squally with passing showers.

30th May.—At 8, increasing winds N. N. W. At noon N. W. latitude 17° 00′ longitude 87° 00′ E. going 6 knots to the S. ½ W. 2 P. M. heavy squalls from the N. W. increasing to midnight; preparing for bad weather.

31st May.—A. M. strong winds and heavy squalls N. W. 6 A. M. more moderate. Noon brisk wind, varying from West to North* till midnight. Latitude at noon 15° 20′, N. longitude 88° 10′. E. Midnight cloudy with squalls.

1st June.—A. M. wind marked S. W. Strong breeze and cloudy, with a heavy swell from the S. W. Noon squally. Latitude 14° 35′ N., longitude 89° 25′ E. Midnight brisk gales and cloudy.

2nd June.—Throughout brisk gales S. W. and cloudy. Noon latitude 15° 10′, longitude 88° 40′ E.

SECTION II.

Eastern Shores of the Bay, with Burrisal and Dacca.

Dr. Hinton, Civil Surgeon of Akyab, in an account of the storm of the 14th and 15th May, on the Eastern shores of the Bay, which with that of December 1841, will form the subject of another memoir now in preparation, sends the following memorandum relative to that of June, which we are now investigating.

" Since writing the above, I have seen in the *Englishman* a notice

* So in the log.

of the severe storm in Calcutta, on the 3rd June, which was not felt here, but about forty miles to the southward, in Combermere Bay, a large row-boat was capsized owing to a tremendous sea, compared by one who experienced it, and was well able to judge, as equalling the sea off the Cape of Good Hope. A second row-boat being in company, went to the assistance of the drowning men, and through the strenuous exertions of W. D. Brown, Esq. not only were nineteen lives saved, but the boat righted and brought into Akyab harbour. The following is Mr. Brown's note :—

Abstract of the Weather from 1st to 5th June 1842, *drawn up by W. D. Brown, Esq. Marine Assistant to the Commissioner of Arracan at Kyook Phyoo,* 1842.

1st June.—For several previous days weather very oppressive, sky overcast. Barometer unsteady.

2d June.—Daylight Barometer 29.60. Thermometer 82°. 9 A. M. left Kyook Phyoo in a row-boat for Akyab, wind blowing fresh from the S. W. with rain. 11 A. M. passed Cape Elizabeth, heavy sea on ; 11h. 30m. wind came round in a heavy squall to the N. W., took in almost every foot of sail, the sudden and violent change of wind caused a tremendous sea, requiring two men to steer. 1 P. M. running for Nundigree Creek, overtook another row-boat which had left Kyook Phyoo two hours in advance of me, found her capsized with nineteen men on her bottom, saved them, righted and baled her out, and brought to for the night in the channel. Midnight blew very heavy from W. and W. S. W. all night.

3d June.—Daylight went in search of ten of the crew of the capsized boat, wind blowing strong from W. S. W.; after some time, found them, having swam to two islands on spars, &c., then proceeded on with wind right aft up the Kenain-known passage, with a succession of squalls and rain all day, and anchored at evening.

4th June.—Daylight made sail, and crossed Hunter's Bay, where the sea resembled the surf at Madras during a gale, and ran up the Meabong Channel ; squalls and rain having continued all day, and anchored at evening.

5th June.—Daylight strong westerly winds with rain. 7h. 30m. A. M. very heavy squall. 7h. 45m. weighed, and reached Akyab at 8h. 30m. A. M.

Chittagong.

From Chittagong I have been favoured by R. Trotter, Esq. B. C. S. with the following letter and register; and in reply to some enquiries, with the note which follows the register:—

"I have the pleasure to send you the accompanying Table, containing a few particulars regarding the state of the weather here during the late hurricane in Calcutta. I find my Sympiesometer a very delicate instrument, indicating approaching changes. It fell to 28.70 during the violent squall on the 3d, about 3h. 30m. P. M.

June.	Sympiesometer by Adie at 9 A. M.		Barometer by Dollond 9 A. M.		Rain Gages. Mr. Sconce's. 9 A. M. to 9 P. M. / 9 P. M. to 9 A. M.	Mr. Trotter's 9 A. M. to 9 A. M.	Wind and Weather. A. M.	P. M.
Wed.	Ther.		Ther.			Inches.		
1	82.6	28.84	82	30.206	....	0.00		
Thurs.					.36			
2	82.4	.80	81	.210	Total. 0.36	0.00	Cloudy. S. E.	Westward to South.
Fri.								S. Westerly, rainy, at 3 30 P. M. a very violent squall from S. W. much rain.
					.92 2.27		S. Ely.	
3	80	.76	79	.200	Total. 3.19	0.469	Rainy. Stormy.	
Satur.								South & S. Westly. at night, after blowing from S. W. a heavy squall from N. W.
					.07 .75		Stormy.	
4	80.4	.82	79	.202	Total. .82	2.968	Sty.	
Sun.								
					.98			
5	80.8	.90	78	.202	Total. .98	4.483	Ditto.	
Mon.								Heavy rain from W.
					.94 .18			
6	80	.88 *	79	.200 †	Total. 1,12	1,666	S. Ely.	South & S. Westly.
					Rain Gages. by Dollond.			

* The attached Thermometer stands 2° higher than the above observations.

† The Barometer stands about 2-10th below the standard in Calcutta.

N. B. I cannot account for the great difference of the results of the Rain Gages; that used by me is a plain tin box, of which the cubical contents are ascertained. The observations of 4th and 5th were checked by actual measurement.

Noacolly.

Dr. Baker, *Civil Surgeon of Noacolly, latitude* 22° 48′ N. *longitude* 91° 04′ E. *has forwarded to me the following report.*

I have the pleasure to furnish you with the following remarks on the state of the weather in this quarter, about the period of the occurrence of the late gale in Calcutta and its neighbourhood :—

Towards the end of May, the heat had been very oppressive. Them. 91° at the highest range, being higher by one degree than I have ever observed it during a residence of many years at this station; the atmosphere exhibited that white hazy appearance, which, as you observe, is noticed in conjunction with earthquakes, and a similar observation was made here regarding it.

On Friday night the 3d instant, it began to blow from the Eastward, and continued increasing until it blew " half a gale" during the 4th and 5th, the wind gradually veering round to the S. E., from whence it continued steady for the last two days, when it subsided. The weather was squally and attended with rain, not very heavy, and at no time could it be said to blow a complete gale, nor had we any inundation.

I am sorry that I cannot give you the Barometrical changes, not being furnished with the necessary instrument; nor did I take any precise notes on the state of the weather during the period in question; but I can vouch for the general accuracy of the above statement, from which it would appear, that the centre of the gale was far to the West of this station. Noacolly is situated about four miles from the North shore of the great embouchure of the " Megna," and opposite to the Island of Hatteah. My correspondents at Chittagong say nothing of the gale in that quarter. Burrisaul is due West from Noacally, distance about fifty miles.

Noacolly, (Bullooah,) J. Baker,
15*th June*, 1842. *Civil Surgeon.*

In reply to some inquiries, Dr. Baker adds as follows :—

" I regret that I am unable to give the precise information which you require, relative to the changes of the wind. I can only state generally, that it commenced from the East, and the E. by South, blow-

ing pretty steadily from that quarter during the first two days, then veering to the S. E. and South gradually, as I mentioned in my former communication. There was nothing so remarkable in the violence of the weather, as to attract my particular attention to minutiæ; had it blown a gale, I should have been more minute in my observations. I think, from the dates I gave you, the stormy weather must have set in earlier by two or three days here than it did in Calcutta, and continued for a longer period, lasting with us three days. I hear there was only a squall or two felt at Chittagong about the period, so that apparently the gale, did not extend very far to the Eastward. At Burrisaul, West of this place, it appears to have been more violent. At Chittagong, to the East, more moderate than here."

Burrisal.

From Burrisal, Mr. Ince *of the Salt Agency, has obliged me with the following remarks, made by himself and a friend at that station:—*

"For several days the heat had been very great. On the 31st May 1842, we had rain, which cooled the air a little; a strong wind all day from the Eastward.

1*st June.*—Heavy rain with squalls from S. E., towards evening it got more to the East, and blew very hard all night, not much rain.

2*d June.*—Still blowing a perfect gale from the East with drizzling rain; continued so all night.

3*d June.*—At ½ past 2 in the morning, the wind got to E. S. E. and blew fearfully, river rose to within a few feet of the Bund; compounds nearly under water, every appearance of an inundation; towards evening it became milder, and the wind appeared inclined to settle at due South, but during the whole night the gale continued, but not quite so violent.

4*th June.*—Wind at South, but still very high, tremendous gusts during the whole night.

5*th June.*—Wind still very high, getting more to the Westward.

6*th June.*—Clearing up, but wind still very high; a vast deal of damage has no doubt been done, but *all* the reports have not yet come

in; fortunate it was that it did not occur during the springs, for with the strong Easterly wind, nothing could have saved us from inundation.

We have since had some very heavy rain, particularly on the 10th."

Dacca.

From Dacca the only Report I have obtained, was sent me by an anonymous Correspondent, who will I hope, accept my best thanks for it.

"In case no fuller account of the late storm, as experienced at Dacca may have been received, the following remarks I made at the time are forwarded for Mr. Piddington's use. The storm was not in any way so violent at Dacca, as it appears to have been in Calcutta. As letters from Chittagong, of the 5th, make no mention of any storm, it probably did not extend much further to the Eastward.

3*d June.*—Heavy rain, wind East, but not particularly strong. Thermometer at 10 A. M. 80°, and air cool.

4*th June.*—Wind from South East and South, very strong in gusts, continued rain and heavy squalls. Thermometer 83° at 10 A. M.

5*th June.*—Wind from South, and more moderate, continued rain, Thermometer at 10 A. M. 84°. At half past 3 P. M. wind changed to South West with a violent squall, the wind stronger at this time than at any other period during the storm. Wind returned in a very short time to the old quarter, or South East, stormy night with heavy rain. Monday, wind abated S. S. West. Thermometer at A. M. 80°. It will be observed that the storm did not reach Dacca till the 4th, and that though the rain continued without intermission, the temperature of the air increased, instead of becoming cooler, as would have been the case under ordinary circumstances. The wind came round by the *South*.

SECTION III.

On the Western Coast of the Bay, from Madras to Kedgeree, we have the following data.

MADRAS BAROMETRICAL REGISTER.

Extracts from the Meteorological Journal, kept at the Madras Observatory, Fort St. George.

Date.	Barometer.			Thermometer.		
	8 A. M.	4 P. M.	10 P. M.	8 A. M.	4 P. M.	10 P. M.
1842.						
May 28th	29.876	29.742	29.776	92.6	92.4	89.5
„ 29th	29.776	..	29.736	87.2	..	90.0
„ 30th	29.752	29.670	29.742	87.5	92.7	92.0
„ 31st	29.752	29.668	29.732	89.0	92.8	90.8
June 1st	29.718	29.616	29.674	88.5	96.3	92.2
„ 2d	29.708	29.610	29.672	90.1	94.3	91.2
„ 3d	29.718	29.616	29.670	89.0	96.3	92.4
„ 4th	29.736	29.638	29.626	88.6	96.7	88.3
„ 5th	29.506	29.322	29.364	90.0	90.8	88.1

(True Copy,) CHAS. BIDEN.

At Covelong the weather, by the Log of the Ship *Ino* of Whitehaven, was fine.

The Brig *Futteh Rohoman,* lying in Poondy Road, between Ganjam and Manikpatam, (latitude about 19° 35′ N.) experienced on the 1st, 2nd, and 3rd June, strong W. N. W. breezes, preventing her from receiving cargo.

From Dr. Cumberland, *Civil Surgeon, Pooree.*

I have the pleasure to send you an account of the weather experienced at Pooree, during the latter part of May, and the early part of the present month. I regret it is not in my power to add the barometrical changes, as I have no instrument.—N. B. The observations were made about 400 yards from the sea.

22*d May.*—Commenced with the usual strong S. W. breezes prevalent at this season at Pooree. The weather was sultry, Therm. 90°.

At 5 P. M. heavy clouds accumulated in N. W. At 5½ P. M. wind N. W. Therm. 84°. At 6½ P. M. wind suddenly shifted to S. W. and blew for half an hour, as if from a furnace, it was so hot; and the thermometer rapidly rose to 90°. A few drops of rain fell.—(N. B. To the S. W. was the open sea about 400 yards off.) The wind then continued variable for about an hour, frequently shifting suddenly in a most remarkable manner, from N. W. to S. W., blowing gently from either quarter for a few minutes. At 7½ P. M. the clouds broke, and the threatened storm appeared to pass away to the Northward; the usual cool S. W. breeze succeeding the hot one, changing however during the night to S. E. From this time until the end of the month, the weather was generally sultry and oppressive; the highest range of the thermometer was 90° 25′, the lowest 79°; the winds were variable, but chiefly from S. E. during the day, with squalls from N. W. in the evening, and the nights calm. Thunder and lightning, but no rain, accompanied the squalls until the 30th and 31st, when nearly an inch of rain fell. On the last day, the wind was from the N., and the sky overcast.

1*st June.*—Wind from N. cloudy, rain, lightning; rain 0.10. Thermometer 83°, lowest 79.°

2*d June.*—Wind N. to N. W. cloudy, rain 0.20. Thermometer 83°, lowest 78°.

3*d June.*—Cloudy, wind from N. W. to S. W. at night calm, and towards morning S. W., rain 0.10. Thermometer 87°, lowest 84°.

4*th June.*—Cloudy, wind S. W. At 7 P. M. thunder, lightning, and rain from N. W., rain 0.05. Thermometer 90°, lowest 82°.

5*th June.*—Early part of day, wind N. W. with rain. At 10 A. M. S. W. cloudy, fresh breeze. At 4 P. M. blowing almost a gale. At 6 A. M. moderate, rain 0.30. Thermometer 87°, lowest 83°.

6*th June.*—Wind S. W. rain at 6 P. M. heavy squall from N. W. with thunder, lightning and rain. Thermometer 86°, lowest 76°, rain 0 inches 85 tenths.

7*th June.*—S. W. cloudy, at night N. W., rain 0.05.

I may here remark, that the surf has been higher during the present month, than I ever witnessed it before at this season. The above may be useful, as shewing the extent of the storm which did so much damage in Calcutta on the 3d instant. During the night of the 3d,

when the storm was at its highest with you, we were *luxuriating* in a sultry calm.

R. B. CUMBERLAND.

From A. MINTO Esq. C. S., *Cuttack.*

I scarcely should have thought it of any use to forward the few imperfect remarks about the weather on the early part of this month, as noted by me; but as you expressed a wish to procure all the information possible, I give you mine, such as it is.

1*st June.*—Continued rain nearly all day, calm.

2*d June.*—Partial heavy showers, calm.

3*d June.*—Partial heavy showers; during the night rain fell heavy, with strong wind from the Southward, which did not continue above an hour.

I may observe, that the wind was considered by me merely a puff, such as frequently accompanies falls of rain; I was in bed at the time, and thought it uncommon; the hour I should say was about midnight.

A. MINTO.

The following is the Report from Balasore by the Master Attendant.

I beg leave to forward a copy of my log kept at Balasore. We have had no gales, but a good fall of rain; only a slight Bank was perceptible to the Eastward on the 31st May.

		9. A. M.	3 P. M.	5 P. M.
28*th May*, 1842,	Barometer,	29.69	29.65	29.60
	Thermometer,	88°	90°	89½°

No wind, air very oppressive at A. M.; light airs from S. E. P. M.

29*th May*,	Barometer,	22.70	29.64	29.60
	Thermometer,	88½°	90¼°	90°

Very close indeed, as yesterday, and slight airs from N. E. and cloudy.

30*th May*,	Barometer,	29.63	29.60	29.58
	Thermometer,	88⅕°	89½°	89°

Slight air from N. E. with heavy clouds to Eastward, wind changing to S. E. P. M.

31*st May*,	Barometer,	29.54	29.50	29.48
	Thermometer,	86°	84°	84°

N. Easterly winds, with cloudy weather and rain throughout.

1*st June*,	Barometer,	29.40	29.37	29.36
	Thermometer,	82°	83°	82$\frac{3}{4}$°

Wind from N. E. to N. W., with heavy rain throughout, and very heavy clouds.

2*d June*,	Barometer,	29.33	29.28	29.27
	Thermometer,	82°	82$\frac{1}{2}$°	81°

Wind from N. W. with heavy rain and gusts of wind throughout, with low flying clouds.

3*d June*,	Barometer,	29.25	29.25	29.23
	Thermometer,	81$\frac{1}{2}$°	81$\frac{1}{2}$°	82°

Wind N. E. to N. W., with heavy rain and gusts of wind 5 P. M.; at 10 P. M. wind from S. W. in strong gusts, a double reefed topsail breeze with rain throughout.

4*th June*,	Barometer,	29.32	29.29	29.29
	Thermometer,	82°	84°	83°

Clearing up, wind S. W. rather Southerly inclined at times, with rain in passing clouds.

N. B.—Barometer always ranges lowest at 5 P. M. and about that time indicates a change or otherwise; on the 5th Barometer 29.50, Thermometer 84°.

A. BOND, *M. A.*

In reply to some inquiries of mine as to the *times* of the changes of the wind, Mr. Bond says, " I have the pleasure to enclose the times of change of wind as nearly as possible for the three days required in June; viz. 1st, 2nd, 3rd."

1*st June* 1842.—Wind N. E. till $\frac{1}{2}$ past 5 P. M., when it changed to N. W. with heavy rain throughout, and heavy clouds, remaining rather stationary from N. W.

2*nd June*.—Wind N. W, and rather more Westerly inclined towards evening, with strong gusts of wind, and heavy rain throughout, and low flying clouds from N. E.

3rd June.—Wind at 8 P. M., veering from N. W. to N. E., with heavy rain; at noon wind N. W.; at 2 P. M. W. N. W., and from that time gradually veering round to West; and at 10 P. M. S. W. with very strong gusts of wind; a good double reefed top-sail breeze with rain throughout.

N. B.—After sunset throughout both Monsoons the winds are more Westerly. N. E. Monsoon at sunset veering to North; 3 A. M. N. W.; S. W. Monsoon at sunset veering to South; at 3 A. M. S. W.; the only exception is when it blows strong at the commencement of either of the Monsoons.

H. C. Pilot and Light Vessels.

I have obtained through the zealous aid of my friend, Captain Clapperton, Acting Master Attendant, very full returns from all the H. C. Pilot and Light Vessels, which will be found embodied in the general Tabular statement, and duly referred to in the summary at the conclusion.

From A. C. Barwell, Esq. *Salt Agent, Hidgelee.*

State of the Thermometer and Sympiesometer kept by a gentleman at this station, from the 1st to the 6th June inclusive.

Date 1842.	Thermometer.	Sympiesometer.	Remarks.
	°		
June 1st,	85	29.400	Cloudy and heavy showers all day from E.
„ 2d,	82	.350	Ditto ditto and strong breezes E. and N. E.
„ 3d,	82	.050	Ditto and constant ditto from N. and N. W. varying to S. W.; at 4 P. M.
„ 4th,	80	.350	Showery and clearing up, wind S. W.,
„ 5th,	80½	.550	Squally and heavy showers from S. W.,
„ 6th,	82	.500	Cloudy now and then, drizzling rain S. W.

The gale here, I imagine, was not in violence to be compared with what took place in Calcutta and its neighbourhood, and was attended with very little mischief.

A. C. BARWELL,
Agent, Hidgelee Department.

From Mr. M. P. Dyer, *H. C. P. S.*

The following Remarks were made off Kedgeree, from 29th May to the 8th June, premising that the weather prior to the 29th was extremely close and oppressive, and Thermometer 95° in shade.

Date.	Bar.	Wind.	Remarks.
May 29th,	29.40	S. to N. E.	3 P. M N. E. squall and change of weather.
„ 30th,	29.35	E. to N. E.	Light squalls with rain.
„ 31st,	29.30	N. E.	Squally with rain; threatening.
June 1st,	29.30	N. E.	More moderate.
„ 2nd,	29.15	N by E.	Strong gales, and threatening with heavy rain.
„ 3rd,	28.73	N. W. to W.	Heavy gales with intervals and heavy rain.
„ 4th,	29.00	S. W.	Strong breezes and moderating.
„ 5th,	29.20	S. W.	Moderate, but dull and hazy.
„ 6th,	29.25	S. W.	Do. do. squalls of rain.
„ 7th,	29.35	S. W.	Do. do. do. do.
„ 8th,	29.40	N. W. to E. S. E. & S.	4 A. M. heavy N. Wester, and by noon the weather cleared off, and wind S.

The extraordinary feature in this gale is, the strength of it being from the Northward and the Westward, instead of being from the Eastward, as is usually the case; and of course you are aware of the sun being vertical, and moon in apogee, to which, and the extraordinary rarefaction prior, the gale may be attributed; in fact, from the extraordinary lowness of the Barometer and N. E. winds, I, as early as the 31st May, brought my Ship, the *Diamond*, back from Saugor to Kedgeree, where we rode out the gale. It was the shift of wind from N. W. to W. that drove the *Globe* and *Symmetry* from their anchors, as it then blew with great violence. I have no further remark to make, but that the latter part of the gale the Thermometer was down to about 82°.

JOHN DYER,
Master Pilot.

In reply to a letter addressed to Mr. Dyer, as to the times of the change, he says, "The change in question took place from midnight on the 2nd to the evening of the 3rd June, from N. by E. to S. W. eighteen hours."

3rd June.

4 A. M. N. N. W.
8 A. M. N. W.
Noon West
4 P. M. W. S. W. } Hardest part of the gale.
6. P. M. S. W. Moderating.

J. DYER.

SECTION IV.

From Kedgeree to, and at, Calcutta.

The Steamer FORBES *was lying at Mud Point, the N. W. extreme of Saugor Island, and Capt. Higgins has obliged me with the following account of the storm there:—*

I proceed to give you a few observations relating to the late gale; but as I unfortunately had no Barometer on board at the time, (or rather it was rendered useless by an accident,) I fear the facts here stated will be of little use to you. During the whole of Thursday the 2nd, it blew strong from the N. E., with occasional squalls of rain, and the appearance of the sky and clouds was continually changing; at times promising a complete clear-up, and again giving every appearance of a gale. At sunset the wind came to N. N. E. and it rained smartly at times till midnight, when it commenced to blow in squalls at North. At 2 A. M. on the 3rd, we had a *very severe* squall, and from that time the gale increased in force, but blowing very steadily from North. A 10 A. M. the wind came round to N. N. W., still increasing in force, and coming on in squalls, each harder and more furious than the last. Noon, the wind at N. W., awful heavy squalls. 2 P. M. W. N. W. At 4 P. M. wind at West, one of the heaviest; I think *the* heaviest and longest squall that we had during the whole of the gale. 6 P. M. wind at W. S. W., squalls still *very* heavy, but moderating a little. 8 P. M. wind S. W.

still moderating, but the rain increasing. 10 P. M. wind S. W., but the gale evidently broken. Midnight heavy S. W. monsoon breeze and squalls.

We were steaming between Diamond Harbour and Mud Point on the 2nd; and on the 3rd, the day of the gale, we rode off Mud Point.

From the appearance of the clouds and the direction of the wind on the 2nd, I fully expected the gale would have come on from the Eastward; indeed at sunset on the 2nd, it looked quite fine to the Westward, the sun setting behind a bank of still looking fine weather clouds; and the only appearance of bad weather being from the Northward and Eastward; yet from that very point [the Westward] that looked so promising on the 2nd, did we have the heaviest of the gale the next day.*

JOHN HIGGINS,
Comdg. Steamer Forbes.

Log of the Barque FAIRLIE, *Captain Garrett; from Captain Biden.*

The Barque *Fairlie*, Captain E. Garrett, left Calcutta at 7 A. M. 2nd June, and was at anchor off Hooghly Point at 7 P. M., having the wind North, and at midnight strong gales and cloudy, with thick rain.

3rd June.—A. M. hard gales North with thick rain, making all snug, and riding with 100 fathoms and 50 fathoms of cable upon two anchors. 3 A. M. wind N. W. 2 P. M. about West, increasing gales. Midnight S. W.: The lowest indication of the Barometer 28.30 is said to have been at 2 P. M. on the 3rd June.

4th June.—A. M. wind S. Westerly heavy gales, moderating at 6 A. M.

At Garden Reach, from 3 to 5 miles south of Calcutta, I have been favoured with the following valuable Notes of the Storm by my friend, WILLIS EARLE, Esq.

I send you a copy of some very rough notes taken at the Gardens on the 2nd, 3rd, and 4th June, which, with one doubtful exception

* Being in the Southern half of the storm circle, Capt. Higgins necessarily had the winds from the Westward; though he *saw* the storm coming in a body from the Eastward, as will be perceived by looking at the Chart.

(an error probably) may be taken, as giving pretty nearly the directions of the gale at the times of observation. I have no Barometer, but a Sympiesometer, (one of Adie's own make, which belonged to the *Duke of York*, that was lost in the May gale of 1833) that is very sensitive, and indicates *relatively*, all the diurnal, &c. changes; but it stands I believe from half an inch to perhaps $\frac{3}{4}$ of an inch below what it ought to do, from defect of fluid I suppose. I have never had the error tested by a standard perfect Sympiesometer.

For instance, this morning at 8h. 43m. A. M. it stood at 29.14 when regulated by its attached Ther., which was at the same time at 81.8, when I suppose a perfect one would have indicated 29.70, or upwards. So you can make the requisite allowances, or if it were in the least worth while, have the error of our Sympiesometer ascertained.

We have so many trees about us, and in and about the Company's Garden opposite to us, that the exact direction of the wind cannot be ascertained. One of our trees, a mahogany one, lies with its head I think somewhere in a S. S. E. direction, opposite Bishop's College; house front standing nearly due North and South.

2*nd June*, 1842.—Thursday very strong N. E. to N. E. by E. wind; throughout the night cloudy, with some little rain 5 30 A. M. Thermometer outside in the North Verandah under 80°. Inside Thermometer 79° 6′, attached to Sympiesometer, which stood at 28.52. At 7 45 A. M. ditto weather with dark lowering clouds in the East. Thermometer 81°., Sympiesometer 28.52. Outside Thermometer 81°. Heavy showers of rain at intervals during the day, and continued high N. E. wind; no rain at night, of moment.

3*rd June*.—Friday during the early part (night) extremely boisterous wind; half a gale from the N. E.; some slight rain towards the morning. 5 45. A. M. inside Thermometer 79° 5′. Sympiesometer 28.25. 6 30 A. M. continual heavy rain, with high wind from the N. W.;* very dark, no thunder heard; and scarcely any lightning seen during the prevalence, for the last five days, of the N. E. breeze. 7 50 A. M. continued stormy wind N. E. to N. N. E., with occasional rain; at times seems to increase. 9 40 A. M. wind rather more northerly. Stronger with heavy beating rain, and so it has been

* Note by Mr. Earle. I think this is an error, it should be N. E.;

for the last 20 to 25 hours. Ther. attached 79° 4′. Symp. 28.12. 10h. 40m. A. M. Ther. 79°, Symp. 28.04. Wind and rain increasing latterly, and at present it is a veritable gale; though not so violent yet as that of May 1833. 5 A. M. Ther. 79° 1′, Symp. 27.99, gale and storm unabated. 11-40 A. M. Ther. 79° 4′, Symp. 27.92. N. N. E. gale continues, rather increasing, with heavy rain. 11-50 A. M. Thermometer 79° 5′, Symp. 27.85, Symp. still falling. 0 7 P. M. Ther. 79° 4′, Symp. 27.83, gale increasing. Mr. Willis's black Schooner on her beam ends, fear she will be swamped. 0.10 P. M. both Mr. Willis's Schooner and his large (20 tons) Saugor boat sunk at their anchors. 0.25 P. M. Thermometer 79° 3′, Symp. 27.74, or the red fluid sunk into the bend of the tube, its height difficult to read off, but the *upper surface* of the fluid in the bulb stood at 0.30 to 33 P. M. about Symp. 28.12, read off in a rough guess way by the eye. A very raging and furious storm, and which must, I fear, do dreadful mischief to the shipping, boats, &c. 0-37 P. M. rain heavier than it has been, quite obscuring the view, wind seems now N. by W. 0-45 P. M. extremely heavy rain, with continued furious blasts of wind. 0-40 to 45, Thermometer 80°, Symp. 28.13; at upper surface of fluid in the bulb. About near 1 P. M. storm still more violent, Ther. 79° 2′ and surface of fluid in the bulb about Ther. 78° 3′, Symp. 28.135, *breathing as it were, or fluctuating with the blasts.** 1-15 to 1-25 gusts of wind still more furious I think, Thermometer 79° 0′, Symp. upper surface of fluid in the bulb 28.135, to 138. Rain as heavy as before, wind apparently about N. by W. 2-15 P. M., during the last 20 to 25 minutes the storm has abated; the wind just now is only pretty fresh from the N. West, with moderate rain, Symp. as it was. At 4-15 P. M. there has been some rain, wind blowing fresh now from the W. to W. S. W., with some rain. 4-15 Symp. in a fix, unmoveable, or at least unchanged. 4-30 P. M. heavy rain with strong gale from W. S. W. 6-30 to 6-40 P. M. excessively heavy rain with stormy wind from the W. by S. to W. S. W.,

* The italics here are mine. The meteorologist will be struck with the analogy between this remark and that of Professor Barlow upon the water Barometer, as also the remarks of intelligent Captains, which so frequently occur in my Memoirs, and in the works of Mr. Redfield and Col. Reid, on the oscillation of the mercury in the gusts of a storm: see also at p. 978 the log of the Algerine, where this phenomenon is again noticed.—H. P.

afterwards bearing to S. S. W., which gale continued more or less all night, although perhaps raging not so fiercely as it did between 0-30 and 2-0 P. M. Sympiesometer so far as observed up to 10 P. M. and later, seemed still in its fixed low state.

4th June.—Saturday, 6-0 A. M. a stiff gale with little rain, still blowing from the S. S. W.; and the same, but in greater degree prevailed during the (past) night, and without very heavy rain. 6-30 A. M. Thermometer 78° 6′, Symp. 28.64 alive again! 7-5 A. M. Thermometer 78° 7′, Symp. 28.66, height of upper surface of fluid in the bulb 28.07, and was during the height of the gale 28.13 to 28.14, as well as I could estimate it by the eye, without applying a rule or scale. 8-15 A. M. Thermometer 80°, Symp. 28.67. 8-15 A. M. strong S. S. W. breeze, little or no rain. Squally and rainy at intervals during the day, with very strong wind from the S. S. W. 7-15 P. M. Thermometer 80° 2′, Symp. 28.685, a strong S. W. or S. S. W. wind, with occasional hard squalls or bursts continued throughout the night.

EXTRACTS FROM THE NEWSPAPERS.

The following are the heights of the Glasses during the Gale of the 30th instant, on board the Barque MARGARET THOMPSON, *Capt. Thurtell, lying at Calcutta.*

Sympiesometer.				Barometer.			
June 2nd,	10	P. M.	28.70	June 3rd,	7	A. M.	28.95
3rd,	7	A. M.	28.35	,,	10		28.70
,,	8	,,	28.25	,,	12		28.50
,,	10	,,	28.05	,,	1	P. M.	28.30
,,	11	,,	27.80	,,	1 30		28.22
,,	12	,,	27.50	,,	3		*28.32
,,	0 30	P. M.	27.30	,,	5		28.25
,,	1	,,	27.30	,,	7		28.60
,,	1 30	,,	27.35	,,	9		28.80
,,	2 30	,,	27.40	,,	10		28.85
,,	5	,,	27.60	,,	12		28.95
,,	6	,,	28.00	June 4th,	7	A. M.	29.20
,,	7 15	,,	28.20				
,,	9	,,	28.50				
,,	10	,,	28·60				
,,	12	,,	28.80				
June 4th,	7	A. M.	29.30				

* 28.22 is probably meant here.—H. P.

Log of the Persian during the Gale.

'*Extract from the Bark Persian's Log, June 3d.*—Commenced with strong N. N. E. winds, dark cloudy weather, and heavy rain. Lying at No. 7, Company's Moorings off Calcutta. Barometer 28.40. Sympiesometer 28.0, had fallen 2-10ths through the night. 10 A. M. increasing to hard gale. About noon a hurricane, the tier ahead adrift, the *Regina* coming into our larboard bow, carrying away jib-boom, and long boat, and sweeping us with her, and dragging the moorings. We drove into the *David Malcolm's* hause, carried away the larboard bulwarks, stancheons, &c., and stove the gig. About 1 P. M. it lulled, found the Barometer had falled 3-10ths to 28.10, Sympiesometer 27.60; got a stream cable ashore and hove taut. 2-30 P. M. light S. W. wind and rain; 3, increasing fast, our bowsprit locked in with *David Malcolm's* masts and another ship's. 4, got clear by letting go, and cutting stays, &c. &c., swung along side the *Warrior*, when the stream cable parted, and we drove up the river striking the ground, till the main rigging caught the *Regina's* cathead; got hawsers from our main and mizen masts to her bow; she being aground, cut the main rigging and swung alongside and lashed. 8 P. M. found the Bar. risen 4-10ths or 28.40, Sympiesometer 28.00, but blowing hard as ever; dark dismal night, with heavy rain. Midnight moderating; glass the same.

'*June 4th.*—Commenced with strong S. W. gales, blowing in squalls, with showers of rain; found the ship at daylight nearly a complete wreck. The glass has been gradually rising all day, and at 9 P. M. stood Barometer 28.80, Sympiesometer 28.60. Midnight blowing hard, with showers of rain.

'The *Persian* lay outside the *Regina*, taking the ground at half tide till 1 P. M. Monday, the 6th June, when after considerable difficulty a Harbour Master and boats were got, and the vessel moored in the stream to her own anchors and cables.'—*Englishman, June 9.*

Range of Barometer on board the Barque DAVID MALCOLM.

TO THE EDITOR OF THE ENGLISHMAN.

DEAR SIR,—In your editorial remarks in your paper of yesterday, I observe you call on Ship Captains for the variations of the Barome-

trical column, as also notes from their Log Books. As I fancy the latter is not of so much importance as the former, our good ships in the river having generally fared *pretty considerably* the worse for it, and our Log Books, I presume, being much about the same, therefore, I have the pleasure to send you one of your requests, as noted under

I am, dear Sir, your's obediently,

R. M.

Englishman, 9th June 1842.]

Range of the Barometer on board the Barque DAVID MALCOLM, *during the late Gale.*

Thursday noon,			29.35	
„	4	P. M.	29.24	
„	9		29.20	
Friday,	6	A. M.	29.10	
„	8		29.07	
„	10		29.00	
„	11		28.87	
„	11 30		28.77	
„	12	or noon	28.70	
„	12 30	P. M.	28.58	
„	1		28.48	
„	1 30		28.40	
„	2		28.32	time of parting.
„	3		28.30	
„	6		28.35	
„	7		28.50	
„	8		28.70	
„	9		28.80	
„	10		28.90	
„	12		29.5	
Saturday,	6	A. M.	29.15	
„	10		29.20	
„	12	noon	29.20	
Sunday noon,			29.45	

R. M.

Storm of 2nd, 3rd, and 4th June, 1842.—Notes by H. Piddington, published in the Englishman and Hurkaru Newspapers.

During the latter part of May the weather was excessively close and oppressive, particularly during the nights. It was on the 27th that we had the first North-Wester, after which the weather was calm.

Generally, before this the white hazy appearance of the sky was very remarkable, and in countries subject to earthquakes would have been called *earthquake* weather, i. e. shocks would have been expected.

On the 1st June.—At 6 A. M., the Barometer had fallen from 29.625, at which it had previously been (the usual average of May being about 29.72) to 29.465. The wind was E. N. E. in variable puffs, scud rising from heavy nimbi and cumuli to the Eastward, and flying fast from about due East to West. Clear, and rather dark blue sky, with light cirrhi and strata above the scud. Cloudy and squally during the day, and threatening a heavy S. Easter* about noon, which seems to have fallen to the Eastward, for it did not reach us. The scud not remarkable in the afternoon, but always coming from E. and S. E., a thick bank hanging to the Eastward.

2nd June.—After midnight, squally from the East, with rain. Daylight heavy and rapid scud from N. E., wind rising and falling, Bar. at 5-30 A. M. 29.355.

Wind rising and falling very remarkably, at varying intervals of 15, 17 and 5 minutes, with the peculiar moaning noise which accompanies high and variable winds.

At 10 A. M., Wind N. E. by N. strong squalls, and Bar. 29.355. Noon 29.355, strong N. E. gale, rapid white scud, with breaks of dark blue sky and masses of white cumuli.

2 P. M., squalls at intervals, Bar. 29.265, calms and squalls to 7 P. M. when Bar. 29.245, but light puffs and calms till 10 P. M.,† and towards midnight, when Bar. about 29.17, squalls increasing from N. E.

* I use this term to express a heavy burst of wind and rain from that quarter, such as we have from the North-west, and which lasts from half an hour to 3 or 4 hours.

† This is another of the frequent, and indeed almost constant, instances in which these hurricanes appear to moderate for a few hours after their commencement.

3rd June.—By 7 A. M., heavy squalls and rain from N. E. At 5-30 A. M., Barometer 29.065. Thermometer 84°, hard gale with heavy squalls, scud rapidly flying from N. N. E. and N. E. by N.

		Barometer.
At 6-15 A. M.,	heavy gusts about N. N. E.	29.075
8 „	ditto N. E. by N.	29.035
8-45 „	ditto „	29.015
9-15 „	ditto „	28.995
10 „	ditto „	28.905
10-30 „	ditto „	28.865
11 „	ditto Thermometer 83° N. by E...	28.735
11-30 „	ditto „	28.715
11-45 „	ditto „	28.675
Noon „	ditto „ N. N. E...	28.625
0-35 P. M.	.. ..	28.475
	Tremendous hurricane gusts at N. E. by N. and N. N. E.	
1-5	Longer intervals between the squalls, though yet very heavy, ...	28.370
1-30	At times almost calm with moderate breezes, ...	28.345
1-45	Calm, ...	
2-0	Calm, ...	28.315
2-30	Ditto scud indistinct, but if driving at all, from E. N. E. to W. S. W., ...	28.285
3 P. M.	Calm ; scud from East, but very slow and indistinct, a light air from East, with drizzling rain, ...	28.275

At this time I drove out on the Esplanade. The appearance of the sky was very remarkable. In the zenith the haze was so thick that the direction of the scud could not be determined, but to the East and N. E. it was slowly moving, as before, to the West and S. W. while in the South, from thick heavy masses of clouds, the scud was rising and flying to the North and N. E. !

		Barometer.
3-30	A light squall and drizzling rain about S. W.	28.275
4-20	Breeze from S. W. increasing fast, (the scud having began to move from the South about 3-20,) with squalls and drizzling rain from the S. W., ...	28.285
5 P. M.	Heavy gusts from S. S. W. to S. W. Scud as rapid from S. W. as before from N. E., ...	28.320

5-30 Tremendous gusts S. W., ... Barometer. 28.385
6 P. M., ... 28.525
6-30 Terrific squalls, ... 28.580
7 „ ditto „ 28.650
7-30 Very heavy, but more moderate between the gusts, .. 28.710
8 Heavy gusts again, S. W., ... 28.755
8-30 ditto, ... 28.815
9 Heavy gusts, but more moderate in the intervals, .. 28.850
9-30 Moderating, but with sudden and severe gusts, .. 28.895
10 Sudden gusts, ... 28.925
10-30 ditto, wind perhaps S. S. W., ... 28.985
10-45 ditto, still with severe gusts, ... 28.995
11-50 ditto, ... 29.000
4th June.—At 2 A. M., moderating, but still strong gale S.W., 29.015
At 4 A. M. strong monsoon gale, ... 29.045
6-10 Strong breezes, but at intervals nearly calm, ... 29.105
10-20 Calm, with breezes at times from the S. W., ... 29.215

From this time till Sunday, the Barometer was slowly rising to about 29.38, with at times a variable 'monsoon gale' from S. W., with intervals of calm, and at others blowing hard in squalls with rain.

From the shift of wind—though in the absence of documents, and on shore, an opinion of the kind is liable to error—I should take this storm to have come up on a track of about S. E. by E. to the N. W. by W.,* in which case, and taking into account the heavy monsoon which was coming up with it, great fears of an inundation about Burrisal and Backergunge may be entertained. From the previous state of the weather, I am impressed with the idea, that it may, not improbably, have been also a storm crossing over to us from the China seas, which has occurred before. My Barometer, I should say, is corrected to that of the Surveyor General's Office.

The following are the Barometrical and other observations from the Surveyor General's Office at Calcutta, from the 26th May, when the gradual depression below the monthly average to which I have alluded at page 1000 commenced, until the 10th June, when about the same pressure again returned.

* I was three points wrong in this estimate, the track being from S. S. E. to N. N. W. See Summary.

Meteorological Register kept at the Surveyor General's Office, Calcutta, from the 26th May to the 10th June, 1842.

Days of the Month.	Moon's Changes.	Minimum Temperature, observed at Sunrise.						Maximum Pressure, observed at 9 h. 50 m.					
		Barometer.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of an Evaporating Surface.	Wind. Direction.	Aspect of the Sky.	Barometer.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of an Evaporating Surface.	Wind. Direction.	Aspect of the Sky.
		Inches	° ′	° ′	° ′			Inches	° ′	° ′	° ′		
May 26		29.613	85.8	81.0	81.0	S. E.	Clear.	29.649	89.2	95.9	88.5	S.	Clear,
,, 27		.589	87.0	82.2	82.0	Calm, ...	Clear.	.634	89.6	95.0	88.0	S. E.	Generally Clear.
,, 28		.586	86.4	82.1	82.0	Calm, ...	Cirro Cumuli.	.634	90.2	95.5	88.0	S.	Clear.
,, 29		.553	87.8	83.8	82.7	Calm, ...	Clear.	.598	91.0	96.4	90.2	E.	Cumulo-strati.
,, 30		.542	87.0	82.5	82.0	Calm, ...	Cirro-strati.	.574	90.5	95.5	88.4	E.	Cumulo-strati.
,, 31		.510	84.1	82.0	80.9	N. E.	Mists Cumuli.	.522	89.0	92.1	87.0	E.	Scattered Clouds.
June 1		29.398	84.0	81.0	80.9	E.	Nimbi.	29.410	87.0	89.0	85.0	E.	Cloudy.
,, 2	☾	.317	82.0	79.7	78.8	N. E.	Nimbi.	.346	85.1	84.5	82.0	N. E.....	Nimbi. [Rain.
,, 3		.066	79.8	78.2	78.0	N. E.	Blowing gale and Rain.	28.910	80.8	78.0	78.0	N.	Blowing gale and
,, 4		.062	79.0	79.9	79.9	S. W.....	Blowing a gale.	29.181	80.4	80.2	80.0	S. (high) ..	Nimbi.
,, 5		.294	80.5	79.1	77.0	S. W.....	Nimbi.	.390	82.4	82.8	89.1	S. W. (high)	Cloudy.
,, 6		.394	80.5	78.0	78.8	Calm, ...	Cloudy.	.418	84.0	84.0	80.4	S. W.	Cloudy.
,, 7		.389	82.2	81.0	78.3	S. W.....	Cloudy.	.434	85.0	86.1	83.0	S. W. (high)	Cumuli.
,, 8		.486	79.0	76.5	76.0	S. W.....	Rain.	.529	80.0	79.0	77.0	S.....	Overcast. [Haze.
,, 9	●	.536	83.0	81.3	82.0	S.....	Cloudy.	.570	84.6	87.5	84.4	S.....	Cirro Cumuli and
,, 10		.554	81.5	78.9	77.0	S. W.....	Cirro-strati.	.615	83.0	83.2	80.0	S. W.....	Cloudy.

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Meteorological Register kept at the Surveyor General's Office, Calcutta, from the 26th May to the 10th June, 1842.

Days of the Month.	Moon's Changes.	Observations, made at Apparent Noon.						Maximum Temperature, observed at 2 h. 40 m.						
			Temperature.			Wind.			Temperature.				Wind.	
		Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Direction.	Aspect of the Sky.	Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Thermometer exposed to the Sun's rays.	Direction.	Aspect of the Sky.
		Inches	° ′	° ′	° ′			Inches	° ′	° ′	° ′	° ′		
May 26		29.626	91.4	98.4	89.0	S.	Clear.	29.594	93.0	102.0	91.0	128.0	S. W.	Cumuli Haze.
„ 27		.618	93.4	100.2	93.0	S. E.	Light Haze,	.581	93·6	102 0	90.0	127.0	S. E.	Cumuli (partialy)&
„ 28		.617	92.4	99.8	90.1	E.	Cumulo-strati.	.554	93.8	101.5	90.8	126.0	S. E.	Cumulo-strati.
„ 29		.574	94.9	99.0	90.0	E.	Cumulo-strati.	.529	97.0	102.5	90.2	126.5	S. E.	Cumulo-strati.
„ 30		.546	92.5	97.8	89.8	S. E.	Cumulo-strati.	.526	89.4	89.0	85.1	96.0*	S. E.	Cloudy.
„ 31		.500	90.0	92.5	87.1	E.	Cloudy.	.482	85.9	82.2	81.0	85.0*	E.	Very Cloudy.
June 1		29.381	88.3	91.0	86.9	E.	Nimbi.	29.330	85.2	80.8	80.2	80.0	S. E.	Drizzly.
„ 2	☾	.305	85.1	85.5	83.0	N. E.	Nimbi. [Rain.	.245	84.2	82.2	81.0	82.5	E.	Nimbi.
„ 3		28.642	81.2	78.5	78.0	N.	Blowing a gale and	28.281	81.0	80.0	80.8	*	N. E.	Overcast.
„ 4		29.193	81.9	81.6	82.0	S. W. (high)	Nimbi.	29.174	82.7	81.7	83.0	*	High S.W	Cloudy. [Drizzly.
„ 5		.382	84.0	84.0	80.0	S. W. (high)	Cloudy.	.374	83.0	82.5	79.5	*	S. W.	Blowing a gale and
„ 6		.409	84.6	84.4	81.8	S. W.	Cloudy.	.409	85.4	85.8	83.1	*	S. W.	Cloudy.
„ 7		.434	86.6	89.0	85.0	S. W.	Cumuli.	.422	88.4	89.0	86.0	100.5	S. W.	Cloudy.
„ 8		.497	82.5	83.0	78.8	S.	Cloudy.	.493	83.5	83·7	79.7	*	S. W.	Cloudy.
„ 9	●	.541	88.0	90.0	86.0	S.	Light Haze.	·514	88.1	90.2	86.5	105.0	S.	Cloudy.
„ 10		.610	84·3	86.0	82.2	S. W.	Cloudy.	.597	86.0	87.0	83.8	109.0	W. S. W.	Cloudy.

* On the 3rd, the most severe gale ever felt at Calcutta, every house, all the Ships in the river, received more or less injury, nor was the Mercurial Column ever so low as 28.278 inches.

Meteorological Register kept at the Surveyor General's Office, Calcutta, from the 26th May to the 10th June, 1842.

Days of the Month.	Moon's Changes.	Minimum Pressure observed at 4 P. M.						Observations made at Sunset.						Rain Gauges.		Moon's Horizontal Parallax at Noon.
			Temperature.			Wind.			Temperature.			Wind.				
		Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Direction.	Aspect of the Sky.	Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Direction.	Aspect of the Sky.	Upper.	Lower.	
		Inches	° ′	° ′	° ′			Inches	° ′	° ′	° ′			Inches	Inches	
May 26		29.564	94.9	98.6	88.2	S. W.....	Cumuli,	29.564	91.0	91.7	84.5	S.....	Generally Clear,			56
,, 27		.554	95.0	99.2	90.6	S.	Cloudy,	.565	91.5	91.5	86.5	S.....	Clear,			56
,, 28		.521	94.1	100.6	90.0	E.	Cumuli,	.526	92.5	94.0	88.5	Calm.	Generally Clear,			55
,, 29		.494	93.3	93.9	88.5	S. E.	Cloudy,	.510	90.0	88.8	84.7	S. E.	Cirro-strati,			55
,, 30		.500	90.4	92.0	86.6	S. E.	Cloudy,	.505	89.4	88.5	86.2	E.	Cirro-strati,			54
,, 31		.430	82.9	82.0	81.0	E.....	Cloudy, Drizzly,	.434	85.9	81.5	80.5	E.	Cirro-strati,	0.09	0.13	54
June 1		29.310	85.5	83.2	82.0	Calm, ...	Drizzly,	29.320	85.0	82.5	82.0	E.	Nimbi,	0.47	0.50	54
,, 2	☾	.234	84.0	81.0	80.4	N. E..... ..	Drizzly,	.234	83.0	81.0	80.0	N. E.	Nimbi, [Rain,		1.02	55
,, 3		28.278	81.0	79.8	79.9	S. W.....	Drizzly,	,,	,,	,,	,,	S. W.....	Blowing a gale &	Over flown.	5.17	55
,, 4		29.162	84.0	83.8	81.0	S. W. (high)	Nimbi,	.150	81.7	80.0	79.8	S. W. (high)	Nimbi,	0.26	0.37	55
,, 5		.370	82.5	81.5	79.0	S. W.....	Cloudy,	.381	82.1	81.0	79.0	W. S. W. ..	Drizzly,	0.66	0.86	56
,, 6		.402	85.5	86.0	83.0	S. W.....	Cloudy,	.406	84.5	84.0	82.5	S. W.....	Overcast,			57
,, 7		.406	89.7	90.0	87.0	S. W.....	Cloudy,	.445	87.0	86.2	84.5	S. W.....	Nimbi,	0.38	0.47	58
,, 8		.490	84.0	84.0	80.0	S. W.....	Cloudy,	.502	83.2	82.0	79.0	S.....	Cloudy,			58
,, 9	●	.514	89.0	90.4	86.8	S. W.....	Cirro Cumuli	.520	86.5	86.0	84.0	S..... .	Cloudy,			59
,, 10		.585	86.0	86.4	82.8	W. S. W..	Cloudy and Haze,	.597	84.5	83.0	81.7	Calm,.... ..	Cloudy,			59

Meteorological Register kept at the Surveyor General's Office, Calcutta, from the 26th May to the 10th June, 1842.

Days of the Month.	OBSERVATIONS MADE AT 8 P. M.				OBSERVATIONS MADE AT 10 P. M.				OBSERVATIONS MADE AT 12 P. M.			
		Temperature.				Temperature.				Temperature.		
	Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.	Barometer.	Of the Mercury.	Of the Air.	Of an Evaporating Surface.
	Inches.	°	°	°	Inches.	°	°	°	Inches.	°	°	°
May 26	.75	90.0	90.0	87.0	.75	90.0	90.0	87.0				
,, 27	.74	90.0	90.0	87.0	.75	90.0	90.0	87.0				
,, 28	.75	91.0	86.0	85.0	.75	90.0	87.0	88.0				
,, 29	.75	90.5	90.0	88.0	.70	90.25	90.0	88.0				
,, 30	.75	90.5	90.0	88.0	.70	90.5	90.0	88.0				
,, 31	.65	85.0	85.5	84.0	.65	85.0	85.5	84.0				
June 1	29.550	86.5	86.0	84.0	29.500	85.0	85.0	83.5				
,, 2	.700	83.0	83.0	82.0	.700	83.0	83.0	82.0	29.100	81.4	81.0	80.5
,, 3	28.900	81.0	81.25	80.5	28.950	81.0	81.25	80.5				
,, 4	29.450	82.0	81.4	80.0	29.450	82.0	81.4	80.0	.500	82.5	82.0	80.0
,, 5	.550	84.5	84.0	83.0	.550	84.5	84.0	83.0	.560	84.5	84.0	83.0
,, 6	.575	84.0	84.0	83.0	.600	84.0	84.0	83·0				
,, 7	.700	85.0	84.5	83.0	.700	85.0	84.4	83.0	.650	85.0	84.0	83.0
,, 8	.700	85.0	84.0	83.5	.700	85.0	84.0	83.5	.750	84.0	83.5	83.5
,, 9	.700	87.0	87.0	87.5	.750	86.5	86.0	86.0				
,, 10	.750	86.0	85.4	84.4	.750	86.0	85.4	84.0				

N. B.—From a comparison of the two Barometers, the Mercury in that at the Dispensary stands 1.10th of an inch higher than that in use at the Surveyor General's Office.

SECTION V.

From Calcutta Inland.

Letter from R. J. Homfray, Esq. Midnapoor, Lat. 22° 25′ N. *Lon.* 87° 25′ E.

" I had no barometer, so am unable to enlighten you on that point. I have delayed answering your letter, that I might inform you of the results to the westward of this station, as from the published accounts of its effects in Calcutta, I was disposed to consider its force less here, and probably more so, as it extended westerly, and which I find to be the case, as on the Subbunreeka river, which separates Bengal from Orissa, and lies in some directions fifty miles, and in other twenty-five miles from hence, its effects were not felt, and only existed in refreshing rain. At daylight on Friday the 3rd instant, heavy squalls following in rapid succession; wind from the N. E., rain plentiful and without interruption, but apparently not falling heavily. Mid-day same, thermometer 78°, strong wind in hard puffs and plenty of scud, wind from N. E., *lulled after mid-day till between two and three o'clock,* when it came on again from the W., blowing stronger and stronger, with heavy gusts at short intervals all night, with heavy and uninterrupted rain; during the night I found the wind at N. W. Saturday morning, daylight, moderated, rain by gage since yesterday morning $6\frac{3}{4}$ inches, gradually moderated all day, wind at S. W. thermometer mid-day 78°, occasionally no rain, the wind blowing strong till evening when it became nearly quiet, and put on the usual appearance of monsoon weather. Sunday morning 5th, rain since yesterday morning $1\frac{1}{4}$ inches. No trees of any consequence fell, but 200 houses and upwards in the native part of the town came down, and the verandah or portico of two gentlemen's houses fell, one having a North, and the other a Western aspect. No thunder or lightning. R. J. HOMFRAY.

Chandernagore.

Observations on the storm of 2nd and 3rd June 1842, made at Chandernagore, by J. St. Pourçain, Esq. Barometer corrected to that of the Surveyor's General's Office by a subsequent comparison.*

* There is no difference in the level of the two places worth noticing.

1*st June.*—Hot weather with fresh breeze from the N. E., squalls and rain at times from the Eastward. Every thing announcing a change of weather and the setting in of the rains. Barometer from 29.594 to 29.494, thermometer 84° to 82°.

2*nd June.*—Bad weather in squalls with rain at times, and blowing fresh from N. West to East, Barometer 29.394, very cloudy, the wind at times falling almost to a calm. At 11 A. M. worse weather, Barometer 29.294. Rain at times, thermometer 80°.

3*rd June.*—Worse weather, heavy squalls from the N. E., and at 6 in the morning Barometer 29.194 and falling, Thermometer 80° blowing hard with heavy squalls from N. E. to N. N. E., every thing announcing a storm, heavy clouds flying from N. to South.

			Barometer.
At 8, very heavy squalls from N. E.	.....	.....	29.094
9, ..	ditto	„	28.994
10, ..	ditto	„	28.894
Noon ..	ditto	„	28.794
1 P. M. ..	ditto	„	28.694
2 „ ..	ditto	„	28.644
3¼ „ ..	ditto	„	28.494
4¼ „ ..	ditto	„	28.394
5¼ „ ...	ditto	„	28.344
6¼ „ ..	ditto	„	28.344

Between ¼ past 5 and ¼ past 6 was the heaviest of the hurricane. It was then blowing tremendously heavy in squalls from the N. E. At 7-15, the barometer began to rise, being at 28.396, the wind terrible and in gusts with longer intervals, but its violence undiminished. At 8-15, the same gusts, as strong but less frequent from N. E. to N. N. E., barometer 28.494, thermometer 78°.

		Barometer.
9-15, the same,	.. ..	28.594
11-15, ditto	.. ..	28.894

4*th June.*—2 A. M. weather more moderate, winds variable, and light from N. N. E. to S. W., with drizzling rain, cloudy and heavy scud driving up from the Southward to the North. At 4 A. M. blowing strong in short but heavy squalls from the S. W. Thermometer 78°. At 6, blowing very hard with terrible squalls from the S. W.

Barometer.

At 8, the same, ... 28.994

At 10, moderating, but at times squalls from the N. W. with drizzling rain, ... 29.194

At noon moderating, but at times squalls from the S. W. 29.194

At 2, clearing up, but slight squalls still; barometer rising gradually from 29.294 to 29.394, thermometer 80°.

This is the heaviest hurricane that I have seen in this country after a residence of 22 years; great damage done in the town to houses and trees.

In reply to some inquiries Mr. St. Pourçain says, "I assure you that we had never the wind from S. E. or S. S. E."

We have two reports from Chinsurah, the first from Mr. Sutherland, Principal of Hoogly College, the second from Mr. Herklots, Principal Sudder Ameen. Mr. Sutherland's letter is as follows:—

The wind appeared as nearly as I could judge to come from N. N. E. on the commencement of the gale, which was about Friday noon. We had rainy threatening weather on Thursday afternoon, and the wind had been to the Northward a day or two before. The wind seemed to me to veer several points ere it flew round to the S. E. and E. S. E. on Saturday night, and there were frequent lulls. There was a lull on Saturday morning and another on Saturday evening, the rain was almost continuous, but most copious on Sunday night when the gale had taken off. We had, early on Sunday night, some thunder and lightning. The upper verandahs of the College to the North and East and South-east are blown completely in, the screens between the windows are torn right out of the pillars, and several windows and doors blown not merely in, but right out of the walls, sills and all.

The following are Mr. Herklot's Registered Observations on the Weather at Chinsurah, from the 30th May to the 9th June, 1842.

From Thursday the 26th to Sunday the 29th May, the thermometer in the shade at 3 P. M. was on each day, ... 100°

May 30th, cloudy, ...no observation.
„ 31st, ditto, wind East, ... 90°
June 1st, in the afternoon a shower, wind East, ... 86°
„ 2nd, a little rain, strong East wind, ... no observation.
„ 3rd, a tremendous gale from N. E.; beginning at 9 A. M., shifting to the North, in the afternoon returned to East, at 5 P. M. most furious, ... 78°
„ 4th, the gale abated; soft rain day and night, ... 80°
„ 5th, rain and wind all day from S. E., ... 80°
„ 6th, cloudy with little rain, wind S. W., ... 85°
„ 7th, ditto ditto W. and S., ... 88°
„ 8th, ditto ditto S. .. .. 90°
„ 9th, clear, with sunshine, wind S. .. .. .. 94°

NOTE.—Rain very moderate, there was no lightning and thunder during the gale. On the 3rd June there was scarcely any rise of the river at flood tide. On the 5th, the river began to rise uncommonly, said to have been occasioned by an extraordinary rise of the Adjye river at Cutwa.

Subsequent to the spring tides of the new moon on the 9th instant, the river has fallen a good deal.

P. HERKLOTS.

It will be remarked here, that while at Chandernagore the gale veered to S. W. after an interval of calm, it veered by the East at Chinsurah. The two stations are four miles apart only, and lie nearly North and South of each other, Chinsurah being to the Northward; I shall further allude to this in tracing the course of the storm.

The following letter is from *about* latitude 24° 48′ N. longitude 88° 50′ E. I was not able to learn the writer's name, but I am assured that this is not far from the true position of the factory.

Effects of the Gale.

TO THE EDITOR OF THE ENGLISHMAN.

The gale commenced here on the morning of the 3d, with strong Easterly winds increasing to a perfect hurricane. On the 4th, wind veered a little to the Northward with occasional tremendous squalls; towards evening temporary lulls, but rain pouring in torrents. On the 5th, wind veering about from E. to S. E. and South, blowing tremendously with torrents of rain. The 6th, still blowing tremen-

dously from S. S. W., and nearly due West; towards evening the gale subsided.

The effects are most dreadful, some of the concerns hereabout losing all hope of one-half of what they expected, others one-third, &c. To add to our disasters, the river took a most unexpected and sudden rise of some $4\frac{1}{2}$ to 5 feet in as many days.

Banks of the Jumna, June 18, 1842.

P. S.—I hear that the gale was much less severe, higher up the river, and towards Mymensing scarcely felt.

From Kissennuggur I have obtained, by the attention of Dr. Fuller, Civil Surgeon, a report from its immediate neighbourhood, and another was published in the Newspaper, which I give after that of Dr. Fuller's friend.

The enclosed is the only tolerable account I can obtain for you, of the late Storm.

2*nd June.*—At Kissennuggur, we had light rain, and the weather very cloudy; towards evening the wind rose and continued the whole of Friday (3rd) from the N. E. with wind and drizzling rain day and night.

4*th June.*—Wind round to the Southward, and the storm less furious, drizzling continuing. No Calcutta dâk in.

5*th June.*—Weather still very unfavorable, rain and wind all day, and no Calcutta dâk in; on the morning of the 6th, the wind had ceased, but there was rain and very dark clouds, towards evening it became fine. There is not a barometer at the station, consequently I fear, that these rough notes will be of little use to you.

C. W. FULLER.

This Report is from a Factory, a short distance from Kissennuggur.

I did not observe the *times*, when the wind varied as it appeared to do every ten or fifteen minutes. The storm commenced on the night of the 4th June, about ten or eleven o'clock, apparently from N. N. W., in the course of the morning; it was S. W. by three or

four P. M. of the 5th, which was the worst time of the gale with us, it blew from S. S. W. for two or three hours, slightly veering to S. E. About midnight of the 5th, the wind came round to the point it began from, blew furiously for about an hour, and gradually subsided into a calm.

Hurrah, 4th July. R. DE COURCY.

Kissennuggur.

The gale commenced here on the evening of the 2nd instant from due East, and continued from that point all the 3rd; on the 4th, when it blew heaviest, it veered round to South, occasionally varying to S. S. W., when at its *height* the wind blew from direct South. On the 5th, it went round to S. East; and finished its fury on the 6th from due East.

As I have already said, 9 inches of rain fell during the continuance of the gale, but I am persuaded, that much more must have fallen, for the force of the wind blew the rain in quite a horizontal direction, consequently, much more rain must have fallen than the rain gauges indicated.—*Englishman, 18th June,* 1842.

The Storm at Plassey, Lat. 23° 47′ *N. Long.* 88° 19′ *E.*

We have been on the look out for letters from the Lower Provinces, giving some account of the effects of the hurricane, but up to this time nothing has been received. A letter of the 3d June, 5½ P. M., from near Plassey on the Bhaugretty, says:—

'It has been blowing a *tremendous gale* to-day from N. E., it is now increasing. My Barometer is *nearly* down to 29 and falling—4th June, 6 P. M. The gale continues, the wind has been from S. E. to-day. I could not get a boat to cross yesterday, my dawk man may be more fortunate this evening.'—*Englishman, 18th June,* 1842.

To Mr. Russell, B. C. S. I am indebted for the following account of the Storm at Berhampoor, Latitude 24° 9′ *N. Longitude* 88° 12′ *E.*

On the 1st, we had fine but warm weather, the Thermometer in the centre room of my house open to the N. and S. standing at daybreak at 83°, and at 3 P. M. 95°, a few days before it had been at 98°.

On the 2nd at ½ past 3 P. M., a storm with much rain from N. W. unattended with thunder and lightning, the morning had been fine, and so was the evening and early part of the night; towards the morning of the 3rd, it became cloudy; at day-break light wind from N. E. and a little rain. At 7 A. M. wind increased and continued to blow with great violence the whole day. About 10 P. M. the wind increased, and blew with fearful violence until the morning of the 4th, when it fell a little, but it still blew with great violence the whole day, with heavy gusts and much rain, and continued so until 8 A. M. on the 5th, when the wind veered round to S. W. or rather nearer W. and blew from that quarter with great violence until next morning, the 6th, when it died away; but the rain did not cease until the afternoon, since then the sky has been clear until this time, with Southerly wind.

C. D. RUSSELL.

In reply to some inquiries, Mr. Russell writes as follows :—

The storm commenced on the morning of the 3d with the wind from N. E., but from 7 A. M. on that day until 8 A. M. on the 5th (Sunday,) it blew steadily from the East, or a little North of East, it then went round to S. W., and remained in that quarter until it cleared up. The storm was most violent during the night of the 3d.

C. D. RUSSELL.

From Jungypore, Latitude 24° 28′, *Longitude* 88° 08′, *we have the following report to Government by Mr. Deputy Collector Smart.*

2*d June.*—4 P. M. a smart shower of rain, with slight gale from N. N. E.

3*d June.*—Raining slightly off and on all day, blowing in slight puffs from N. N. E. 9 P. M. blowing in tremendous gusts from the same quarter and continued the whole night, with little rain.

4*th June.*—Blowing from the same quarter, and pouring in torrents till 7 P. M., when veered to the East, blowing furiously all night, with plenty of rain.

5*th June.*—6. A. M. wind veered to S. E.; 1 P. M. blowing from S. S. E.

6*th June.*—Wind veered to S. S. W., gale abating, noon blowing in subdued gusts from W.

The gale could not have been so severe here, as it appears to have been in Calcutta; *not a tree or hut blown down.* The most remarkable feature was, the quantity of rain that fell. Lands which are inundated so late as August, are completely flooded. The river is rising rapidly.

E. SMART, *Deputy Collector.*

Mr. Lautour, Magistrate of Dinagepore, Latitude 25° 07′ *N. Longitude* 89° 40′ *E. has kindly sent me the following report of the weather as experienced at that station.*

2*d June.*—Heavy shower from the S. E. and E. S. E. at 5 P. M.

3*d June.*—Cloudy throughout, and towards evening every appearance of a gale, which commenced about 10 o'clock, and continued increasing throughout the night, with small rain, wind N. E.

4*th June.*—Gale and rain continue without abatement, wind N. E. and E. N. E., no abatement during the night.

5*th June.*—The gale moderating, the wind gradually drawing round to the Southward of E., gradually declining in violence throughout the day, and the whole country under water on Monday morning. I have no means of giving you any Barometer returns; the quantity of rain which fell during the gale was from four to five inches. It extended some distance North of this, as a friend of mine was put down in his palkee between this and Titalyah; the gale was not felt at Darjeeling, where the weather however was wet. During the gale, the wind never veered to the West. I suspect you will find Titalyah to have been its northern terminus.

E. LAUTOUR, *Magistrate.*

I did not neglect Mr. Latour's remark, and in reply to my application, Mr. Montgomery, the Post Master, has been good enough to send me the following account of the weather experienced there. Titalyah is in latitude 26° 28′ *N. longitude* 88° 25′, *or about on the meridian of Calcutta.*

In reply to your letter of the 15th instant, I beg leave to state, that the weather here from the 1st till about one o'clock A. M. 4th, was

gloomy, with much rain, accompanied with squalls from the N. W. and a great deal of thunder and lightning. About 1 P. M. on the morning of the 4th, it blew almost a hurricane from the S. E., with heavy rain, thunder, and lightning; this continued for about two hours, when it fell calm, but the rain still continuing to fall heavily till the morning of the 5th.

I had no means of noting the temperature of the air during this time, not having any instruments.

P. MONTGOMERY, *Offg. Post Master.*

Mr. Martin, Magistrate of Purneah, latitude 25° 45′ *N. longitude* 87° 23′ *E. has kindly sent me the following account of the weather as experienced there.*

The gale which caused so much disaster in Calcutta, set in here about 7 A. M. on Saturday the 4th June, with strong squalls from the North East, accompanied with driving sleet; over-head the scud was flying very fast, and without intermission. On the earth the wind frequently moderated for short intervals during the day of the 4th, but towards nightfall set in with increased violence from the same point of the compass, blowing hard all night. For several days previous, the weather had been murky and oppressive, but we had no Barometer to consult, and were not aware that a storm was impending. On the morning of the 5th, the gale continued with unabated rigor, and blowing from the same point, or N. E. so far as I can remember, but towards evening it veered a point or two to the Eastward, still blowing with the same violence. Thus it continued till 5 or 6 P. M. of the evening of the 6th, when the storm appeared to be breaking, and the clouds to rise all round. On the morning of the 7th, the wind had quite abated, though the clouds were still heavy, and boded much rain. Suddenly about 7 A. M., a strong North-wester sprung up with extraordinary violence, and it blew as hard as ever for about an hour and half, accompanied by a deluge of rain. I don't remember that the wind ever came from the South-east, as stated in the Calcutta newspapers.

E. MARTIN, *Magistrate.*

Purneah, July 1842.

Soorajgunge, latitude 24° 26′ *N. longitude* 89° 42′ *E. Memorandum from his register by J. Martin, Esq.*

2*d June.*—Appearances of bad weather, squally, large and heavy clouds surrounding the horizon.

3*d June.*—At 2 A. M., gale commenced blowing from the Eastward, followed almost immediately by a torrent of rain, the wind increasing every hour.

4*th June.*—The wind shifting from E. to E. S. E., and blowing with the same violence as the day previous.

5*th June.*—At 8 A. M., the wind suddenly shifted from E. S. E. to S. W. after a momentary calm, blowing almost a hurricane the whole day and night.

6*th June.*—Weather the same at noon, the winds abated a little, and at 5 P. M. shifted from S. W. to W., the storm having subsided into a light Westerly breeze.

From Kunjirpore Factory, Bhaugulpore Zillah, a few miles E. by N. or E. N. E. of the station, lat. about 25° 12′ *N. long.* 87° 09′ *E., I have received from Mr. A. Pinard, the following Memorandum on the gale of the* 3*rd to* 6*th June* 1842 *:—*

3*d June.*—At 6. A. M. wind South, weather threatening from that quarter, dreadful heat, large drops of rain falling scantily. At 4 P. M. wind from the North, and from the same quarter all night.

4*th June.*—Wind has veered to N. E., blowing fresh with drizzling rain, Ther. 82°. At 10, wind came to E. N. E., heavy rain and blowing strong till noon, when the wind came back to N. E., and the rain ceased, Ther. 81°. At 2 P. M. wind E. N. E., heavy rain and wind, Ther. 82°. At midnight the gale was at its height; wind E. N. E., the rain reduced to mist by the force of the wind.

5*th June.*—At 5 or 6 A. M., the same wind and weather, Ther. 79°. At 10, wind from the North, heavy wind and rain, Ther. 78°. At noon wind N. W., heavy rain, wind not so strong, Ther. 79°. At 4 P. M., wind W. N. W., heavy rain at 6 P. M., wind veered to West, still blowing strong, and heavy rain.

6th June.—Wind West, drizzling rain, dark cloudy weather, wind almost calm or very light at times. At 6 P. M., the weather was fine.

The river began to rise from the 4th by the heavy rains on the mountains to the South of Bhaugulpore, and great mischief was done. I regret much that I had no Barometer.

A. PINARD.

Bancoorah, latitude 23° 14′ *N. longitude* 87° 10′ *E.*

Dr. Cheek, Civil Surgeon, gives me the following valuable accounts of the storm, the first being his own, and the second procured from Mungulpore, a station about fifteen miles to the N. by E. of Bancoorah.

My dear Sir.—Yours of the 22d, duly reached me on Saturday last, and you would have heard from me before on the subject of the late terrific gale, could I have given a report worth your having. I feel deeply interested, I am sure, in the inquiry you have in hand, it is a subject of importance to all. I had lent my Barometer to my friend Hannyngton at Purulea; he I am pretty sure has sent his report.

On the 2nd, we had rather high wind nearly all day from the Eastward, with occasional heavy showers. At about 4 P. M. the wind came round to the North with great violence and with heavy showers, blowing nearly from the same quarter all night. On the 3rd, it was W. N. W., with heavy gusts and continued rain. About 5 P. M. it came to the S. W., and from that quarter continued till the 4th, blowing tremendously, with thick small rain. 5th, wind in the same quarter, with heavy rain till the afternoon, when it was less severe, the wind coming round to the South. On the 6th, wind South, with heavy rain. 7th we had fine weather which continued to the 14th. Night of 14th, a severe North-wester. From that time to this we have scarcely seen the sun; we have had gusts of wind with heavy showers till to-day. I have never seen such weather at this time. I do very much regret my report is not more scientific, the reason I have stated, not having had my Barometer.

G. N. CHEEK.

Bancoorah, July 16, 1842.

My dear Sir,—As I promised, I wrote to Mr. Erskine, who during the late gale was near the Raneegunge coal mines on the Damooda, in reply he states as follows :—

I got your note with Piddington's, which I forwarded to my brother. I don't believe he has kept a memorandum of the weather. I generally do, but am not particular about the hour. Here is a copy of what I have, if it be of any use. At Munglepore 23° 33′ N. 87° 13′ E. from the 26th May, we had strong Easterly winds, which continued very regular to the 30th, when it began to be cloudy; the moon was very "watery looking," with a circle round her. On the 31st, the wind was more Northerly, and cloudy.

1*st June.*—Easterly wind, heavy white scuds, with a dark blue sky.

2*d June.*—Strong N. E. winds, in puffs, with occasional showers, in the day clear, evening light winds.

3*d June.*—Strong N. E. wind and scud with rain, with slight intermissions, and getting stronger and more Northerly; gale, and rain all night.

4*th June.*—Strong Northerly gales and incessant rain, wind veering to the Westward, but no intermission of rain, all night Westerly gales.

5*th June.*—Wind South-westerly, more moderate, and rain abating; at noon Westerly gale again and very heavy showers; evening S. W. wind, rain more moderate, clearing up at midnight after a heavy thunder storm with rain.

6*th June.*—Southerly winds, heavy clouds but no rain, fair all day, wind changeable from S. W. to S. E.

7*th June.*—Southerly airs, clear and sunny, and we had little rain till it began again on the 15th to fall regularly."

G. N. CHEEK.

Monghyr—Newspaper Report.

A Gale.—We have had an opportunity of perusing a letter dated the 9th instant, from Monghyr, which mentions, that on the 31st ultimo, the station was visited with strong breezes from the S. E., which gradually wore round to the N. E., and at times to the N. N. E.

increasing in force until the 4th instant, when it subsided. From the extent of injury done, it would appear that the strength of the storm there was not at all equal to that felt in Calcutta; as the letter in question observes, that with the exception of a few native boats having been driven on shore, and some of the branches broken off the trees in the fort, no other damage worthy of record had been sustained. Many boats had, however, been lost between that station and Bhaugulpoor. It was also stated, that Monghyr and the surrounding districts had experienced several slight shocks of earthquakes during the month of May, but none of them would seem to have been unusually severe.—*Hurkaru.*

Messrs. Willis and Earle, from letters of their Correspondents, have obliged me with the following.

Mr. Bluett, who manages a factory for us about forty miles from Monghyr, nine miles from Surrajgurrah on the Ganges, at Lucky Serai, reports a severe earthquake there on the 23d May, and subsequently very hot and oppressive weather with Easterly winds; and then in date of June 6th, says, "We have at last had rain, and enough of it too. It set in on Friday, 3rd June, and all Saturday and Sunday it rained hard, and blew almost constantly *from the Northward,* it cleared up about midnight on the 5th instant." The river, Kewl (or Queule, a mountain stream from the Curruckpore hills,) rose suddenly two feet higher than last year, running a foot over Lucky Serai village, or higher than has been known many years.

Mr. E. Morgan from Monghyr, in date of the 8th June, writes,

"A few days ago, there was a short but strong dry storm, which sunk about twenty boats near this. I think the rains may be said to have set in on the 3rd instant; from that to the night of the 5th instant, there was heavy rain and a strong gale, so that I think more boats must be lost. On the 6th, 7th, and to-day, there has been rain."

From Mr. Palmer of Monghyr, latitude 25° 23′ *N. longitude* 86° 38′ *E. I have received the following interesting detail of the weather at that station about the time of the storm.*

The whole of this season, I mean from January, has been rather a remarkable one, and very different from that which I have observed

at this station for the last seven years. The annual passing showers of January and February did not visit us. March and April, though generally one stream of strong N. W. and N. E. winds, approached us with somewhat less fury, and with a secession of a day or two intervening between the gusts. May was sultry in the day without the usual hot-winds, but attended with a cooler feeling by midnight, until near the 19th, when the air became heavy and oppressive to a degree, and the sky had a peculiar hue about the time of the setting of the sun; this continued until the morning of the 21st, and though we look forward to some kind of coolness, or a light air about dawn, it was the reverse this morning, a lethargic sensation seemed to hang about one until quarter after nine, when the earth was observed to tremble and rock from E. to W. for half a minute, vibrating those wall shades only in *that line;* when, as if a second shock, though I could perceive no stop, came from the direction of N. and S. affecting the wall shades again in that line; the last undulation appeared the strongest, this was repeated three times each with less force. On the 23rd, two more slight shocks were felt, since which period up to the night of the second of June, the sky assumed every evening an ashy colour, blended with tints of a salmony hue, and very oppressively hot. A strange effect it appeared to have on all trees in either blossom or young fruit. As a proof of this, the whole of the fruit in my garden was stunted in its size, with a kind of harsh flavor, though free from any worm; the blossoms falling off in a manner as if each leaf was partially baked to make it crisp. The star-apple flowered three times, and fruited twice in May and June, and several kinds of plants seemed to shrink and stay their growth. As I am no Botanist, and but a bad Agriculturist or Horticulturist, I cannot, I regret to say, give you a better relation.

The night of the 2nd June and the whole of that day, there was not sufficient air to move a single leaf; it was so oppressive, that I observed the very air produced from the punkah, when pulled, descended hot, and this oppression continued apparently in an increased ratio until about two o'clock in the morning of the 3rd, when the first burst of wind came on from the N. W.; so sudden and so rapid was its progress, that nothing I could write, could explain the rapidity of the change, when it chopped round to N. E. in awful gusts, such as I

have never before witnessed, accompanied with a deluge of rain; this continued without intermission for three days, (3rd, 4th and 5th,) rain pouring in torrents, and the wind with awful force playing from the W. to N. E. and S. E. The first gust of the W. wind, no doubt with the assistance of the rain, had a tendency to raise the waters of the Ganges, which it did to near five feet the first night. There appeared but little thunder or lightning during the whole time.

I have but one remark more to make. I have observed these awful visitations, commonly known by the name of the May gale, visit us with the greatest severity every *ninth* year. Its annual visitation is severe enough; but those which follow in *ninths*, are accompanied with greater disasters to the shipping and the country than the annual ones. On this subject, and its peculiarities, I have drawn up a paper, which I believe will be made public.*

PETER PALMER.

Sooree in Beerbhoom. Latitude 23° 54′ *N. longitude* 87° 32′ *E.*

Mr. Saunders, in a report to Mr. Masters of La Martiniere College, which he obligingly desired might be communicated to me, gives the following account of the weather :—

1*st June.*—Was a bright sun-shiny day.

2*d June.*—Drizzling rain in the morning up to 2 or 3 P. M., wind I believe Easterly, heavy showers during the night.

3*d June.*—Overcast in the morning, with drizzling rain at intervals. At about 5 P. M. it began to rain sharp, and soon after dark very heavily, with high wind from the N. E., incessant rain all night, and all day of the—

4*th June.*—With strong wind in the same direction up to 9 P. M., when I went to bed; during the night the wind shifted round to the West. It was in that direction about 2 or 3 in the morning of the—

5*th June*,—Rain continuing throughout incessant and very heavy. At about 2 P. M., the wind shifted more to the North, say N. W. At 5 P. M., the wind and rain moderated, but it continued all night, and morning of the—

* Mr. Palmer will confer a great obligation on meteorologists by this publication. —H. P.

6th June,—It was calm. I have no Barometer, the gale was strongest on the morning of the 5th, after the wind had shifted to the Westward, say between 4 and 7 A. M. Observed no calm, rain and wind incessant from the evening of the 3d to the evening of the 5th; one tree in my court-yard blown down. A tall palm, about three feet in circumference, was blown down during the night of the 4th, or rather morning of the 5th, most probably before 7 A. M. of the 5th, lying E. by N. and roots W. by S. Heavy rain. All the country overflowed, mud walls washed down; but no roofs blown off, and no thunder and lightning.

Between 1 and 4 P. M. of the 3d, it was gloomy drizzling weather, with not much wind; what there was came from N. E.

Purulia, latitude 23° 20′ *N. longitude* 86° 24′ *E.*

From Captain Hannyngton, 1st Assistant to the Governor General's Agent, S. W. Frontier, Maunboom, I have received a valuable report, and he has subsequently ascertained the difference of level between his station, Purulia, and Calcutta, so as to enable me to apply the barometrical correction, reducing the observations to the same level as those taken at Calcutta. Purulia being 672½ feet above the level of Calcutta, the correction becomes 0.676. additive, to his observations, to reduce them to the standard of ours, which has been done in printing his table, by adding a second column to them, headed "Corrected to the level of Calcutta."

Meteorological Register, Purulia. Latitude 23° 20′ *N. Longitude* 86° 24′ *E. Barometer by Bate of London. Thermometer by Levy, Bristol, boiling point* 213°.

Date.	Hour.	Bar.	Bar. corrected to the Level of Calcutta + .676	Ther.	Direction and force of Wind.		Remarks.
1842		°	°	°			
June 3rd	8 A. M.	29.05	29.726	78	N. E.	Moderate gale,	The gale commenced at N. E. on the morning of the 3rd at about 4 A. M., and continued with gusts and heavy showers throughout the day. The wind drew very gradually round to the N. W., in which quarter it remained steady, and at its greatest force for about thirty hours. Then drawing by degrees more and more Westerly, the gale abated, and terminated at W. S. W.
,,	Noon	.04	.716	82	,,	Increasing,	
,,	4 P. M.	.03	.706	79	N.	to	
,,	6 P. M.	.02	.696	79	N. N. W.	Fresh gale, and	
,, 4th	7 P. M.	.01	.686	80	,,	Strong gale	
,,	6 A. M.	29.00	.676	79	N. W.	,,	
,,	8 A. M.	.00	.676	79	,,	to	
,,	Noon.	28.96	.636	79	,,	Whole gale,	
,,	4 P. M.	.96	.636	79	,,	,,	
,, 5th	8 P. M.	.96	.636	79	,,	,,	
,,	8 A. M.	.95	.626	78	W. N W.	Moderate gale,	
,,	10½ A. M.	.945	.621	79	,,	moderating	
,,	Noon	.945	.621	77	W.	to	
,,	2½ P. M.	.94	.616	78	W. S. W.		
,,	4 P. M.	.94	.616	79	,,	Moderate breeze,	
,, 6th	8 P. M.	.94	.616	79	,,	Gentle breeze,	
,,	5 A. M.	.92	.596	77	S. W.	,,	
,,	Noon	.92	.596	79	,,	,,	
,,	8 P. M.	.92	.596	82	S.	,,	

Heavy and constant rain.

N. B.—The above terms are according to the memorandum, dated Admiralty, Dec. 28, 1838.

During the 6th June, the wind drew to the South, and has since alternated between South and West.

It is observable, that the Barometer continued falling after the storm ceased, and has since risen very slowly, being now, (noon, June 10th,) only 28.95. The average height of the Barometer at this station is 29.50.

Should this memorandum present any discrepancies, they may perhaps be ascribed to the neighbourhood of an extensive range of hills, having an elevation of 1,000 to 1,200 feet, distance about 8 miles, and bearing from S. W. to West.

MAUNBHOOM DIVISION,
Principal Assistant's Office, Purulia, 9th June, 1842.

J. HANNYNGTON,
Principal Assistant.

In reply to some inquiries, of which the purport will be seen by the answers, Captain Hannyngton says, "In making observations on the late storm, I was anxious to note any sudden shifts of wind, and unless they occurred during the nights, (which I have no reason to think probable,) I feel tolerably certain that none such took place. The changes were so gradual, that I could not fix the times to any satisfactory degree of accuracy.

"The weather here became unsettled and gloomy on the 1st June, and on the 2d, we had a fresh breeze from the East, with nearly constant rain. It would seem, that the storm travelled from Calcutta to this place, and lost much of its force in the transit. We had a strong gale, but nothing more; no trees or houses were blown down."

The following reports embracing, as they do, a large zone from Tipperah to Assam, and thence to the West, through Oude, to Almora, Kurnaul, and Bombay; and in the South at Sumbulpore, &c., will be read with interest, as comprising good accounts of the effects of these storms, beyond their strict limits.

It is not intended to assume here, that all the phænomena recorded, were the effect of the storm, but that some of them may be well *supposed* to be so, and the whole are worthy of being noted, as giving some idea of what occurs inland, over a large tract of country, on these occasions. The indications of the Barometer at Bombay, and at Deesa, are evidently proofs, that the atmosphere was affected even at this great distance.

From Comillah, Lat. 23° 28′ *N. Long.* 91° 2′ *E. by Dr. Foaker, Civil Surgeon.*

Deeming it of consequence that you should be informed how far the storm that lately raged at Calcutta, extended in this direction, I have the pleasure of informing you, that from the best information I can collect, Dacca appears to be the nearest place at which it was felt, for it did not extend to Doudkandy, a thanah at the mouth of the river Goomty, 32 miles from this in a Westerly direction, nor was it felt

for many miles to the South of this district, nor, as I am informed, at Chittagong.

On the night of the 3d of June, we had a severe squall attended with heavy rain from the N. W., veering round to the South; but this was nothing out of the common course, as we had been visited with similar ones for weeks before; in fact, we have had a succession of stormy and rainy weather since 25th of February, from which time until this date, (the 23d,) 3 feet 4 inches 2-8ths of rain have fallen, and during the entire year 7 feet 11 inches 5-8ths. I am not able to give any information regarding the Barometer, as there is not one in the station. The Thermometer here on the 1st, 2d, and 3d, varied from 87° to 88°.

T. FOAKER,

Comillah, June 23, 1842. *Assistant Surgeon.*

In the vicinity of Seebsagor, Upper Assam, from R. H. Buckland, Esq. Superintendent, Assam Company.

Meteorological Observations taken at Nazera, in June 1842.

Date.	Sunrise.			2. P. M.			Sunset.			Remarks.
	Barometer.	Thermometer.	Weather.	Barometer.	Thermometer.	Weather.	Barometer.	Thermometer.	Weather.	
1	29.13	75	S. E. Rain.	29.12	83	E. Cloudy.	29.13	83	S. Cloudy.	
2	" 12	76	S.E. Cloudy.	" 13	84	S. Do.	" 12	84	S. E. Do.	
3	" 11	75	S. Fair.	" 11	85	S. Do.	" 05	86	S. E. Do.	Distant Rain.
4	" 08	78	S. Rain.	" 07	83	S. E. Do.	" 05	84	E. Do.	
5	" 10	78	E. Do.	" 05	86	N. E. Do.	" 08	82	E. Rain.	
6	" 06	78	E. Cloudy.	" 03	86	N. Stormy.	" 03	77	N.E.Cloudy.	

True Extracts,

R. H. BUCKLAND,

Secretary, Assam Company.

Rungpoor, Upper Assam from Mr. J. Owen, Assistant Assam Company.

Situated on one of the Naga Hills, East of Jaipoor, Upper Assam, and distant 12 or 14 miles, at an elevation of nearly 1500 feet above the level of the sea, observed

June 1st. Hot sultry day, slight S. S. W. breeze.

„ 2d. Rain from 6 A. M. to noon; wind throughout variable.

„ 3d. Hot sultry day. Slight S. S. W. breezes.

„ 4th. Very hot day, wind variable.

„ 5th. Ditto ditto,

„ 6th. Rain at noon. Fresh breeze from the Southward and Westward. J. OWEN.

Darjeeling. Latitude 27° 7′ *N. Longitude* 88° 21′ *E. from Dr. Campbell, Resident. N. B.—Elevation about* 7,000 *feet.*

"I beg leave to furnish the following particulars from memory, of the state of the weather at this place during the 2nd, 3rd, 4th, and 5th. About midnight of the 2nd, it commenced blowing strong gusts from the N. W., and continued to do so all day of the 3rd, accompanied by showers. On the 4th, we had stormy weather and rain, the wind blowing from the S. E., and the weather continued unchanged during the whole of the 5th; although the wind was strong throughout the greater part of the 3rd, 4th, and 5th, it did not amount to a storm, at least it was not such a storm as we experienced here on the 4th and 5th of May 1840."

Mozuffurpore in Tirhoot. Lat. 26° 8′ *N. Long.* 85° 31′ *E.*

A memorandum from my friend, Mr. Samuells, Magistrate of Tirhoot, says,

"After much inquiry, I cannot learn that there is any person in the district who keeps a meteorological register, or indeed any memoranda of the weather. My recollection, however, of the state of the weather at the time of your great storm, agrees precisely with that of the Doctor, and who moreover tells me, that he has invariably remarked the same appearances in the weather here during the May and October gales in the Bay of Bengal. The weather, according to our recollection, was

hazy, the sky covered with light fleecy clouds, and there were light airs, with occasional gentle breezes from the East, the quarter from which the wind almost invariably blows in Behar during the rainy season. The force of the gale would appear to have expended itself among the Rajmahal hills.

Tirhoot, Amooah. Latitude 26° 33′ *N. Longitude* 85° 24′ *E. from J. B. Higginson, Esq.*

Knowing that you gladly receive any information respecting winds and weather during the late hurricane, I send the following extract of a letter from Amooah in Tirhoot:—

"During the late dreadful storm you had in Calcutta, we had a steady, but rather strong easterly wind, with dark hazy, sultry and very oppressive weather, with every appearance of bad weather setting in; and although the light scud went with the wind, *the upper dark masses of clouds were whirling about in a most extraordinary manner, but driving towards the S. E.* The sun was not visible for two days."

Gya. Latitude 24° 47′ *N. Longitude* 85° 12′ *E.*

I have been favoured with a report from this station from W. St. Quintin, Esq. the Magistrate, as follows:—

21*st May.*—At 20 minutes before 9 o'clock A. M., we had two smart shocks of Earthquake, from West to East; for some days before, and after this, the sky had a white, thick, hazy appearance. The heat of the weather was very oppressive. Thermometer never under 90°, and after at 95° in the house, and 115° in the shade of the outside verandah.

22*nd May.*—Hot, thick, and cloudy, slight rain, wind, storm and thunder. Wind Westerly.

23*rd* ,, Cloudy and hot wind from the West.

24*th* ,, Dreadful heat, wind S. W.

25*th* ,, Ditto,

26*th* ,, Ditto, wind N. S. E. and W.

27*th* ,, Ditto, wind W. and N.

28*th* ,, Ditto.

29*th* ,, Ditto,

30*th* ,, Cloudy and windy, in gusts from the E., and cloudy.

31*st* ,, Ditto.

1*st June.*—Ditto.

2*nd* ,, *Ditto, clouds driving about in all directions,* and wind very gusty.

3*rd* ,, Cooler, cloudy, slight rain, wind S. E., cloudy.

4*th* ,, Rainy and cool strong S. E. wind, very gusty and cloudy.

5*th* ,, Steady rain in the morning, very cool S. E. wind, and strong Easterly in the evening.

6*th* ,, Cool and cloudy, East wind at, mid-day a strong, hot, damp Westerly wind set in.

7*th* ,, Strong Westerly hot, damp wind.

Patna. Latitude 25° 37′ *N. Longitude* 85° 15′ *E.*

From E. C. Ravenshaw, Esq. C. S.—" Observing in the papers that you wish to be informed of the places to which the storm of the 3rd instant did not reach, I beg to mention, that we had no storm at Patna, but only a slight fall of rain ($\frac{11}{100}$ of an inch) on the 4th from the East. On the 10th, however, we had a violent storm from the West, at 8 P. M.; it lasted about two hours. There was very little thunder, at least it was not very loud, but blew with great violence, up-rooting several trees in my compound. My pluviometer was upset and broken, so I cannot state the amount of rain, but it must have been two inches I think."

E. C. RAVENSHAW.

From Ghazeepoor, Latitude 25° 35′ *N. Longitude* 83° 33′ *E. by Lieut. Sherwill, Revenue Survey, on the Ganges between Cawnpoor and Dinapoor.*

30*th May,* 1842.—Steady Westerly wind in forenoon. In afternoon, strong East wind and cloudy.

31*st May.*—Strong East wind all day, and cloudy.

1*st June.*—Strong Easterly wind until 3 P. M., when the wind suddenly ceased, heavy clouds commenced rising in the West; at half past 3 P. M. a furious hurricane burst forth from the West, which lasted

for three hours; during the whole of the first hour, the atmosphere was perfectly darkened with dust and clouds, so dark, that *nothing* was visible, the hand was *scarcely* visible when held against the sky, the sky itself was barely discernible from the earth, so complete was the darkness. At 4 P. M. or one hour after the first commencement of the storm, heavy rain fell, the wind increased in violence, and the noise and roaring of this wind was perfectly awful and terrific; the water of the Ganges was driven far over low sand banks that a few minutes before had been perfectly dry. The hurricane, for I can call it nothing less, was at its height about 6 P. M., when it subsided as suddenly as it had commenced; all was then quiet and refreshed, for, before the commencement, the air was heavy, and the heat almost insupportable. The Manjee of my boat would not proceed, saying he was certain something was about to take place. I expected a return of the earthquake, which was felt at Cawnpoor, Dinapoor, and Chunar on the 21st May, 1842. The East wind set in again immediately the storm had passed away, and blew steadily all night; my position during the storm was about fifteen miles to the S. W. by W. of Ghazeepoor. At Ghazeepoor, the storm was seen travelling on the South bank of the river, (right bank,) distant a few miles to the South. It was seen about 4 P. M. travelling due East.

2nd June.—On the morning of the 2nd, the wind blew steadily from the East until 11 A. M., when it increased and blew a heavy gale for one hour; at noon it veered round to the North, and continued blowing a steady stiff breeze till sun-set, when it failed entirely.

3rd and 4th June.—Fine weather, moderate East wind and showers.

5th June.—Steady East wind; at 7 P. M. a furious Easterly gale set in, which blew for two hours. Heavy lightning to the N. W., where was collected a heavy bank of clouds, which disappeared during the night. I was then about fifteen miles to the S. E. of Ghazeepoor.

6th June.—At noon, a heavy Northerly gale commenced, and blew for two hours. The wind was excessively boisterous, the heavens overast with dark clouds. Position about ten miles North of Ghazeepoor.

7th and 8th June.—Steady Westerly wind all day, fine weather.

W. S. SHERWILL, *Lieut. R. A.*
Surveyor.

Journal kept at Lehra, in the Goruckpoor district. Latitude about 27° 0′ *N. Longitude* 83° 30′ *E.*

1*st June.*—At daybreak a few clouds in the North, 8 A. M., rain from the North ; thunder and lightning and heavy rain. Noon cloudy, slight rain at intervals, light E. wind. Evening fine, with many clouds, light E. wind.

2*nd June.*—Light showers during the past night. Morning steady rain, light E. wind. Noon, cloudy. Evening fine, with a few clouds

3*rd June.*—Light Easterly wind, a few clouds, very sultry.

4*th June.*—Wind East, but scarcely perceptible all day. Morning, a few clouds. Noon cloudy. Evening, nearly cloudless.

5*th June.*—Rain during the past night. Morning, heavy rain. Noon cloudy. Evening nearly cloudless. Wind East all day, but so slight, as to be hardly perceptible.

6*th June.*—Heavy rain during the latter part of the past night. Morning, cloudy. Noon and evening, a few clouds, light East wind all day.

7*th June.*—To the 20th; the wind was almost without exception Easterly and light, the weather more or less cloudy, and a few drops of rain occasionally fell. From the 3rd to the 20th, the heat was very oppresssive. The last was a day of nearly continued rain.

Allahabad. Latitude 25° 27′ *N. Longitude* 81° 50′ *E. Lieut. Chamier, Ordnance Department.*

I should observe, that this account is from *memory ;* you will therefore be able to estimate its value, and reject it, should more authentic accounts reach you from this station. I have added an extract from my register of the Thermometer (Fahrenheit's,) in case it should be of any use.

Memo.—On the morning of the 2nd instant, about 8-30, large masses of clouds formed in the N. W., and came rolling up in a S. E. direction. About 9, the wind blew with considerable violence from the N. W., and so darkened the air by raising the dust, that it was impossible to see across the room. In half an hour, a heavy shower of rain fell ; the wind gradually subsided, and by 11 o'clock A. M., the storm had cleared off. A few small trees were blown down, but I have not heard of any other damage being done. Since the storm, the wind has remained pretty steady at W. and N. W.

Register of the Weather, Koorsun Factory, left of the Ganges, and 2½ miles North of Allahabad Powder Works, June 1842; *from J. Kelly, Esq.*

Date.	Sunrise.		Noon.		3 P. M.		Sunset.		
	Fahrenheit.	Adie's Sympiesometer.	Fahrenheit.	Sympiesometer.	Fahrenheit.	Sympiesometer.	Fahrenheit.	Sympiesometer.	
	° ′		° ′		° ′		° ′		
June 1st	94.30	29.84 Moderate	99.0	29.64 Calm	101.0	96.60 Variable	98.0	13.74 Moderate	A. M. N. Easterly breeze, calm at times 2 P. M. light Wsly. wind for ½ an hour. 3 30 a heavy sand squall from N. E., remainder moderate and cool, cloudy throughout
,, 2nd	95·0	.86 Light	83.30	.94 Moderate	89.0	.94 Light	90.0	.88 Light	Cool N. Easterly breeze during the night. 9 A. M. a smart squall from N.W. with thunder and heavy rain, continuing till near 1 P. M. remr. N Easterly light wind, cloudy throughout.
,, 3rd	90.0	.96 Calm	92.0	.96 Light	93.30	.86 Variable	93.30	.84 Calm	First and latter parts calm, middle variable light wind N., towards East cloudy weather.
,, 4th	92.0	.98 Vble. Nly.	94.0	.88 Variable	94.30	.76 Vble. Wly.	94.0	.74 Variable.	Light wind throughout, varying between W. round by N. to N. E., cloudy weather.
,, 5th	89.30	.98 Light	95.0	.84 Light	98.0	.72 Light	97.0	.70 Light	Westerly light breeze throughout, during afternoon some distant thunder.
,, 6th	93.30	.96 Variable	93.0	.86 Light	92.0	.30 Light	93.0	.96 Calm	Variable light airs and calm at times, cloudy weather.
,, 7th	95.0	.88 Light	95.0	.78 Strong	98.0	29.72 Strong	98.0	.74 Light	Westerly wind throughout, 1st and latter parts light, middle strong breeze, cloudy weather.

☾ .... 1st at 0 44 P. M.
● .... 9th ,, 4 07 A. M.
☽ .... 15th ,, 10 45 P. M.
○ .... 23rd ,, 3 15 A. M.
} From Rushton and Co.'s Almanac, which differs somewhat from the others.

Note.—The Sympiesometer is kept in a small office room 16×16, built due East and West, with doors on each side, and the instrument is placed on the Southern wall.

Extract from the Meteorological Register, kept at the Lucknow Observatory, Latitude 26° 51′ 18″, Longitude 80° 58′ 35″, from Major Wilcox, Astronomer to His Majesty the King of Oude.

Month and Day.	Barometer.		Thermometer.			Direction and strength of the Wind (by Lind's Wind-gauge), Description of Clouds and General Remarks.
	Mean Height.	Mean Temp. of Merc.	Mean of Standr.	Mean of Dry.	Mean of Wet.	
	°	°	°	°	°	
May 28	29.332	93.2	98.7	99.3	75.4	The general direction of the wind was from the N. W. Sky covered with cumuli, and atmosphere thick with dust.
,, 30	29.262	94.4	98.5	99.0	78.8	Easterly wind till 11 A. M. and since then Northerly. Sky clear throughout the day.
,, 31	29.206	95.4	98.0	98.6	79.4	The wind variable between 1 A. M. and 3 A. M. and blowing fresh. From 5 A. M. its direction was altered to the E.; its average strength .05, clear sky in the evening, dusty towards the horizon.
June 6	29.116	92.7	94.3	96.0	79.8	The wind variable between 1 A. M. and 9 A. M. blowing from the E., E. N. E., N. E., S. E., and N. W,, but from 11 A. M. it changed to the W.; its average strength 05. Cloudy day.
,, 7	29.122	93.3	97.6	99.0	76.5	The wind variable, blowing from 1 to 3 A. M. from the S. W.; from 5 A. M. to 3 P. M. from the W.; and since then North-westerly and Westerly; its average strength 13. Cloudy day.
,, 8	29.205	92.8	105.9	98.4	75.4	The general direction of the wind was from the W., excepting between 11 A. M. and 1 P. M., which was North-westerly, cloudy day.

Date and Time of Observation. Civil.	Barometer.		Thermometer.			Wind.		Cloud.		Remarks.
	Height.	Temp. of Merc.	Standr.	Dry.	Wet.	Direction.	Strength	Mass (1--10)	Description.	
June 1st	°	°	°	°	°					
0 48 m	29.160	95.3	92.8	92.8	79.9	E.	.05	...	....	Clear.
*2 57	132	93.8	90.7	91.2	78.8	E.	.05	5	Cirri.	
4 44	125	92.5	88.8	89.6	78.4	E.	.03	5	Thin cir. cum.	
6 44	148	90.7	88.1	89.0	78.6	E.	.20	6	Cirri & cir. cum.	
8 44	160	93.0	92.8	94.4	80.3	E	.15	...	A few cirri.	
10 45	164	95.9	98.0	99.4	81.4	E.	·15	5	Cirri & cir. cum.	Atmosphere thick with dust.
P. M.										
0 44	135	96.9	100.3	99.8	82.0	E.	.20	8	Cirri & cir. cum.	Ditto ditto ditto.
2 45	099	96.8	97.3	98.2	79.7	E.	.20	...	....	Overcast with dust.
4 44	069	96.0	96.1	97.1	79.0	E.	.10	...	....	Somewhat obscure with dust, towards the horizon.
44	103	94.7	92.5	93.0	77.3	E.	.08	...	....	Ditto ditto ditto
8 44	138	91.3	88.5	89.4	76.0	E.	.10	3	Cumuli, ...	Clouds to the E. and wind blowing in gusts.
10 47	188	91.0	87.5	88.0	77.2	E.	.10	3	Cumuli, ...	Ditto ditto ditto.

* N. B.—The hour is reduced to Civil time. Observatory is about 360 feet above the level of Calcutta, the average difference of height of the Barometrical columns at the two places is·380.

Extract from the Meteorological Register, kept at the Lucknow Observatory.

Date and Time of Observation.	Barometer. Height.	Barometer. Temp. of Merc.	Thermometer. Standr.	Thermometer. Dry.	Thermometer. Wet.	Wind. Direction.	Wind. Strength	Cloud. Mass (1—10)	Cloud. Description.	Remarks.
June 2d										
h. m.	o	o	o	o	o					[from the E.
0 46	29.128	90.4	86 2	87.0	76.2	E.	.15	10	Cumuli, ...	Lightning flashing
2 45	142	90.3	85.2	86.0	77.2	E.	.05	8	Cumuli.	
4 45	150	89.5	83.4	83.8	.....	E.	.05	.....	... ...	Clear.
6 45	195	89.3	83.7	84.7	.....	E. S. E.	.08	9	Cirro-cum. to the N. or E. & nimbus to the W. & S. ...	Thunder, with a few drops of rain.
8 45	260	89.1	85.7	86.5	76.2	E.	.15	10	Cumuli.	
10 45	223	89.6	85.3	86.1	76.2	E.	.15	10	Cumuli.	
P.M 0 45	234	89 0	86.4	87.2	76.9	E.	.10	10	Cumuli.	
2 45	174	90 5	87.0	88.2	78.2	E.	.05	10	Cumuli.	
4 44	148	90.7	89.2	90.3	77.6	E.	.02	10	Cumuli.	
6 44	140	90.7	88.0	88.6	78.0	E.	.03	8	Cirri, cirro strati and cumuli.	
8 47	187	89.6	86.7	87.0	77 3	E.	.02	7	Cumuli and cum.	
10 45	192	88.5	85.8	86.3	77.8	E.	0	10	Cirri. [strati.	
June 3d										
0 45	29.174	88.0	85.2	85.7	78 0	E	0	9	Cumuli & cirri.	
2 47	178	87.4	85.0	85.6	77.7	E.	0	8	Cumuli & cirri.	
4 45	178	87.3	84.5	84.6	77.8	E.	.02	8	Cumuli & cirri.	
6 45	204	88.0	84.8	86.0	78.1	E.	0	9	Cirro cumuli.	
8 45	250	90.0	88.4	90.0	79.0	E.	.01	10	Cirri.	
10 44	246	91.0	87.4	89.5	80.2	S. E. S.	.02	7	Cirri, cirro cumuli & cumuli.	
P.M 0 47	202	91.8	91.2	92.7	81.7	E.	.02	7	Cum. & cir. cum.	
2 46	146	92.0	94.1	96.2	81.3	E.	.02	5	Cumuli.	
4 45	114	91.8	95.2	95.8	81.4	S. E.	.02	6	Cumuli.	
6 44	120	92.1	93.7	94.5	80.3	E.	.02	6	Cumuli.	
8 45	146	91.4	90.1	90.4	79.8	E.	.02	.....	... ...	Clear.
10 45	176	91.7	88.4	88.2	80.4	E.	.01	.....	... ...	Clear.
June 4th										
12 46	29.150	91.2	86.7	86.6	80.5	E.	.02	.....	... ...	Clear.
14 45	142	90.2	85.6	85.5	79.4	E.	.02	.....	... ...	Clear.
16 45	138	88.8	84.8	85.2	79.1	E.	.02	.....	... ...	Clear.
18 45	151	88.2	86.8	88.4	80.4	E. S. E.	.05	.....	... ...	Clear.
20 45	176	91.4	91.7	94.0	81.0	S. E.	.03	.....	... ...	Clear.
22 45	175	93.5	96.3	98.1	80.5	S. S. W.	.10	3	Cirro cumuli.	
0 47	135	93.0	98.8	100.7	.....	E. S. E.	.07	7	Cirro cumuli and cumuli.	
2 46	083	93.2	101.6	103.1	80.8	S	.06	8	Ditto ditto.	
4 46	079	94.0	95.2	95.9	81.4	E. N. E.	.05	10	Cumuli.	
6 44	084	93.3	93.1	93.5	80.4	E. S. E.	.08	7	Cirro-cum. &cum.	
8 44	138	92.0	89.7	90.2	79.2	E. S. E.	.05	10	Ditto ditto.	
10 44	188	91.2	89.5	90.2	79.0	E. S. E.	.05	10	Ditto ditto.	

Mean height of the Barometer during the week previous to the storm, 29.332.

R. WILCOX

Agra. Lat. 27° 12′ *N. Long.* 77° 56′ *E. from Dr. Balfour, Surgeon to the Hon'ble the Lieut. Governor of the N. W. Provinces.*

	Day of month.	Thermometer at 9 30 A. M.	Sympiesometer at do.	Wind at do.	Thermometer at 4 P. M.	Sympiesometer at do.	Wind at do.	
		°	°		°	°		
May.	28	91½	23.08	W. N.	93	28.91	NW.	During three days nothing very remarkable in the weather, the ordinary hot wind of the season blowing.
	29	92¼	,, 03	N. W.	94½	,, 87	NNW	
	30	93	,, 00	N. W.	94½	,, 84	NW.	
	31	94	28.91	N. W.	95	,, 74	NW.	
June.	1	94½	,, 82	N. W.	96	,, 62	NW.	1st. Wind very strong and rather gusty, almost a gale, during the night shifted to East and blew fresh; 9 30 of 2nd wind at South, shortly afterwards backing to East, at which it continued steady.
	2	94	,, 86	S.	94½	,, 73	E.	
	3	93	,, 89	E.	93¾	,, 75	Ey.	3rd. Cloudy during forenoon.
	4	98½	,, 85	Ey.	94	,, 70	NWy.	5th. Cloudy and rain drops in morning; at 5 P. M. wind to S. with squalls and again settled at Westward.
	5	93¼	,, 83	W.	94½	,, 72	W.	6th. Shower for two minutes from N. W. at noon.
	6	93¼	,, 86	S. W.	94	,, 72	W.	

The temperature is taken in a room, where is neither punka nor tatties; the direction of the wind in the tables is that at the time of observation, and may not be correct to a point, but it is nearly so. Of the shift on the night of the 1st, I can give no further account than I have entered in my notes. I was struck with it at the time as curious, succeeding to such a strong N. W. wind with a falling glass.

I commence the tables from the 28th ultimo, to shew the steady fall of the Sympiesometer. On that day it stood at the average for the month; viz. 29° 08′ A. M., and 28° 93′ P. M., the day before, however, it was as high as 29° 04′, and after the 6th, it continued to rise till the 11th, when it reached 29° 15′, and has since gradually fallen to about 29, indicative I hope of the approach of the rains. As Agra is about 500 feet, (I believe) above the sea, allowance must be made for that height in comparing these tables with others; to aid this, I give the average for the month of April here compared with the same in Calcutta; should a longer series of averages be desirable, I can give you the same for two years nearly.

	Morning.	4 P. M.
Agra,.....	29° 15′.....	29° 01′
Calcutta, ...	29° 74′.....	29° 65′
Diff.....	—.59′	— .64′

JOHN BALFOUR,
Assist. Surgeon, Agra.

Dadoopoor in the Protected Sikh States. Latitude 30° 12′ 12″ *N. Longitude* 77° 23′ 45″ *E., from* 28*th May to* 6*th June,* 1842. *From Capt. W. E. Baker, Engineers.*

The height of Dadoopoor above the level of the sea is from 900 to 1000 feet, but in consequence of a small quantity of air having got into the barometer tube, a correction of +0.083, should be applied, besides that for temperature and elevation.

W. E. BAKER,
Bengal Engineers.

Extract of the Meteorological Register kept at Dadoopoor, from 28th May to the 6th of June 1842.

Dates.	At Daybreak.					At 10 A. M.					At 4 P. M.					At 10 P. M.					Remarks.
	Barometer.	Thermometer. Attached.	Detached.	Wet Bulb.	Rain Gauge.	Barometer.	Thermometer. Attached.	Detached.	Wet Bulb.	Rain Gauge.	Barometer.	Thermometer. Attached.	Detached.	Wet Bulb.	Rain Gauge.	Barometer.	Thermometer. Attached.	Detached.	Wet Bulb.	Rain Gauge.	
1842.		°	°	°			°	°	°			°	°	°			°	°	°		
May 28	28.722	85 0	84 0	78 0	0 0	28.762	101 0	100 0	85 0	0 0	28.630	108 0	107 0	85 0	0 0	28.626	94 0	93 0	83 0	0 0	Clear light variable wind.
,, 29	28.602	84 0	83 0	75 0	0 0	28.684	105 0	104 0	88 0	0 0	28 602	110 0	109 0	88 0	0 0	28.602	93 0	92 0	80 0	0 0	Do. do. N. W. do.
,, 30	28.594	84 0	83 0	77 0	0 0	28.672	100 0	99 0	85 0	0 0	28.582	114 0	110 0	87 0	0 0	28.590	94 0	93 0	78 0	0 0	Do. do. variable do.
,, 31	28.542	82 0	81 0	74 0	0 0	28 616	103 0	102 0	88 0	0 0	28.482	111 0	112 0	88 0	0 0	28.464	94 0	92 50	81 0	0 0	Do. do. do. do.
June 1	28.486	86 0	85 0	80 0	0 0	28.506	102 0	101 0	89 0	0 0	28.382	112 0	110 0	91 0	0 0	28.424	91 0	90 0	83 0	0 0	Do. do. do. do.
,, 2	28.494	85 0	84 0	78 0	0 0	28.564	93 0	92 0	83 0	0 0	28.492	106 0	105 0	89 0	0 0	28.508	89 0	88 0	83 0	0 0	Do. strong Easterly do.
,, 3	28.520	83 0	82 0	79 0	0 0	28.580	96 0	95 0	83 0	0 0	28.452	106 0	105 0	82 0	0 0	28 570	91 0	90 0	85 0	0 0	Do. light do. do.
,, 4	28.462	86 0	85 0	82 0	0 0	28.520	99 0	98 0	88 0	0 0	28.402	109 0	108 0	86 0	0 0	28.432	93 50	92 0	85 0	0 0	Do. do do. do.
,, 5	28.402	84 0	83 0	81 0	0 20	28.484	93 0	92 0	85 0	0 0	28.410	104 0	103 0	81 0	0 0	28.440	92 0	91 0	85 0	0 0	A M. Lt. Easterly wind. P. M. a squall from N. W. with a shower.
,, 6	28.486	87 0	86 0	82 0	0 0	28.510	67 0	96 0	88 0	0 0	28.420	105 50	104 50	84 0	0 0	28.444	95 0	93 0	87 0	0 0	Clear light N. W. wind.

N. B.—The Thermometer has ranged in the house under tatties from 16th of May to 6th of June 1842, from 90° to 96°, and was generally above 92°, and the previous four years it was generally between 86° and 88° till the setting in of the rains.

WILLIAM DAWE, *Conductor,*
Delhi Canal Department.

Almorah. Latitude 29°-35′ *N. Longitude* 79° 40′ *E. from J. H. Batten, Esq. Assistant Commissioner of Revenue, Kemaon.*

This valuable and graphic account of what seems to be the ultimate effect of the storm, which I owe to the polite attention of Mr. Batten, will be perused by the Meteorologist with much interest.

" As storms are frequent in the hills, (though this year has been excessively dry,) and the great rains are generally preceded by the " chota bursât" at the end of May or beginning of June, I did not make any particular observations at the time of your storm; but as the smallest information as to the weather at that period would appear to be valuable, I beg to send you these few lines.

" The weather at Almorah, during all May, was unpleasantly warm *for the hills.* Up to the 18th May, the Thermometer in the house shewed a maximum heat of 75°, and a minimum of 73°, and I often saw the mercury at noon day 74°, and at midnight still standing unmoved at 74°. After the 18th, the heat began to increase, and from that day till the 30th, the minimum height of the mercury was 75°, and the maximum was sometimes, though rarely, as high as 80°; but for the greater number of days it attained to 77°. On the 21st, there occurred a dry North-wester at evening, and from the numerous ploughed fields which surround the station, arose a regular storm of dust, such as is seen on a larger scale in the plains. During the whole month, the atmosphere was unusually thick and hazy, and the mountains, only two miles distant in a horizontal direction, were obscured from view. During the hot dry weather in the hills, this hazy appearance is usual, and whenever the haze becomes very thick indeed, *at the horizon,* rain may generally be expected to follow. Here and there slight rain did fall, and the appearance of the clouds, piled up in cumuli at the horizon from S. E. to S. W., from which a constant scud issued and passed over towards the Snowy range, was highly electrical. During the last week of the month, the wind which had been at S. W., with dry N. Westers occurring nearly every evening, changed to the N. E., E., and S. E. On the 30th and 31st, the weather was very sultry, and the haze extraordinarily thick. On the 31st, from 4 P. M. to 6 P. M., there was a fine fall of rain, the wind veering from N. W. to N. E. On that evening, the Thermometer in the house fell from 80° to 72°; and in the verandah it was as low as

70°; the mists now began to flit on the hill sides. Wednesday the 1st of June was very sultry, the Thermometer in the house 80°, all day sky cloudy, and the near atmosphere hazy to a degree. At 8 P. M. the wind became a gale from the N. W., and brought with it a flood of rain, which lasted for two hours with tremendous violence, excavating deep ravines in the hill side, and changing the shallow mountain streams into deep and tumultuous torrents. The 2nd and 3rd were cloudy without much wind, and a fine shower of rain fell on each day. Maximum of Thermometer 75° in the house, wind veering from S. W. to N. W., and round by N. to E. Saturday the 4th was a very sultry, and hazy day, but from 9 P. M., the wind blew with *great violence* from N. E. to S. E., lightning vivid, with constant loud thunder, and rain fell in torrents. The weather cleared at 10 A. M. on the 5th, and from that time till yesterday, the 15th, there only occurred at Almorah, (to which place my observations are strictly confined,) one smart shower on the afternoon of the 10th; the sultry haze returned with strong W. and S. W. winds, and the Thermometer latterly attained to a height of from 77° to 81° in the house. At last, yesterday the 15th, the heat seemed to have attained its climax. But as the scud of clouds still continued to be blown strongly from the *West*, I hardly expected rain, though the lightning was vivid from heavy cumuli at the S. E. corner of the horizon. Between 8 and 10 P. M., however, the wind changed to N. W. and round by N. and N. E. to E. and S E., and at the latter hour *the rains* set in with a vengeance. Thunder and lightning all night, with strong winds and constant pouring of water from the heavens. To-day the rain is steady, and the misty clouds are rolling about the hills, and into the windows. Thermometer at noon in house 72°. My house is the lowest in the station, and is about 5,260 feet above the sea. Common Barometers with the usual scale of degrees, are of course of no use here.

I see by the Delhi Gazette of the 11th, that on the 3rd instant there was no storm at Bareilly, and that a heavy storm without rain occurred at that place on Wednesday the 1st, and that the rainy weather which we had up here was, from the appearance of the sky, suspected. I also perceive, that the Bareilly correspondent of the Delhi Gazette describes the height of the Thermometer on the 30th ultimo as 96°, with tatties and punkahs; so that even with our usual

heat, at that time at Almorah, there was a difference in our favor of 15 degrees. The highest point of ground in the Cantonments of Almorah is, I may mention, about 5,500 feet above the sea.

J. H. BATTEN.

STORM REPORT, Deesa near Poonah, 4th July 1842.

Extract from the Meteorological Register, 2nd or Queen's Royal Regiment, for June 1842.

Date.	Hour.	Ther.	Wind.	Weather.
		°		
June 1	6 A. M.	86	S. W.	Morning overcast; watery to the S. W., soft breeze.
,,	3 P. M.	98	S. W.	Mid-day, fresh breezes
,,	6 P. M.	97	S. W.	Clear (fresh or strong breezes may be here supposed.)
,,	9 P. M.	96	West	High winds with dust.
,, 2.	6 A. M.	86	South	Overcast, fresh soft breeze with watery fleecy clouds.
,,	3 P. M.	97	South	High winds, with volumes of dust.
,,	6 P. M.	95	S. W.	Ditto.
,,	9 P. M.	92	N. W.	Fresh breezes and clear.
,, 3.	6 A. M.	87	South	[clouds. Few drops of rain at 4 A. M., overcast watery bank and
,,	3 P. M.	97	South	Fresh breezes, (cloudy may be here supposed.)
,,	6 P. M.	97	South	Squally, clouds to the Southward
,,	9 P. M.	93	South	*Hard gales and squalls,** with heavy dark clouds and [volumes of dust.
,, 4.	6 A. M.	86	South	Fresh breezes and cloudy.
,,	3 P. M.	96	S. W.	Ditto.
,,	6 P. M.	95	South	Banks.
,,	9 P. M.	94	S. E.	Strong gales and clear.
,, 5.	6 A. M.	86	South	Fresh breezes and cloudy.
,,	3 P. M.	98	South	Strong breezes and cloudy.
,,	6 P. M.	97	South	Light banks.
,,	9 P. M.	94	South	Strong gales.
,, 6.	6 A. M.	86	South	Strong breezes, and very cloudy.
,,	3 P. M.	96	South	Ditto ditto.
,,	6 P. M.	96	South	Banks and clouds.
,,	9 P. M.	92	S. W.	Strong gales.
,, 7.	6 A. M.	86	S. W.	Fresh soft breezes, and very cloudy.
,,	3 P. M.	95	S. W.	Strong breezes.
,,	6 P. M.	94	S. W.	Thick dust, haze, strong breezes
,,	9 P. M.	91	S. W.	Fresh gales.

Full Moon.—From this period the wind continued in the S. W. for more than a week, with the usual weather of the season.

R. B. A. HUNTER,

Assistant Surgeon, in Medical charge 2nd or Queen's Royal Regiment.

N. B.—The direction of the wind not to be depended upon *exactly to a point*, and any change of direction between the periods of observation not noticed.

During the hot season, high winds from the S. and S. W. always darken the air, more or less, with dust, and particularly at the commencement of the S. W. monsoon.

* This was so heavy, that we entertained great fears at the time for the Shipping in Bombay and on the East coast.

The late Storm at Calcutta.

TO THE EDITOR OF THE BOMBAY TIMES.

Sir,—Mr. Piddington of Calcutta being very anxious, it appears, to obtain all the information he can, relative to the state of the weather in all parts of India, about the period of the recent storm, I beg to furnish him, through your journal, with the following notes from my Weather-Book, and only regret that they are not more detailed:—

State of the weather at Chowpatty, (3 miles from the fort of Bombay,) from the 1st to the 6th of June 1842.

1*st. June.*—Morning, sky overcast; temperature very sultry; wind, N. W.—Day cloudy and hot.—Evening, sky overcast; sultry; wind N. W.

2*nd June.*—Morning, sky overcast; wind N. W.—Day very hot and oppressive; hazy and cloudy. Thermometer 90° at 12 o'clock. —Evening, sky overcast; black and lowering appearance in the S. W. quarter; wind blowing strongly from N. W.

3*rd June.*—Morning, sky overcast; wind N. W.—Day hot, cloudy and hazy.—Evening, sky overcast; wind N. W.—A heavy shower of rain fell in the fort district last night.

4*th June.*—Morning, sky overcast; a slight shower of rain after 5 o'clock; wind N. W.—Day hot, cloudy and hazy.—Evening, cloudy; wind N. E. temperature very sultry; a few small showers of rain. Some rain fell last night.

5*th June.*—Morning, sky overcast; sultry; wind N. W.—Day hot and cloudy, with a thin haze; a few showers of rain.—Evening, cloudy and very sultry; wind N. E.

6*th June.*—Morning, sky overcast; sultry; a little rain; wind easterly.—Day, very hot. Thermometer 92 degrees at 2 o'clock.— Evening, cloudy; fine showers of rain; temperature oppressively close and sultry; wind N. W.

The most remarkable change observed by me during the above period, was that of the wind, which was North-westerly during the mornings, till the 5th; when it veered to the East—its usual direction at that time of the day; and this circumstance, as well as its blowing

for two evenings, (the 4th and 5th,) from the North East, led me to anticipate, in common with others, a serious disturbance to the equilibrium of our atmospheric system.

Your's obediently,

Chowpatty, 22d June, 1842. BOREAS.

The Calcutta Hurricane of the 3rd and 4th June, 1842.

When we promised in our last to revert to this subject, we were under the impression, that we should have been able to lay our hands on a larger body of facts, to have placed beside those supplied by Mr. Piddington, than that wherewith we have as yet had it in our power to supply ourselves: we despair not as further returns come in, yet to obtain information bearing on that collected at Calcutta. We subjoin an extract from the register of the Bombay Observatory for the 2nd, 3rd, 4th, and 6th of June,—the 5th being Sunday, when no observations were made. On the 1st, the Barometer had not departed from its usual average. On the 2nd, it had fallen somewhat, but that not much; and it was on the morning of the 3rd that it first began to assume symptoms of extreme irregularity. This state of matters continued all over the 4th. By the 6th, the instrument had assumed its ordinary monsoon level. As formerly stated, the belief amongst the natives was universal, that a tempest might be looked for about the 5th; nothing came, however, and the falling of the instrument was generally, and too correctly, assumed to have been occasioned by a tempest raging at a distance.

Barometer uncorrected.

Time.	2nd.	3rd.	4th.	6th.
6 A. M.	29.608	29.596	29.530	29.610
7	.630	.618	.560	.620
8	.656	.634	.572	.638
9	.660	.640	.592	.656
9½	.664	.636	.592	.660
10	.664	.636	.592	.664
10½	.656	.636	.592	.664

Time.	2nd.	3rd.	4th.	6th.
11	29.650	29.616	29.592	29.664
0	.636	.616	.580	.656
1 P. M.	.620	.608	.570	.644
2	.612	.594	.548	.630
2½	.608	.586	.542	not obsd.
30	.600	.576	.540	ditto.
3½	.600	.576	.532	ditto.
4	.600	.560	.532	ditto.
4½	.600	.558	.532	.616
5	.596	.552	.536	.616
5½	.600	.558	.538	not obsd.
6	.608	.558	.532	.624
7	.614	.560	.532	not obsd.
8	.624	.572	.562	ditto.
9	.626	.580	.562	ditto.
9½	.620	.576	.562	ditto.
10	.620	.576	.562	ditto.

[*Bombay Times, June* 22, 1842.

Lohurduggah, Ramghur district. Latitude 23° 28′ *N. Longitude* 84° 50′ *E.*

" The storm of the 3rd did not reach this length. We had a few puffs of wind all round the compass, with tolerably heavy showers all day, but nothing more."

22*nd June,* 1842. T. M. TAYLOR.

Sumbulpoor. Lat. 21° 33′ *N. Long.* 83° 47′ *E. from Messrs. Willis and Earle, Calcutta, June* 24, 1842.

In a letter of June 20th, received this day from Mr. C. L. Babbington of Sumbulpore, in answer to some inquiries made of him in our letter of the 15th instant, he says,

" With regard to the late gale we did not experience its effects here. The rains were ushered in on the 1st instant, also on the 2d and 4th by the usual North-westers, which only lasted a few hours

each time, and nothing particular in the state of the atmosphere, except that the rains did not set in with the usual masses of white clouds, which generally collect for three days previous, but merely as though a heavy shower might be expected."

JAS. WILLIS.

For the sake of easier and comparative reference, I have now, as in my former memoirs, arranged in tables, abbreviated notices of all the effects of the storms which the logs and reports offer, from about the middle of the Bay to Monghyr, Purneah, Dinagepore, &c. where the different storms appear to have broken up, and to have only been felt in those squalls of one or more hour's duration, which are called North-westers, North-easters, &c., according to the quarter from which they come. I have not carried the tables beyond the limits of the true rotatory storms, not considering it worth while to do so, and as rather complicating them for purposes of reference. In the summary which follows them, where the storms are tracked in detail, and the facts and arguments upon which the various results are founded are alluded to, and laid down, farther reference to that portion of the documents which relates to those places which were out of the limits of the storm will be made.

Tabular View of the Calcutta Hurricane, of 2nd and 3rd June 1842.

In the Bay of Bengal.

Date. and Time.	Name of Place or Ship.	Winds and Weather.	Lat. N.	Lon. E.	Bar.	Ther.	Simp.	Remarks.
Noon 28th May, 1842.	Brig Algerine, ..	Variable dark masses of clouds and threatening weather. *	° ′ 10 4	° ′ 92 26	28.60	..	..	Preparing for bad weather.
	Barque Ariel, ..	A. M. heavy squall N. E. to W. Noon continually veering as per Log.	13 57	89 42	29.49	89	..	P. M. Continual veering, N. E. to S. W. Bar. 29.49 to 29.59, preparing for bad weather.
	Barque Augustus,	Easterly and light to S. East, fine weather.	19 16	85 53	29.58	..	..	Saw Manickapatam Pagoda N. W. by N.
	Barque Norfolk,	Light winds and fine.	19 40	88 5	.. ..	..	..	
	Barque Jno. Wm. Dare, ...	Calm and clear, ...	20 32	.. ..	.. ..	..	..	Current to N. E.

Western Coast of the Bay, from Madras to Kedgeree.

At Balasore, ...	No wind, air very oppressive. P. M. light airs from S. E.	....	9 A. M. 29.69 3 P. M. 0.65 5 P. M. 0.60	88° 90 89½	

* See Captain Buckton's letter at page 977.

In the Bay of Bengal.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat. N.	E.	Bar.	Ther.	Simp.	Remarks.
Noon 29th May, 1842.	Augustus, ...	Noon light breezes and calms. P. M. moderate N. Easterly. Midnight fine, ...	° ′ 19 39	° ′ 86 18	29.57	..	..	Off Black Pagoda.
	Panthea, ...	Calms and light Northerly airs, ...	18 54	.. ..	.. ..	..	..	Long. about that of Augustus.
	Jno. Wm. Dare,	Light and moderate N. E. to N. E. by E. ..	19 56	.. ..	29.50	..	..	Freshening at midnight.
	Algerine, .. .	Increasing steady gale from S. S. W. to S. W. by W. heavy appearance, ...	10 45	91 20	28.70 28.56			
	Ariel, ...	Strong gales, heavy rain, sea, thunder and lightning. Wind variable from N. to West. P. M. the same, ...	13 59	90 07	29.44	88	..	Wind West to W. S. W. at midnight.
	Barque Norfolk,	Steady breeze N. E. & N. by E. to midnight,	18 32	87 15	.. ..	..	..	Midnight squally.

Western Coast of the Bay, from Madras to Kedgeree.

At Balasore, ...	Very close indeed as yesterday, light airs N. E. and cloudy, ..	.. ..	9 A. M. 29.70 3 P. M. 0.64 5 P. M. 0.60	$88\frac{1}{2}$° $90\frac{1}{4}$ 90	

Date.	Name of Place or Ship.	Winds and Weather.	Station.	Bar.	Ther.	Remarks.
28th and 29th May 1842.	H. C. P. V. Coleroon,	Light winds and fine weather. Wind on 28th from E. b S. increasing. ..	Floating Light of Eastern Channel E. bS. in 7 faths. water.	29.86 Noon 29.88 4 P. M. 77	..	A Westerly set, on 28th P. M.
	H. C. P. V. Megna...	The same; threatening from Eastward on 28th, latterly fresh from NE. to N. N. E.	At anchor Kedgeree Green 6½ fathoms a breast of Flagstaff.			
	H. C. P. V. Cauvery,	Light breezes NE. to ESE. 8 P.M. 29th cloudy and lightning to the SW.	Cruising off False Point 25 to 37 fms.			
	H. C. P. V. Saugor,	28th, Calms throughout the day, light airs SE. to S. S. W. At night 29th fine, and moderate winds from SE. to E. throughout, ...	Outer Floating Light E. by N.			
	H. C. F. L. V. Beacon.	29th, Light airs first part. Midnight fresh breeze E. S. E.	.. .. ..	P. M. 29.65 Noon .71 P. M. .50		
	H. C. F. L. V. Hope.	The same.	.. .. ..	A. M. 29.55 Noon 29.55 29.55	88° 88 88	

Date.	Vessel's Name.	Winds and Weather.	Station.	Bar.	Simp.	Ther.	Remarks.
28th and 29th May 1842.	H. C. F. Light Vessel Beacon.	28th Light Southerly and S. S. E. winds and hazy. 29th, the same. P.M. fresh from S. E., thick and cloudy all round with drizzling rain.	.. .. ..	.. .. ..	.. ..	.. ..	28th Bar. A. M. 29.74. Noon 29.74. P. M. 29.64. 29th A. M. 29.65. Noon 29.71. P. M. 29.50.
	At Kedgeree 29th, ..	S. to N. E. 3 P. M. N. E. squall and change of weather.	.. .. ..	29.40			

From Kedgeree to Calcutta and Inland.

	Calcutta.*	Eastward, hazy, close. ..	.. ..	S.G. 29 617 .574	.. ..	92.4 94.9	28th. 29th.

* The object of this Table being to exhibit the state of the weather at different points, in reference to my summary at the conclusion, I have not entered in it the different observations made at Calcutta, and close to it, as at Garden Reach and on the River, but have given my own, and the observations made at the Surveyor General's Office, (distinguished by S. G.) only, with here and there a note from the detailed accounts given in the preceding pages.—H. P.

In the Bay of Bengal.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Ther.	Simp.	Remarks.
Noon. 30th May.	Augustus, ...	Moderate N. N. E. P.M. squally. At 9 N. E. heavy squalls & showers.	° ′ 19 1	° ′ 86 39	29.34	..	..	Strong S. Westerly current.
	Panthea, ...	A. M. Light P. M. Northerly breezes, hazy and lightning, ...	18 57	.. ..	.. ..	..	..	Not far from the Augustus.
	Jno. Wm. Dare,	To Noon N.E. b E. P. M. N. E. increasing to a gale at S. E. b. E. at 6. At 12 S. S. E.	17 57	.. ..	29.50 6 P. M. 29 30	..	..	Heavy cross sea ; at 8 P. M. hove to.
	Algerine, ...	Increasing steady gale S. S. W. to S. W. b W. heavy weather, ..	12 04	90 02	28.70 to 28.56			
	Ariel, ...	Day-light hard gales W.S.W. Noon more moderate. P. M. lying to, ...	13 39	88 58	29.41	..	..	Midnight W.S.W. more moderate, sea considerably fallen.
	Barque Norfolk,	Increasing N. N. W. Noon N. W. P. M. heavy squalls from N.W.	17 00	87 00	.. ..	..	..	Preparing for bad weather, steering to the Southward 6 knots.
	Brig Arethusa, ..	P. M. strong breezes SW.	.. ..	.. ..	.. ..	..	..	11 P. M. a heavy fall of the Barometer.

Western Coast of the Bay to Kedgeree.

Madras, ..	.. .. ..	.. ..	8 A. M. 29.75	89°
			4 P. M. 29.67	93
			10 P. M. 29.73	91
Balasore, ..	Light airs N. E. very heavy clouds to the Eastward. P. M. wind S. E.	.. ..	9 A. M. 29.63	
			3 P. M. .60	
			6 P. M. .58	

H. C. Pilot and Light Vessels.

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Ther.	Remarks.
30th May 1842.	H. C. P. V. Coleroon,	Fresh breeze E. by N. to E. S. E. with passing squalls. P.M. threatening a gale from the Eastward	At anchor 7 fathoms, Floating Light Vessel E. by S.	Noon 29.77 4 P.M. 29.73	..	Veered to 100 fathoms and made all snug.
	H. C. P. V. Megna,	N. E. to N. N. E. fresh breezes and rain, ...	At anchor at Kedgeree.			
	H. C. P. V. Cavery,	Day light a squall with rain E. S. E. Noon fresh N. E. breeze. 2 30 the rain from East. 3 P. M. to midnight blowing hard N. E., N. E. by N. and N. N. E. with frequent squalls and lightning to the East.	Conjong Bay N. N. W. to N. 32 fms. P. M. standing out to the East.	....	..	Unsettled threatening appearance all round, standing out to sea.
	H. C. P. V. Saugor,	Wind from the Eastward & a succession of squalls with rain throughout...	Noon out of soundings. Sea Horse W. N. W. 5 30 P. M. came to in 10½ fathoms. ..	....	..	P. M. not able to fetch the Coleroon *on account of the heavy set to the West,* came to in 10½ fathoms.
	H. C. L. V. Beacon,	Increasing with gloomy appearance to the Eastward from 8 A. M. At 4 P. M. strong wind E. to E. N. E. and N. E. hard squalls and dark to N. E. 8 P. M. to Midnight. Fresh at East and weather the same.	As before.	A. M. 29.62 Noon 0.62 P. M. 0.52	..	*Westerly set.*

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Simp.	Remarks.
30th May, 1842.	H. C. F. L. V. Hope,	Day light fresh E. S. E. 8 East. Noon E. to E. S. E. to sunset squally and drizzling rain. 8 P. M. to midnight the same.	....	....	..	Lightning to Sd. and Eastward at 8 P. M. heavy sea, riding with 105 fathoms.
	At Kedgeree, ...	E. to N. E. light squalls with rain, ...	....	29.35		

From Kedgeree to Calcutta, and Inland.

Calcutta,	....	East and S. East,	....	....	S.G. 29.546	92.5

In the Bay of Bengal.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Ther.	Simp.	Remarks.
Noon. 31st May,	Augustus, ...	8 A. M. fresh gales NE b N. to Noon. P.M. NE. veering to E. b N. by 7 and to midnight heavy squalls and much lightning, ...	18 38 N.	87 17	29.34	..	..	Black Pagoda to False Point,
	Panthea, ...	Freshening to a gale from N. N. E.	No obs.	..	..	..	..	Not far from Augustus.
	Jno. Wm. Dare,	2 A.M. South, 5 moderating, 10 increasing, noon wind about South. 1 P. M. SW. b. S. 11 P. M. S. b. W.	..	..	29.20	..	..	7 P. M. more moderate, heavy cross swell from W. S. W. to midnight.
	Algerine, ...	Steady increasing gale from S.S.W. to S.W. b. W. from 29th, ..	13 52	88 41	28.70 to 28.56	..	..	Heavy suspicious weather.
	Ariel,..	Moderate at times, but hard gales and squalls from W.S.W. ..	14 01	69 13	29.38	86	..	P. M. very heavy squalls, Bar. 29.38, lying to under storm staysails, midnight clearing a little.
	Barque Norfolk,	Heavy squalls N. W. Noon *veering from W. to North* till midnight.	15 20	88 10	..	..	..	Midnight cloudy and squalls.
	Brig Arethusa,..	Increasing from S.W. b. W. and S.W.	14 20	84 29	..	..	..	High sea breaking over the brig.

Western Coast of the Bay to Kedgeree.

Madras.	.. .. ..	..	8 A. M. 29.75	89°			
			4 P. M. 29.66	93			
			10 P. M. 29.73	93			
At Pooree,.. ..	Wind from the North, sky overcast.	..	.. ..	..	..	..	Very heavy rain.
			9 A. M. 29.54	86			
At Balasore, ..	N. East winds, cloudy and rain throughout,	..	.50	84			
			.48	84			

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Ther.	Remarks.
31st May, 1842.	H. C. P. V. Coleroon,	Strong breeze from E. by S. squally, rain and lightning in the latter part, ..	At anchor 7 fms. Fl. Light E. by S.....	29.77 4 P.M. 29.64	..	Heavy sea. At noon, Saugor P. v. S. W. ½ S.
	H. C. P. V. Megna,	Squally N. E. to East with rain, latterly fresh gales from East, ...	At anchor & aground to 10 A. M.	....	..	Threatening weather.
	H. C. P. V. Cavery,	A. M. Blowing hard at N. E. by N. and N. N. E., squalls, rain and heavy sea. 10 A. M. to Noon the same from the Northward. Dark squally weather, every appearance of a gale. Noon a gale at N., heavy squalls, rain, and sea. 2 P. M. gale increasing. 4 Blowing a hard gale and increasing, veering to N.N.W. with hard squalls, showers and heavy sea. 8 P. M. hard gale N. N. W. in heavy puffs, lightning to East & Southward. Midnight a hurricane for 3 hours from N. N. W. in hard squalls and rain; lightning to the Southward,	Hove to out of Soundings, off Conjong Bay, ...	....	..	Vessel laboring much, hove to under close reefed main topsail and fore topmast staysail.
	H. C. P. V. Saugor,	East to E. by S., with squally weather throughout the day, ...	At anchor as yesterday,....	....	..	120 fms. Cable out. Hove the Log, *and found the set to the West to be 2½ miles per hour, per Massey's patent Log.*

Date.	Vessel's Name.	Winds and Weather.	Station.	Bar.	Ther.	Remarks.
31st May. 1842.	H. C. L. V. Beacon,	A. M. Blowing hard at East. Noon heavy gusts. Sunset E. S.E. 8 P. M. blowing hard at E. S. E. to Midnight, ...	.. .. ..	8 A. M. 29.38 29.38 29.34	85° 86 86	Throughout heavy squalls, rain and cloudy unsettled weather. Riding with 160 fms.
	H. C. L. V. Hope, ..	1 to 4 strong Easterly and veering to E. N. E. and N. E. Noon strong at E. N. E. 4 P. M. at East, E. N. E. and N. E. 8 P. M. hard gale E. N.E. Midnight East & E. b S.	.. .. ..	A. M. 29.38 Noon 29.55 P. M. 29.47	..	Squalls, rain and dismal weather throughout.
	At Kedgeree, ..	N. E. squally with rain ; threatening, ...	.. .. ..	29.30		

From Kedgeree to Calcutta and Inland.

Calcutta, ...	Easterly, scattered clouds,	.. .. ..	SG. 29.50	90.0	

In the Bay of Bengal.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Ther.	Simp.	Remarks.
Noon. 1st June.	Barque Augustus,	A. M. E. by N. 11 N.N. W. P. M. N. N. W. 11 P. M. N. W. by N. strong gales, ...	° ′ 19 18	° ′ 86 23	29.19	..	..	Black Pagoda to False Point.
	Panthea, ...	Gale N. Eastward from midnight. P. M. veered to Westward. Midnight blowing hard at West,..	.. ..	.. ..	....	..	..	Not far from Augustus.
	Jno. Wm. Dare,	2 A. M. heavy squalls S. W. P. M. wind W. N. W., hove to again, ..	.. ..	.. ..	29.10 falling 28.80 midnight	..	..	10 A. M. Bore up, crew being worn out and ship leaky. P. M. hove to again.
	Algerine, ...	From 29th May steady increasing gale S. S. W. to S. W. by W...	15 25	87 58	28.70 to 28.56	..	..	Suspicious weather, much lightning.
	Ariel, ...	Strong gales S. S. W. ..	14 37	89 18	29.41	85	..	P. M. Strong gale about S. S. W. to Midnight.
	Barque Norfolk,	S. W. wind & heavy swell throughout. Noon squally, brisk gale. ..	14 35	89 25				
	Brig Arethusa, ..	Strong gales S. S. W. to W. S. W. throughout, ...	13 49	84 5				

Eastern Coast of the Bay and to Dacca.

Chittagong, ...	....	22 10	91 51	9 A. M. 30.20*	68.26	28.84	
In Combermere Bay & Kyook Phyoo, ...	Weather oppressive, sky overcast. Bar. unsteady,	20 0	90 58	.. ..	..	..	

* This Bar. stands about two-tenths below the standard in Calcutta.

Date.	Name of Place or Ship.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Simp.	Ther.	Remarks.
1st June. 1842.	At Burrisal, ..	Heavy rain with squalls from S. E. Veering to East in the evening & blowing hard all night,	° ′ 22 · 44	° ′ 90 20	.. ..	..	..	Not much rain.

Western Coast of the Bay to Kedgeree.

At Madras, ..	.. ..	° ′ 13 3	° ′ 80 16 E	8 A. M. 29.728 4. P. M. 29.626 10 P. M. 29.674	88.5 96.3 92.2		
Poondy Roads, ..	Strong W. N. W. breezes, ...	19 35	85 3				
At Pooree, ..	Wind from the North; cloudy, rain and lightning, ...	19 48	85 45	.. .. ..	79 to 83		
At Cuttack, ..	Rain and calm throughout, ...	20 31	86 4				
At Balasore, ..	N. E. to N. W., heavy rain and clouds throughout, ...	21 31	87 11	9 A. M. 29.40 3 P. M. .37 5 P. M. .36	82 83 82¾		Wind N. E. to ½ past 5 P. M. when veering to N. W., heavy clouds nearly stationary to the N.W.

Date.	Vessel's Name.	Winds and Weather.	Station.	Bar.		Remarks.
1st June, 1842.	H. C. P. V. Coleroon,	Strong breeze E. S. E. to E. N. E., squally with rain and heavy sea, ..	At anchor 7 fathoms, Floating Light E. by S.	29.53 4 P.M. 29.50	..	Saugor P. V. S. W. ½ S.
	H. C. P. V. Megna,	Fresh gales from the Eastward. P. M. from N. E.	At anchor, 100 fathoms cable out, ...	Bar. of 3 Ships,		29.60 29.18 29.80
	H. C. P. V. Cavery,	1 to 2 A. M. nearly a hurricane, sea rising high and lightning to the southward. Daylight to noon more moderate, though still hard gale from N. to N. N. W. and N. W., high sea, squalls and dirty appearance. Noon hard gale N. W., heavy showers and sea. P. M. N. W. W., N. W. and West, moderating and veering to W. S. W. and S. W. 8 P. M. hard squalls at West. 8. P. M. to midnight blowing hard at S. W. and S. W. b. W. with thunder and lightning to the S. E., but moderating on the whole, ...	Standing to the S. S. W. and N. N. E. under close reefs, ..	..	..	A. M. noon to 8 A. M. a little moderated, set topsails. Evening much moderated. Heavy sea throughout.
	H. C. P. V. Saugor,	Daylight *every appearance of fine weather!* middle and latter incessant heavy squalls, with rain, ...	At anchor as before,	..	..	Daylight hove to in 85 fathoms. P. M. veered away to 120 fathoms again.

Date.	Vessel's Name.	Winds and Weather.	Station.		Barometer.	Simp.	Ther.	Remarks.
			° ′	° ′				
1st June.	H. C. L. V. Hope, ..	From East to E. S. E. blowing hard, about noon moderating. P. M. strong Easterly breezes. 8 P. M. E. N. E. and unsettled, ...	21 26	88 07	8 A. M. 29.33 Noon 29.30 P. M. 29.26	..	..	At 11-30 A. M. hove to in 105 fathoms, bad weather, still unsettled.
	H. C. L. V. Beacon,	1 to 4 A. M. East to E.S.E. strong. 8. A. M. abating at East, with occasional squalls. Noon moderate to8 A.M. Midnight strong Easterly winds, ...	21 04 N.	88 27	.. ..	..	..	Unsettled throughout, sunset fresh at E. N. E. and dark dismal weather.
	At Hidgellee, ..	Cloudy and heavy showers from East all day, ..	Lat.	Long.	.. ..	29.40	85	
	At Kedgeree, ..	N. E. *more moderate*, ..	21 55	88 16	.. ..	29.30	..	

From Kedgeree to Calcutta and Inland.

Calcutta, ..	E. N. E. and variable and squally, ..	22 34	88 22	S. G. 29.381	..	88.3	
At Chandernagore, ..	Fresh N. E. hot, ...	22 53	88 20	29.59 to 29.49	..	84to82	Every appearance of the approach of the rains.
At Munglepore, ..	Easterly winds, ...	23 32	87 15	.. ..	..	..	Heavy white scud and dark blue sky.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Ther.	Simp.	Remarks.
Noon. 2d June.	Barque Augustus,	6 A. M. N. W. Noon, W. b N. 1 P. M. West. 7 W. S. W. Midnight S. W. strong gales throughout,	° ′ 19 40	° ′ 86 16	29 24	..	..	Between Black Pagoda and False Point.
	Panthea, ...	W. S. W. A. M. to S. W. P. M. moderate, ...	..	..	..	..	..	5 30 P. M. Ganjam W. N. W.
	Jno. Wm. Dare,	W. N. W. fresh gales. P.M. the same, ...	..	..	Noon 29.0 Midn. 29.0	..	..	Current (or drift) 3 miles per hour.
	Brig Algerine, ..	Gale increased, hove to, heavy rain and furious squalls from W. S. W. to N. W., N. N. W. and North, ...	° ′ 17 20	87 6	28.45 to 28.18	..	..	9 A.M. a cross sea S. W., N. W. and N. E., most from S. W. Midnight more moderate. Barometer 28.36.
	Ariel, ...	Strong gales West to S.S.W. Noon moderating,	15 03	89 02	29.38	84	..	P. M. strong gales about S. W., but less sea.
	Barque Norfolk,	Brisk gales S. W. & cldy,	15 10	88 40				
	Brig Arethusa, ..	Wind S. W. strong gales,	14 22	83 24				
	At Chittagong, ..	Cloudy. Wind A. M. S. E. P. M. West to South, ...	22 10	91 51	9 A.M. 30.21	82 4	28.80	
	At Burrisal, ...	Gale from the East and drizzling rain to midnight, ...	22 44	90 20				
	Combermere Bay,	Heavy squall, N.W. wind,	20 0	90 58	..	..	..	Tremendous sea, blowing heavy from W. and W. S. W. all night.

Western Coast of the Bay to Kedgeree.

Date.	Name of Place or Ship.	Winds and Weather.	Lat. N.	Long. E.	Barometer.	Simp.	Ther.	Remarks.
2d June. 1842.	At Madras, ..	.. ..	.. ..	.. ..	8 P. M. 29.708 4 P. M. 29.610 10 P.M. 29.672	.. .. ..	90 1 94 3 91 2	
			° ′	° ′				
	In Poondy Roads, ..	Strong W. N. W. breezes, ..	19 35	.. ..				
	At Pooree, ...	Wind North to N. W., cloudy and rain, ..	19 48	85 45	.. ..	..	78 to 83	Rain.
	At Cuttack, ...	Rain and calm throughout,	20 31	86 4				
	At Balasore, ...	N. W. heavy rain and gusts, low flying clouds throughout, ...	21 31	87 11	9 A. M. 29.33 .28 .27	..	82 82½ 81	Rather more Westerly, in the evening low flying clouds to the N. E.

Date.	Vessel's Name.	Winds and Weather.	Station.	Bar.	Ther.	Remarks.
2d June. 1842.	H. C. P. V. Coleroon,	Blowing a heavy gale of wind from E. N. E. to Northward and Westward, hard squalls, rain and heavy sea.	To 2 A. M. at anchor as before. Parted and stood to the S. E., lying to under fore topmast staysail.	A.M. 7.30 / 8.30 / 10.45 / 11.45 / P.M. 2.49 / 5.30 / 7.0 / 8.0	29 40 / 29 32 / 29 16 / 29 10 / 29 0 / 28 94 / 29 0 / 29 0	2 A. M. parted, 10 30 heavy gale from E.N.E. Noon wind *shifted* to North. 2 P.M. wind shifted to N. W. 5 30 wind shifted to W. N. W. Midnight heavy gale at W. S. W.
	H. C. P. V. Megna,	N. E. to East, fresh gales, heavy squalls and rain, and threatening. P. M. the same. ..	At anchor at Kedgeree.	.. ..	..	Noon wind settled at NE. Sunset North blowing hard and thick rain. 9 A. M. hard gale steady at North; 100 fathoms of cable out.
	H. P. V. Cavery, ..	A. M. to daylight blowing strong at S. W. by W. and W. S. W. with squalls and lightning. Daylight moderate W. S. W. and clearing up. 7 A. M. blowing strong in hard squalls at S. W. Noon blowing hard at S. S. W. P. M. steady at S. W. Evening decreasing, and sea going down. 10, a severe N. Wester. 10 30 light at N. N. W. Midnight N. W. squally and raining, lightning to the Northward, Eastward and Westward.	Noon soundings 50 fms. Standing in to 32 fms. black sand. P. M. No observation at noon.	.. ..	..	Noon sea running very high. P. M. going down. Midnight single reefed topsails.
	H. C. P. V. Saugor,	Wind N.E. during the day gradually veered round to the N. W. and increased towards midnight to a perfect hurricane from N. W. with heavy thunder, lightning and rain.	At anchor. 4 P. M. parted; ran 21 E. S. E. per Log and hove to at 8 P. M.	28.65	..	10 A. M. veered to 250 fathoms of cable, but at 4 P. M. parted, hove to, Midnight lost main-topsail, fore topmast staysail, and jibboom.

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Simp.	Ther.	Remarks.
2d June. 1842.	H. C. L. V. Hope,	A. M. gale at E. N. E. 4. E. N. E. to E. S. E. heavy gale. 8 East to E. S. E. 5 P. M. East. Midnight E. to E. N. E. and N. N. E. ..	....	8 A. M. 29.26 Noon, 29.11 4 P. M. 29.05 8 P. M. 28.93	....	84° 84 84 84	Heavy, squalls &c. throughout. Riding with 240 fathoms of cable.
	H. C. L. V. Beacon, ..	A. M. to 8 A. M. increasing at N. E. Noon blowing hard at N. E. 4. P. M. heavy gales at N. E. 8 P. M. very heavy gale at N. N. E. Midnight a perfect hurricane at N. N. E. veering to the Northward, ...	....	P. M. 29.68 Noon. 29.60 P. M. 29.68*	....	....	Heavy squalls and rain throughout, with dismal weather.
	At Hidgellee, ..	....	....	....	29.35	82	Cloudy and strong breezes E. and N. E.
	At Kedgeree, ..	N. by E. strong gales, threatening weather with heavy rain, ...	....	29.15			

Kedgeree to Calcutta and Inland.

Steamer Forbes,	In the day N. E., blowing strong with squalls. Sunset N. N. E. Midnight North...	Diamond Harbour to Mud Point.	....	..	..	Sky very variable and threatening at times.
Barque Fairlie,	7 P. M. North. Midnight strong gales, cloudy and thick rain, ...	Hooghly Point.	..	..	..	Sky very variable and threatening at times.

* This difference in the Barometers I have remarked upon.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Barometer.	Simp.	Ther.	Remarks.
			° ′	° ′				
2d June. 1842.	At Calcutta,..	Gale from N. E. by N. Noon moderating. P. M. and increasing again by midnight.	..	..	S. G. 29.305 H.P. 29.350 Midnt. 29.170	..	81.2	P. M. from 2 to 7 decreasing to puffs and calms. From 10 to midnight increasing, but Bar. always falling.
	Chandernagore,	N. East to East, bad weather in squalls and calms. 11 A.M. increasing, ...	..	..	29.394 Noon 29.294	..	80	Rain at times.
	At Kissennuggur,	Light rain and cloudy. P.M. increasing breeze from due East, ..						
	At Berhampore,	A squall from N. W. P. M. fine, ...						
	At Jungypore, ..	4 P. M. squall and slight gale N. N. E. ..	24 28	88 08				
	At Soorajgunge Factory, ..	Appearances of bad weather, ...	24 26	89 42	.. ..	..	..	Squally, large heavy clouds surrounding the horizon.
	At Dinagepore,	5 P. M. heavy showers S. E. to E.S.E., ...	25 07	89 40				
	At Bancoorah. ..	A. M. wind East to 4 P. M. North blowing hard to midnight, ...	23 14	87 10	.. ..	..	..	Squalls and rain throughout.
	At Munglepore,	Strong N. E. wind and in puffs, ...	..	..	.. ..	..	..	At night freshening.
	At Monghyr.....	Calms and very oppressive throughout, ..	25 23	86 38				
	At Sooree. ..	Easterly light showers, ..	23 54	87 32	.. ..	..	..	On 1st bright sunshiny day.

In the Bay of Bengal.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Ther.	Simp.	Remarks.
			° ′	° ′				
3d June, 1842.	Barque Augustus,	S. W. to W. S. W., latterly fine.	.. ..	.. ..	29.30	..	..	Off False Point.
	Panthea, ...	Fine weather.	20 8	.. ..	....	..	..	
	Jno. Wm. Dare,	7 A. M. S. S. W. P. M. fresh gales S. W. and cloudy.	.. ..	.. ..	....	..	..	Weather more moderate. On the 4th lat. 19° 12′ long. 90° 33′ S. E. Bar. 29.10, wind S. S. W. and monsoon weather.
	Brig Algerine, ..	Steady gale S. W. by W.	19 10	86 42	....	..	..	At 11 P. M. Bar. again 28.20 in a squall from N. W.
	Ariel, ...	Strong gales S. W.	16 21	87 29	29.31	89½	..	Running to N. W., 5 knots.
	Brig Arethusa, ..	A strong monsoon S S. W. to S. W.	14 26	82 53	....	..	..	

Eastern Coast of the Bay to Dacca.

					9 A. M.			
At Chittagong,..	A. M. wind S. Easterly and strong. P. M. S. Westerly.	22 10	91 51	30.20	80	28.76	At 8 30 P. M a very violent squall from S. W. with much rain.
At Noacolly, ..	.. .. ..	22 48	91 08	.. ..	..	..	At night began to blow from the Eastward and increasing to midnight.
At Burrisal, ..	At 2 30 A. M. E. S. E. blowing fearfully, towards evening abating at about South. ..	.. ..	.. ..	.. ..	..	..	Narrowly escaping an inundation at this station. Gale during the whole night.
At Dacca, ..	Heavy rain. Wind East, not very strong. ..	.. ..	.. ..	.. ..	80 10	A. M.	Cool weather.

Western Coast of the Bay to Kedgeree.

Date.	Name of Place or Ship.	Winds and Weather.	Lat. N.	Long.	Barometer.	Simp.	Ther.	Remarks.
3d June. 1842.	At Madras, ..	.. .. ..	.. ..	.. ..	8 A.M. 29.718 4 P. M. 616 10 P. M. 676	88 6 96 7 88 3		
	In Poondy Roads,	Strong W. N. W. breezes,	19 35					
	At Pooree, ..	Wind from N. W. to S.W. Night calm. A. M. S.W.	19 48	85 45	.. ..	..	84 to 87	Rain 0.10
	At Cuttack, ..	Rain and calm throughout. At night a squall from Southward.	20 31	86 4				
	At Balasore, ..	A.M. N.E. to N.W. heavy rain and gusts. Noon N.W. to 5 P.M. 10 P. M. S.W. stray gusts. ..	21 31	87 11	1 A. M. 29.25 3 A. M. 25 5 P. M. 23	..	81½ 81½ 82	A double reefed topsail breeze with rain throughout. At 8 A.M. N. E. to N.W. Noon N. W. 2 P. M. W. N. W. veering to West, and at 10 P. M. S.W.

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Remarks.
3d June. 1842.	H. C. P. V. Coleroon,	Heavy gale in first and middle parts from W. S. W. latter moderating from S. W.....	Lying to at noon. Lat. obs. 19° 54′ N. ..	A.M. 8 29.32 10 29.40 12 29.42 P.M. 2 29.42 4 29.42 8 29.46	8 A. M. heavy gale from W. S. W. 3 30 P. M. gale shifting to S. W. and moderating. Midnight moderate from S. W. b. W. and heavy rain.
	H. C. P. V. Megna,	Gale from W. S. W. to S. W. latterly West to W. S. W.	Kedgeree at anchor.	....	6 A. M. shifting to the Westward. 8 A. M. N. N. W. 10 A. M. N.W. Noon, heavy gale at West. 3 P. M. S. W. to S. S. W. at its highest pitch and continued blowing hard from the South for three days after.
	H. C. S. Cauvery, ..	1 A. M. hard squalls N. W. to W. N. W. and W.S.W 2 A. M. to daylight moderate at W. S. W. and S. W. Daylight to noon moderate at S. W. and fine weather. Noon light S. W. and *fine clear weather*. P. M. moderate and fresh S. W. and S.S.W. & fine.	A. M. running along the Coast to the N. of Ganjam from 1½ to 2 miles. Course N. N. E. P. M. hove to in 45 fathoms soft mud, suppose off Jaggernath.	....	Daylight saw the southern part of Ganjam hills, bearing W. N. W. in 36 fathoms. Sunset Northern part of Ganjam hills N. N W.
	H. C. P. V. Saugor,	Gradually drawing round about 2 30 A. M. to W. & S. W. with unabated violence. From 4 A. M. to 4 P. M. gradually abating from a hurricane to a strong S. W. wind, with rain at intervals.	Hove to under bare poles. Afternoon made sail.	....	3 A. M. foresail blew away. Afternoon gradually made sail and stood in to the Westward.

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Simp.	Ther.	Remarks.
3d June. 1842.	H. C. L. V. Hope, ..	A. M. hurricane at N. N. E. 4 A. M. the same, N. N. E. to North and N.N.E. 8 A. M. the same N. W. to W. N. W. Noon decreasing a little W. S. W. 8 P. M. decreasing at W. S. W. To midnight the same, but wild and threatening, ...	Parted. At daylight anchored in 30 fms.	8 A.M. 28.96 Noon 29.10 8 P.M. 29.18	..	..	2 A.M. parted. Daylight brought up with 160 fms. in 30 fms. soft blue mud.
	H. C. L. V. Beacon,	Midnight to 4 A.M. very heavy gale N. N. E. veering to North. 8 A.M. perfect hurricane at N. N. W. veering to N. W. Noon no alteration, but veering to West and W. by S. 4 P. M. veering to W. S. W. 8 P. M. moderating W. S. W. Midnight still moderating. ..	Station.	A. M. 29.72 Noon 29.72 P. M. 29.71	..	..	Weather still unsettled at midnight.
	At Hidgellee, ..	Cloudy and constant strong breezes from N. and N. W. veering to S. W. at 4 P. M.	.. ..	.. ..	29.05	82	
	At Kedgeree, ..	4 A. M. N. N. W. 8 A. M. N. W. Noon West. 4 P. M. W. S. W. 6. P. M. S. W. and moderating, ...	.. ..	.. ..	28.73	..	Hardest part of the gale from noon to 4 P. M. Heavy gales till evening.
		Kedgeree to Calcutta and Inland.					
	Steamer Forbes, ..	2 A. M. severe squall and increasing from North. 10 N. N. W. Noon N. W. 2 P. M. W. N. W. 4 P. M. West. 6, W. S. W. moderating a little. 8, S. W. 10 to midnight S. W.	Mud Point. ..	.. ..	..	..	Heaviest squall at 4 P.M. but blowing excessively hard throughout. P. M. rain increasing. Midnight, monsoon gale.

Date.	Name of Ship or Station.	Winds and Weather.	Lat. N.	Long. E.	Bar	Ther.	Remarks.
3d June. 1842.	Barque Fairlie, ..	A. M. hard gales North. 3 A. M. N. W. 2 P. M. West. Midnight S. W. ..	..	.. ..	2 P. M. 28.30		At Hooghly Point riding with 100 and 50 fathoms on two anchors. Hardest of the gale at 2 P. M.
		At Calcutta and Inland.					
	At Calcutta, ...	Gales from N. E. by N. & N. by E. increasing to hurricane from 10 A.M. to 1 P. M. At 1 45 calm, and by 6, hurricane again from S. W. till 9 or 10, decreasing to heavy gale at midnight.	22 34	88 22	Noon SG. 28.64 Lowest 28.278 H. P. 28.625 Lowest 28.275	81 2	Lowest depression of the Bar. lasted about half an hour.
	At Midnapore, ...	At daylight wind from N. E. heavy squalls in rapid succession and heavy rain. Noon lulling to 2 and 3 P. M. when it increased again from the West to a gale all night, veering to N. W.	22 25	87 25	.. ..	78	Rain 6½ inches.
	At Chandernagore,	Gale from N. E. to N.N.E. Noon N.E.	.. ..	.. ..	28.794 5 to 6 28.34	..	Heaviest of the storm from ¾ past 5 to ¼ past 6, when blowing tremendously from N. E.
	At Chinsurah, ...	N. E. tremendous gale at 9 A. M. P. M. North, veering to East. 5 P. M. most furious.	..	.. ..	.. ..	78	
	Banks of the Jumna, ...	A. M. strong Easterly winds increasing to a hurricane.	24 47	88 52	.. ..		
	At Kissennggur, ..	N. E. to East, with thick drizzling rain.	.. ..	.. ..	.. ..	..	Accounts differing a little.
	At Plassey, ...	P. M. Tremendous gale from N. E. and increasing, ...	..	.. ..	.. ..	..	Bar. nearly down to 29.0.
	At Berhampore, ..	At 7 A. M. increasing to a gale from N. E. to midnight when very heavy.	..	.. ..	.. ..	..	Veering (apparently) more to Eastward.

Date and Time.	Name of Place	Winds and Weather.	Lat.	Long.	Bar.	Simp.	Ther.	Remarks.
1842. 3d June.	At Jungypore Factory, ...	Slight squalls and rain with puffs from N.N.E. 9 P. M. heavy gale N.N.E..... ...	° ′ 24 28	° ′ 88 08	.. ..	..	..	Gale all night, with heavy rain.
	At Dinagepore, ..	Cloudy. Evening appearance of gale. 10 gale commenced from N.E.	25 07	89 40	.. ..	..	..	Increasing throughout the night from N. E.
	At Soorajegunge,	2 A. M. Gale commenced from the Eastward and increasing.	24 26	89 42	.. ..	..	..	Torrents of rain.
	At Bhaugulpore*	6 A. M. Wind South, threatening weather. 4 P. M. to midnight North.	25 10	87 4	.. ..	..	..	Dreadful heat, threatening from the South, a few drops of rain.
	At Bancoorah, ..	W. N. W. heavy gusts. 5 P. M. S. West; to midnight the same. ..	23 14	87 10	.. ..	..	..	
	At Munglepore, .	Strong N. E. Wind and scud with rain, increasing and drawing Northerly.	23 28	87 12	.. ..	..	..	Gale and rain all night.
	At Monghyr, ..	2 A. M. N.W., veering to N. E., heavy burst and rain.	25 23	86 36	.. ..	..	..	Continuing to midnight.
	At Sooree, ...	A. M. Overcast. 5 P. M. rain at night, high wind from N. E.	23 54	87 32	.. ..	..	..	Incessant rain all night.
	At Purulia, ...	Gale commenced at N.E. at 4 A.M. drawing gradually to N. 4 P. M. N.N.W. at 6 & N. W. at midnight.	23 20	86 24	29 716†	..	..	Unsettled weather and gloomy on 1st and 2d, when fresh from East with rain.

* Properly from Kunjirpore Factory, a few miles E. by N. from it.

† Corrected to level of Calcutta, see Table.

Eastern Coast of the Bay and to Dacca.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Barometer.	Ther.	Simp.	Remarks.
1842. 4th June.	At Chittagong, ...	A. M. Stormy, Southerly. P. M. South & S. Westerly.	22 10	91 51	9 A. M. 30.202	79	28 82	At night. after blowing hard from S. W. a heavy squall from N. W. 2.968 inches of rain in 24 hours.
	At Noacolly, ...	....	..	..	....	..	..	Wind veering to-day from E. and E. b. S. to S. E. Half a gale.
	At Burrisal, ...	Wind South, very high.....	..	..	....	..	..	Tremendous gusts during the night.
	At Dacca, ...	Wind S. E. and S. S. E. very strong in gusts.	..	..	....	83	..	Continued rain and heavy squalls.

Western Coast of the Bay to Kedgeree.

	At Madras, ...	....	....	....	8 A. M. 29.736	82 6		
					4 P. M. 638	96 7		
					10 P. M. 626	88 3		
	At Pooree, ...	S. W. Cloudy. P.M. squall from N.W.	....	....	....	82to90	....	Rain 0.05
	At Balasore,....	S. W. inclining at times to Southward, clearing up.	....	...	....	....	....	Rain and passing showers.

Date.	Vessel's Name.	Winds and Weather.	Station.	Bar.	Remarks.
842. 4th June.	H. C. P. V. Coleroon,	Strong breeze from S. W. moderating to fine weather.	Noon running in W. N.W. under foresail and close reefed topsails. P. M cruizing off Point Palmyras.	8 M. 29.50 Noon 29.54 8 A. M. 29.56	2 A. M. heavy squalls S. W. 4 A. M. made sail and stood in W. N. W. 6, water discoloured, no ground 40 fms. to noon 1 P. M. 35 fms. blue sand 3 P. M. 22 fms. red sand, 4 25 fms. dark sand, 15¾ miles per Log, since noon. 8 P. M. in 23 fms. off Point Palmyras.
	H. C. P. V. Megna, ..	West to W. S. W. more moderate.	At anchor Kedgeree.	.. .. ..	A barque on shore on the Mizen. Symmetry missing.
	H. C. P. V. Cauvery,	Fine monsoon breezes from S. S. W. to S. W.	A. M. Off the southern part of Conjong Bay. P. M. at anchor in 14 fathoms black mud and sand. False Point Light N.W. ½ N.	.. .. ..	7 30 Juggernath bearing N. N. W. 10 Black Pagoda N. by E. ½. E.
	H. C. P. V. Saugor,	Strong breezes from S. S. W. to S. W. and fine weather.	Standing in; at noon on the Ridge 32 fms.	.. .. ..	Found we had run in 55 miles by Log since noon yesterday to the W. N.W.

Date.	Vessel's Name.	Winds and Weather.	Station.	Barometer.	Simp.	Ther.	Remarks.
1842. 4th June.	H. C. L. V. Hope,..	Gale at S. W. throughout with heavy sea, rain and threatening appearance.	Station.	8 A. M. 29.25 Noon. 29.28 8 P. M. 29.31	....	84° 84 85	Riding with 220 fathoms, cable out.
	H. C. L. V. Beacon,	The same.	....	A. M. 29.71 Noon. 29.71 P. M. 29.72			
	At Hidgellee, ...	Showery and clearing up. Wind S. W.	Lat. Long.	....	29.35	80	
	At Kedgeree, ...	S. W. Strong breezes and moderating.	....	29 0			

Kedgeree to Calcutta and Inland.

Barque Fairlie, ...	A. M. S. Westerly heavy gales, moderating at 6 A.M.	Hooghly Point.				
At Calcutta, ...	Gale from S.W. decreasing till 10 A. M. when calm & squalls till midnight.	° ′ ° ′ 22 34 8422	S. G. 29.193	81.6	....	Barometer gradually rising to the 11th.
At Midnapore, ...	Wind S. W. blowing strong.	....		....	....	Latterly Monsoon weather and winds.
At Chandernagore, ..	P. M. N. N. E. to S.W. 4 A. M. S.W. in squalls increasing, but moderating at 10,	....	29.194	....	....	Scud from Southward to Northward.
At Chinsurah, ...	Gale abated.	....	....	....	80	Soft rain.
Banks of the Jumna,	Veering a little to the North from the East with lulls P. M.	24 47 88 52	....	....	....	Torrents of rain.

Date and Time.	Name of Place or Ship.	Winds and Weather.	Lat.	Long.	Bar.	Simp.	Ther.	Remarks.
1842. 4th June.	At Kissennuggur, ..	South to S. S. W.	.. ..	.. ..	.. ..	..	..	Accounts very imperfect; at the height of the gale, wind South.
	At Plassey, ...	6. P.M. gale continuing, wind from S. E.						
	At Berhampore, ..	Blowing heavily the whole day, East or a little North of East.	.. ..	.. ..	.. ..	..	..	Eastward.
	At Jungypore, ..	N. N. E. heavy gale to 7 P. M. when veered to East, blowing furiously all night.	24 28	88 08				
	At Soorajegunge Factory, ...	Wind shifting from E. to E. S. E.	24 26	89 42	.. ..	..	..	Blowing with the same violence as on the 3rd.
	At Dinagepore, ..	Gale continued without abatement, N. E. and E. N. E.	25 07	89 40	.. ..	..	..	Not abating during the night.
	At Titalayah, ..	A. M. blowing almost a hurricane from S. E. for about 2 hours. Rain, thunder and lightning.	26 28	88 25	.. ..	..	..	From 1st to 4th gloomy weather, with rain and squalls from N. W. Much thunder and lightning.
	At Poorneah, ..	7 A. M. gale commencing in strong squalls from N. E., with sleet. P.M. increasing.	25 45	87 23	.. ..	..	..	Wind moderating in short intervals. Weather murky and oppressive on previous days.
	At Bhaugulpore, ..	A. M. N. E. drizzling rain. 10 E. N. E. Noon N. E. blowing hard. 2 P. M. E.N. E. Midnight E. N. E. gale at its height.	25 10	87 04	.. ..	..	81	Rain blowing into mist by the force of the wind.
	At Bancoorah, ..	Blowing tremendously, thick small rain. About S. W. throughout.	23 14	87 10 E.				
	At Munglepore, ..	Strong Northy gales, incessant rain veering to the Westward.	23 28	87 12 E.	.. ..	..	..	Westerly gales and rain all night.

Date.	Name of Place.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Simp.	Ther.	Remarks.
1842. 4th June.	At Monghyr, ...	From West to N. E. and S. E.	25 23	86 38	..	..	..	Torrents of rain. Wind continually veering.
	At Sooree, ...	Strong wind N. E., during the night changed.	23 54	87 32	..	..	..	Incessant rain, change about midnight.
	At Purulia, ...	N. W. gale throughout.	23 20	86 24	29 636	..	79	

Eastern Coast of the Bay and Dacca.

Date.	Name of Place.	Winds and Weather.	Lat. N.	Long. E.	Barometer.	Simp.	Ther.	Remarks.
1842. 5th June.	At Dacca, ..	South and more moderate; 3 30 P. M. wind changed to S. W. in a violent squall and back to S.E.	.. ..	.. ..	.. ..	..	84°	Stormy night and heavy rain.

Western Coast of the Bay to Kedgeree.

	At Madras.....	.. .. ..	.. ..	.. ..	8 A. M. 29.506	..	90 0	
					4 P. M. 29.322		90 8	
					10 P. M. 29.364		88 1	
	Pooree, ...	N. W. to S. W. 4 P. M. strong, ...	.. ..	.. ..	.. ..	..	83to87	Rain 0.30.

H. C. Pilot and Light Vessels.

Date.	Names of Place Ship.	Winds and Weather.	Station.	Barometer.	Simp.	Ther.	Remarks.
1842. 5th June.	H. C. P. V. Hope,	Blowing hard at S.W. throughout.	Station.	8 A. M. 29.36 Noon 29.41 8 P. M. 29.41	.. .. ..	84° 85 85	
	H.C. L. V. Beacon,	The same.	.. ..	A. M. 29.71 Noon 29.71 P. M. 29.71			
	At Hidgelee, ..	Squally and heavy showers from S. W.	.. ..	.. ..	29.55	80½	
	At Kedgeree, ..	S. W. moderate, but dull and hazy.	.. ..	29.20			
	At Midnapore, ..	S. W. Monsoon weather.					
	At Chinsurah, ..	S. W. Monsoon.					
	Banks of the Jumna, ...	Wind veering about from East to S. E. and South, blowing tremendously...	.. ..	.. ..	..	..	Torrents of rain. On 6th Monsoon gale, S. W.
	About Kissennuggur, ...	At 3 or 4 P. M. 5 blowing hard S. S.W. South, & Midnight S.E.	.. ..	.. ..	..	..	Accounts very imperfect.
	At Berhampore, ..	To 8 A. M. from the Eastward. P. M. from S. W.	.. ..	.. ..	..	..	Time of change or veering not given.
	At Jungypore, ..	6. A. M. wind veered to S. E. 1 P. M. S. S. E.	° ′ ° ′ 24.28 88.08				
	At Dinagepore, ..	Gale moderating, wind drawing to the Southward of East and declining.	25.07 89.40				

Date.	Name of Place.	Winds and Weather.	Lat. N.	Long. E.	Bar.	Simp.	Ther.	Remarks.
			° ′	° ′				
5th June.	At Purneah, ...	A. M. gale continuing from N.E. P. M. veering a little to the Eastward. ...	25 45	87 23	.. ..	..	..	
	At Soorajegunge Factory,	8 A. M. shift of wind from E. S. E. to S. W. after a short calms.	24 26	89 42	.. ..	..	..	Blowing almost a hurricane throughout.
	At Bhaugulpore, ...	To 5 or 6 A. M. Wind as at midnight E. N. E., heavy gale. 10, wind North blowing hard. Noon N. W. decreasing, 4. W. N. W. 6 West...	25 10	87 04	.. ..	..	79	Blowing strong, and heavy rain to midnight.
	At Bancoorah, ...	S. W. gale decreasing P. M. and drawing to the South.	23 14	87 10	.. ..	..	..	
	At Munglepore, ...	Wind S. W. & moderating. Noon Westerly gale again. P. M. S. W.	.. ..	.. ..	.. ..	..	..	Hard rain or heavy showers throughout. Clearing up in the evening, with a heavy thunder storm.
	At Munghyr, ...	West to N. E. and S. E.	26 23	86 38	.. ..	..	..	Torrents of rain, wind continually veering.
	At Sooree, ...	2 A. M. West, wind shifted to N.W. 5 P. M. moderating to midnight.	23 54	87 32	.. ..	..	..	Incessant rain, height of the gale from 4 to 7 A. M.
	At Purulia, ...	8 A. M. W. N. W. Noon West. 2 P. M. W. S. W. 8 P. M. to midnight S. W.	23 20	86 24	29.621	..	77	Moderating from midnight.

Date.	Name of Place.	Winds and Weather.	Lat.	Long.	Bar.	Simp.	Ther.	Remarks.
6th June.	At Kissennaggur, ..	Gale ending at N.N. W.	...	....	....	..	..	Blowing furiously for an hour only from N. N. W.
	At Jungypore, ...	Wind veered to S. S. W. gale abating. Noon subdued gusts from West. ..	24 28	88 08				
	At Soorajegunge,....	Noon abating a little. 5 P.. shifted from S. W. to W.	24 26	89 42	....	..	..	Storm had subsided to light breeze at 5 P. M.
	At Purneah, ...	Gale continuing till 5 or 6 P. M. when abating. ...	25 45	87 23	....	..	..	7 A. M. on 7th a strong N. Wester for about an hour and a half with a deluge of rain.
	At Bhaugulpore, ...	West, drizzling rain light winds. 6 P. M. fine.	25 10	87 04				
	At Bancoorah, ...	South, heavy rain.	23 14	87 10	....	..	..	Monsoon weather.
	At Munglepore.	Southerly, fair all day.						
	At Sooree, ...	Calm.....	23 54	87 32				
	At Purulia, ...	5 A.M. S. W. to P. M. South.	23 20	86 24	29.596	..	79	Moderate and gentle breeze.

Summary and Results.

I shall now endeavour to deduce from the evidence afforded by the foregoing documents and tables:—

1. The origin and track of the Storm.
2. Its circular (or other) motion.
3. Its rate of travelling.
4. Other phænomena.

I. II.—*The Origin and Track of the Storm, with its circular motion, will be best considered together.*

If we look in our table of the 20th instant, at the logs of the *Algerine* and *Ariel*, p. 977 and 978, we shall find that in the S. E. part of the Bay, or between latitude 10° and 14° N. and longitude 90° and 92½ E* over a space of 290 miles, the distance of the two vessels apart, some atmospheric disturbance was apparently taking place, and over a considerable extent. This was continued on the following days, but seems to have been nothing more, at least with them, than the setting in of the monsoon; for on the 31st May, the *Ariel, Algerine,* and *Norfolk* were all, as will be seen, about in the middle of the Bay, and within a circle of 100 miles in diameter, with variable winds and squally weather from North to N. W., West, and S. W. The *Arethusa* four degrees further to the Westward had a strong monsoon. Up to the 1st June, indeed, these ships had nothing but a strong monsoon. It was *not* then with them that the storm began, and the only trace we find of it in the Bay, beyond the Sand Heads, is with the *John William Dare,* which vessel being bound to Penang, got as far as about latitude 17° N., and about on the line from the Light Vessel to Cape Negrais, on her route from the Sand Heads, but was obliged to put back on the 1st June. She had a smart N. Easterly breeze in latitude 17° 56′ and longitude *about* 93° 30′, or about 250 miles S. E. by S. from the Light Vessel at the Sand Heads, on the 30th May; and running to the Southward and Eastward with this breeze it became a S. Easterly, S. S. Easterly, and eventu-

* I use round numbers here; the tracks of the two vessels are given upon the Chart.

ally a Southerly gale on the 31st, with a heavy cross sea; her Barometer falling from 29.50 on the 30th to 29.30 on the 31st, when she hove to. If this was the beginning of the rotatory storm, which I have called the *Cauvery's* storm, (see Chart,) as it may well have been, this change of wind is exactly what should have occurred, and the fall of the Barometer and heavy cross sea confirm the probability, that it was the North Eastern part of the vortex which she met with. The *Norfolk*, which was four degrees to the W. by S. of the *John William Dare*, had also threatening weather, with wind from the N. N. W. becoming N. W., as she ran to the Southward, she being on the S. W. quadrant of the storm, if there was one. At the Sand Heads and False Point, we find by the logs of the Pilot Vessels, that the winds and weather were gloomy, squally, and threatening a gale from the Eastward, with their Barometers falling (*Coleroon* and *Beacon's*), while to the Southward we find the *Algerine* and *Ariel* with heavy weather (or the monsoon ?) from the W. S. W. and S. S. W. This state of winds and weather all over the Bay is also, it will be noted, that which we might suppose to occur at the first part of a rotatory motion occasioned perhaps by a struggle between the N. East and S. W. monsoon, which last, as we see by the log of the *John Craig*, was apparently blowing strongly up from latitude 6° N. We cannot assign any place for the centre of the storm, but if there was one, it was doubtless between the position of the *John William Dare*, Point Negrais, and the *Norfolk*.

31*st May*.—It was at noon blowing half a gale from N. E. by N. to N., increasing to a gale from N. N. W., and to a hurricane at midnight, with the H. C. P. V. *Cauvery*, which stood to sea from her station off False Point and to the S. E. of it, off Conjong Bay,* where she hove to. With the Light Vessels also a gale had set in from E. to E. N. E., though at Kedgeree, the weather was only threatening, and at Calcutta there was nothing remarkable, as to the wind and weather, to common observers; though the Barometer had fallen from the average of 29.64. to 29.50.

The ship *Augustus* had the commencement of this storm, (which as felt most strongly by the False Point station vessel, we may call the

* In the Charts, *Codgone* Bay.

Cauvery's storm,) from the N. E., but it must have been of small extent, for it did not reach the *Panthea,* which vessel was about 90 miles due West of the *Augustus* at noon ; and hence we may also deduce, that the Easterly gale felt by the outer Light Vessel was also not truly a part of it, but probably the combined effect of the Monsoon, the disturbed weather felt in the middle of the bay by the *John William Dare* and *Norfolk,* &c., and of the outskirts of this small vortex I have placed the centre of the *Cauvery's* storm in latitude 18° 20′ N. longitude 87° 53′ E. ; but it may have been farther to the Southward, for no log was kept of her run to sea, nor of her drift when hove to. It was the 3d before she got back to sight the land off Ganjam.

1*st June.*—From midnight the *Cauvery* was still drifting to the South, with a hurricane from North to N. N. W., which veered by noon (as the centre passed to the Northward of her position,) to the N. W. to W. at 8 P. M. and S. W. at midnight. This storm may have exhausted itself before it reached the shore, though the *Panthea* felt the N. E. gale of its N. W. quadrant; but we have unfortunately no account from Ganjam or Pondy, about, or to the South of which places it would have reached the shore if its centre landed upon the coast. At Pooree it was only felt as heavy rain on the 31st.

The *Augustus* on this day had the wind veering from the E. by N. to N. W. by N., confirming the evidence derived from the *Cauvery's* log, of its having really been a small storm. I have therefore marked a small circle for it, with the *Cauvery's* place at noon upon the Chart.

We may thus fairly allow that this was a separate storm of small extent, preceding that of which the centre passed over Calcutta, by about 62 hours. Whether it also was the one which appears to have been originating with the *John William Dare,* on the 30th of May, or whether her storm of that date gave rise to both this and the Calcutta storm, we do not know. I am inclined to *think,* that the *J. W. Dare's* storm *was* the *Cauvery's* hurricane, because if its track had been more Northerly, it would have brought the centre closer to the *John William Dare,* than she seems to have had it. We have, however, no right to conclude, that a rotatory storm does not at any part of its progress separate into two or more storms, since (see Capt. Tapley's report, 3rd Memoir, Journal of the Asiatic Society, Vol. X.

p. 1,011,) they certainly *include* whirlwinds which are separate from, although included in the main body of the storm, and our Calcutta storm certainly separated into others on subsequent days.

1st June.—We have no data on this day from which we could with any degree of probability assign any fixed centre for our Calcutta storm of the 3rd, and indeed I am of opinion, that it was only now forming itself,* in the Northern part of the Bay.

For we find that at Chittagong and Noacolly, they had no signs of a gale, Barometrical or of other kinds. At Burrisal, they had, it is true, heavy rain and squalls from S. E. veering to E. in the evening and blowing, hard all night; but this may scarcely be considered, I think, as more than an indication of the *commencement* of an atmospheric disturbance at least till midnight; and as I have before remarked, we must allow of a commencement somewhere. A part of this S. Easterly gale and rain may indeed have been owing to the *Cauvery's* hurricane which was now, at midnight, as just described, at its height; but then we find that it certainly did not reach to the Northward and Eastward so far as the Floating Light, *Saugor* and *Coleroon*, all three of which had moderate weather (the *Saugor* even at daylight " every appearance of fine weather ;") this must wholly preclude our considering this Burrisal commencement as any part of the *Cauvery's* hurricane.

2d June.—We find, first as to the ships in the middle of the Bay, from 15° to 17° 20′ N. (*Norfolk*, *Ariel*, and *Algerine*,) they had, as has occurred before, a heavy monsoon blowing across the Bay, the swell of which seems also now just to have reached the Arracan Coast, produc-

* I have before remarked, that these storms must begin *somewhere*. I may add here, that they must also begin *somehow* and *somewhen*, i. e. we must find (or allow) for their commencement, place, cause, and time,—if we can. We may suppose that when a rotatory storm forms, it begins at the centre increasing outwardly—or at the circumference—or in parts of either? and these parts may be even at different distances from the central space, and that, when the *rota* is formed by one set of forces, another may begin to operate to move it onwards, and that its first progress may be slow while the vortex is spreading? We may also suppose, since, we *know* nothing on the subject, that the same force which produces the rotation, produces also the progression? One of the first effects of the strong rotation and progression must be to draw in other currents of air, or to throw them outwardly, and to influence those already existing, that is to say, it may draw in by its progressive motion while it throws others out by its rotatory (centrifugal) force?

ing the heavy swell and N. W. squall, described there in Captain Brown and Dr. Hinton's reports.

Farther northward in the Bay, we find the *John William Dare*, (which vessel had done all she could to get to the N. W., since she bore up on the 1st in about latitude 18° North,) with her Barometer falling to 29.00, and a strong W. N. W. gale; but she does not appear to have been within the true circle of the storm, which hereabouts and at this time was only perhaps slightly influencing the true S. W. monsoon by its Southern quadrants. We have thus no data in the *middle* of the northern part of the Bay, nor on its Eastern shores; and on its Western side from 15° to 17½° N., and towards the meridian of False Point we have nothing in the logs of the *Ariel*, *Algerine*, and *Norfolk*, but a strong or heavy monsoon. We must thus infer that the Calcutta storm commences, for us, with the log of the *Beacon*, the outer Light Vessel at noon, where with her and at Calcutta there was a gale at N. E.,* and that it was of small extent, and yet very irregular, (perhaps still forming?) for though the *Beacon* had a steady gale at N. E., the *Hope* Light Vessel, 25 miles to the N. N. W. of her, seems to have had it very variable and Easterly, and at Kedgeree and on the river it was mostly between North and N. N. E. throughout the day, settling at N. E. at noon at Kedgeree. To seaward, the *Cauvery* off False Point, and the *Augustus* and *Panthea* off the Black Pagoda and Ganjam, had the storm of the 1st moderating and running into the monsoon from S. W. and S. S. W. to West. The *Cauvery* was at this time (noon) about the same distance to the S. W. or S. S. W. of the *Beacon*, that Calcutta is to the North of her station, and the centre of the storm to give the *Beacon* the wind at N. E., must have been about on the latitude of False Point, which would have given the *Cauvery* a Northerly (N. by E. to N. N. W.) wind, and not one from the S. W., which she now had. We find indeed that it was nearly midnight when she had winds from the N. W., that is when the *Cauvery's* hurricane had sufficiently left her to allow the Calcutta one to be felt, though it was now very severe with the *Coleroon*, which vessel was obliged to run out, and almost met the centre coming up, as the rapid change from E. N. E. to W. S. W., or 16 points in the 24 hours, or less time

* Which moderated in the evening at Calcutta, but increased again towards midnight.

fully shews. At Kedgeree also by sunset, the gale was N., "blowing hard," and at 9 P. M. a hard gale, steady at N.

The *Coleroon's* log will give us the nearest approximation to the place of the centre of the Calcutta storm at noon this-day. This vessel, lying at anchor close to the *Beacon*, parted at 2 A. M., and stood to sea to the S. E. with the wind at E. N. E. heaving to probably, about 30 miles to the S. E. of the *Beacon*, where she had the wind at North at noon, and the *Beacon* had it at N. E. This would give about an E. by N. or E. N. E. wind at Calcutta, but as the gale there moderated greatly from noon towards evening, we may suppose its true circumference to have scarcely reached that city at this time, or at most, that this was but the exterior of it, as at False Point, which place is about as far to the West of this spot as Calcutta is to the North of it. To seaward, i. e. to the S. Eastward and Southward also, the circumference cannot fairly be said to extend to the radius which it would require (140 miles) to include Calcutta. At Burrisal, to the N. N. E. of this centre, they had an Easterly gale with rain, which is what should occur on the N. E. quadrant of these storms, with moreover the effect of the deflected S. W. monsoon from the Aracan coast which must be allowed for.

The point, thus, for the centre of the Calcutta storm at noon on the 2d June, may not unfairly be taken as in latitude 20° 30′ N., longitude 82° 20′ E.; and as the centre passed over Calcutta at, say 2-30 P. M. on the following day, and the distance between these two spots is 140 miles, this will give 140 miles in 26½ hours, or a rate of 5.3 miles per hour for the track of the storm upon a N. N. W. course,* taking it to have followed a strait line; and measuring back on this line, the distance travelled over from noon to 2h. 30m. P. M., we have the point which I have marked, 12½ miles S. S. E. of Calcutta, for the place of the centre on the 3d June at noon.

It will be noticed by the table, that just at the time of the gale and shift of wind at Calcutta on the 3rd, the same phænomenon took place at Midnapore, which is 70 miles to the W. b. S. This requires a separate consideration. The first supposition is, that the calm space of the storm *might* be as much as 70 miles in breadth (?) but this con-

* My newspaper estimate says, about a N W b W. course. This was judged of by the shift of wind, as well, as that could be ascertained, in the middle of a town.

tradicted in too many ways for us to admit it. For, first, if we say that the storm was moving at the rate we have estimated, 5.3 miles per hour, and that the calm lasted at Calcutta, at the most from 1h. 30m. P. M. to 3h. 30m. P. M., or two hours, this would give, say, 11 miles for the diameter of the calm space; and that it was not more, is corroborated by the fact, that, to the southward, the Barque *Fairlie*, at Hooghly Point, 25 miles to the SS. Westward of Calcutta, and at the towns of Chandernagore and Chinsurah, 17 and 20 miles to the northward, no mention* is made of any calm interval; so that our estimate of 11 miles for the utmost breadth of the centre is not far wrong. Again, to the Southward of Hoogly Point, to Kedgeree and Saugor, which are about the same distance from Calcutta, in that direction, that Midnapore is to the W. b S., no calm took place. We are thus obliged to allow, that at Midnapore, there was a separate vortex of small extent, for it appears by Mr. Homfray's report, that it was not felt along the valley of the Subunreeka, which he says, averages about 40 miles to the Southward of that stations.†

And this fact again precludes our considering it as any relic of the *Cauvery's* storm just described, even if the interval of time, and the want of any trace inland of this storm, did not also wholly make this supposition improbable. The interval of time is from the 31st at midnight, when the *Cauvery*, then about 100 miles to the S. S. E. of *False Point*, had a hurricane at North, the centre of it being not far to the Eastward of her, to about 2 P. M. on the 3d, or 62 hours; and the distance from the estimated place of the centre to Midnapore, would not be more than 240 miles. Midnapore also bears about North a little Westerly from this supposed centre. To have reached that station, the storm must have travelled about on a North course up between the Light and Pilot Vessels and Balasore, and passed close to Kedgeree. Not only there is no trace of this at Kedgeree, but the veering of the wind, from North to a hurricane at N. N. W. and ending at West, *must* have been that of a storm travelling from the S. E.

* Mr. Earle, in his excellent account of the storm at Garden Reach, see p. 996, mentions no calm; but that, from a hurricane at about N. b. W. it became "blowing pretty fresh at N. W." before it again blew a hurricane from S. W. and W.S.W. He was only 4 or 5 miles from Government House.

† Speaking no doubt of the road distance. I find that by Mr. Tassin's map it averages about 30 only.

We have thus shewn, that the Midnapore vortex was *not* the Calcutta one, and that it was *not* the *Cauvery's* storm. We must therefore consider it as a separate one, and generated in the neighbourhood; in other words, as an independent eddy from our greater one, for though heavy, no great mischief was done.

We must now, in endeavouring to ascertain the track of the storm between the 3rd and 4th June, consider, that at noon on the 3d, (giving it, as I have done on the Chart, only a radius of 90 miles, or a diameter of 180) its N. Western and Western quadrants, were then impinging against the range of low hills which form the outliers and parallel ranges of the Vindyha range* called to the North Eastward, (or those to the South of Bhaugulpore on our Chart,) the Curruckpore, further South the Pachete, and to the South of the Subunreeka river the Balasore hills. We do not know the height of these, but some of them may not be much short of 1500 or 1800 feet, the station of Purulia being, by Barometrical admeasurement, 670 feet above Calcutta: perhaps we may take 1000 feet as an average height, and W. N. W. as the average direction of the longest vallies? These ranges are separated, as will be seen, by the valleys through which the feeders of the Soobunreeka, Roopnarain, and Dummooda rivers find their way, and must, doubtless, with the transverse ridges and valleys, cause much disturbance, and consequent irregularity, to a storm. It is certain, that buildings and groves of trees do so to the small whirlwinds, and from strict analogy we may assume, that 500 or 1000 feet of hills or ascents, with breaks and intervals amongst them, may do the same with larger ones.

If thus, as above said, we take a radius of 90 miles, and strike with it a circle of 180 miles in diameter on an accurate Chart,† we shall find as below :—

At	The wind *should be*	By reports the wind *was*, by estimate about
Calcutta,.....	N. N. E.....	N. E. by N.
Beacon Light Vessel,....	W. $\frac{1}{2}$ N.....	West.
Kedgeree,....	N. W. $\frac{1}{2}$ W...	due West.

* This is the bending of the Vindyha chain to the South, to join the Coromandel range, as sketched on my map in the First Memoir, Journal of the Asiatic Society, vol. 8, p. 636, and also on the Chart to the present Memoir.

† My Chart is not quite accurate. The tangents in the first column are laid down from Commander Lloyd's Survey of 1840.

At	The wind *should be*	By reports the wind *was*, by estimate about
Mud Point, E.N.E. 9 miles from Kedgeree,..	N. W. by W...	N. W.
At sea, to the S. E. of the Light Vessel (Log of the *Coleroon*,)....	S. W.....	S. W.
Balasore,.....	N. W. by N.....	N. W.
Burrisal,.....	S. by E.....	about S. S. E.*
Kissennagur,....	East.....	N. E. to East.

I have not included here such places as Berhampore, &c., because they are on the verge of the circle or out of it, and at Bancoorah we have the anomaly of the wind at W. N. W., with that already noticed in the Midnapore vortex. It will be seen that the rest of the tangents agree well enough† to form a circle of, say 180 miles in diameter.

Towards the stations situated not far from the first rising of the spurs of the Sub-Himalaya, as Dinagepore and Poornea, we find that on this day the gale commenced at the most Easterly of these two, Dinagepore, which is about on the meridian of Calcutta, but 153 miles to the North of it, at 10 P. M.; but at Titalayah which is really on the ascent, and 81 miles further North, nothing was felt on this day, or on the succeeding.

We have now to consider the course of the storm from noon of the 3rd to noon of the 4th. We find that by noon of the 4th, it had quitted Calcutta entirely, and that it was

At Chandernagore,.... .... Variable N. N. E. to S. W.

,, Chinsurah, ... Abating.

Both these places being then towards the verge of our supposed circle, and in its retreating S. E. quarter.

* The report says, " E. S. E. at 2-30 A. M. veering to South, and moderating in the evening. Now this may be called veering 6 points in 16 hours, and as from 2-30 A. M. to noon there are 9½ hours, this would give 3¾ points of veering to noon, or from E. S. E. to S. S. E. ½ E. We do not know that it *did* veer at equal rates, in equal times, and probably did not."

† I say here, "well enough" adverting to the difficulties which, as I have pointed out in former memoirs, always exist in determining what was the true direction of the wind ; how that direction was influenced at the surface of the earth by local causes ; and finally, the great probability that the wind at the circumference is often not a tangent, but a spiral curve. This I have endeavoured to shew on the diagrams and in the title, and Midnapore circles.—See also Col. Reids and Mr. Redfield's works.

At Kissennuggur, ... S. to S. S. W.
,, Plassey, gale from ..... S. E.
,, Sooree, strong wind.. ... N. E. changing to W. at night.
,, Berhampore, ... E. or a little to the N. of it.
,, Mungulpore, ... { Northerly gales, veering to the Westward.

These are also accurate enough for a part of the circle of the Calcutta storm, but it will be seen, there was evidently also at this time one, if not two other smaller vortices, one to the West and the other to the East of the main, or centre, or Calcutta one; for the wind was also at this time, noon of the 4th,

At Bancoorah, blowing tremendously from.. about S. W.
,, Purulia, ... N. W. gale throughout.

To the Eastward we have:—

At Dacca, very strong in gusts,..... S. E. to S. S E.
At Soorajegunge, shifting from..... East to E. S. E.

Banks of the Juboona, veering a little to Northward of East, with lulls,—which also shew that the vortex, which on the following day certainly passed over Soorajegunge factory at 8 A. M., was now forming, or *had* formed, and was travelling up, as I have marked it on the diagram. At Dinagepore we find the gale continuing, and at Purneah, farther to the Westward, it is marked as commencing in strong squalls from the N. E.

On the 5th, we have, as before stated, a vortex passing over Soorajegunge factory at 8 A. M., the effects of both this and of the Jungypore storm being felt at the factory on the banks of the Juboona. At Bhaugulpore we have also the wind veering so rapidly from E. N. E. in the morning to West in the evening, as to shew that a vortex was passing close to the Eastward of that place; and at Berhampore, and Rungpore there are also indications of the passage of a third. We shall take these in the order I have named them. We have then for the Soorajegunge storm,—

At Soorajegunge, ... At 8 A. M. shift of wind from E. S. E. to S. W.
,, Banks of Juboona, { 65 miles to the West by N.; wind veering about from East to S. E. and South.
,, Dinagepore,.. .. .. Declining at S. E.
,, Dacca,..... .. .. South, S. W., and S. E with squalls.

It will be seen by the diagram that these tangents (or parts of spirals) form part of a circular storm, which we must observe was evidently checked to the Eastward (see Comillah report,) by the Cachar hills, and disturbed by, and mixed up to the Westward with the other vortices, and perhaps to the Southward and South Westward with the S. W. monsoon, which at the Sandheads, and probably from thence over to Chittagong, had now fairly set in, as it had at this last station.

About and at Bhaugulpore, (my report being from a factory within a few miles of the station. I have used this name, as that of a well known spot easily found,) we have the wind as follows:—

Bhaugulpore.—From midnight E. N. E. heavy gale at its height; at 10 A. M. North ; noon N. W. ; and at 6 P. M. West.

At Monghyr, we have for the 4th and 5th, just such phænomena as might be expected from the confused action which would arise at the junction of two circular storms. On both days, it is described as veering from West to S. E. and N. E., with torrents of rain. At Surajgurrah factory, 40 miles to the WbS. of Monghyr, we find the wind to have been blowing almost constantly "*from the Northward,*" which we may take to be any point, or all the points, between N. W . and N. E. ; and at Purneah, which is 40 miles to the N.N.E. of Bhaugulpore, and not far from whence the winds would be deflected by the hills, we find it was a continued gale from N. E., but veering a little to the Eastward in the evening. To the W. and N. W. (Tirhoot and Ghazeepore,) the storm did not reach ; but at Lucknow the Barometer between the 28th May and the 6th June, was affected 0.2 of an inch. We should also bear in mind, that this Bhaugulpore storm, if it was that of Calcutta, had to force its way over the Curruckpore hills, the range which forms the Southern barrier of the valley of the Ganges as far as Rajmahl, so that the irregularities may have arisen also from various streams of air pouring through the different defiles, as they could find a passage.*

The third vortex seems to have been a small one to the West of Jungypore, where on this day we have the wind which had been on the 4th a heavy gale at N. N. E., veering to East and blowing furiously all night, on the 5th veered at 6 A. M. to S. E., and by 1 P. M. to S. S. E. ; though at Berhampore, only 5 miles to the S. by E. of it, the wind was S. W. in the afternoon, having changed to that point from

* See Note at p. 1089.

8 A. M. in the morning, when it was Easterly. If we say even ESE. and that it changed by the South, as it must have done, this was a veering of 10 points in 6 or 8 hours at most; and at Jungypore it was not much less, being, say, from S. E. at 6 A. M., to S. S. E. at 1 P. M., or 10 points in 7 hours. It is true that, as shewn by the arrows, the N. N. E. gale of the 4th at Jungypore might be allowed for as an anomaly arising out of the double effect of the Calcutta and Soorajgunge vortices, with perhaps other local causes with which we are unacquainted; but then we find that this rapid veering was taking place just at the time that the same took place at Bhaugulpore, which is 100 miles to the N. W. of Jungypore, and as before stated, separated from it by the Curruckpore hills. There must then have necessarily been two vortices, and I have so marked them.

We have only for the 6th, the different gales abating in the quarters they should do if they arose from the passage of a circular storm, and farther to the South and South Westward, calms or light monsoon weather, which does not call for any remark, and we may consider that on this day, all direct traces of the storms as circular ones cease. The secondary effect of this great atmospheric disturbance over most of the Bengal provinces were, it will be seen, felt as far as Almora; and the Barometer was probably more or less affected all over India, though unfortunately we have only good observations at Calcutta, Madras, Bombay, Poona, Lucknow, Purulia and Dadoopore, and none for the N. E. angle (Assam.) For the Eastern frontier, from Cachar to Tenasserim, where observations would have been very interesting, we have only those of Chittagong and Akyab.

III.—*The rate of Travelling.*

That already laid down from the Sand Heads to Calcutta of 5.3 per hour between the 2nd and 3rd is, I think, the only one for which we have any fair grounds of inference; for we cannot afterwards take upon ourselves to say, what influence each vortex might have had upon the other.

IV.—*Other Phænomena.*

The reports from Gya, and from Amooah in Tirhoot, that is to the East and N. E. of the limits of the storm, should not be passed

over without notice, for we may fairly say from them, that though the storm was not felt there at the surface of the earth it was distinctly *seen* over head in the "clouds driving about in all directions and winds very gusty" of the Gya report, and the more express "upper dark masses of clouds whirling about in a most extraordinary manner, but driving towards the N. E." of that from Amooah. From the nature of the ground,—Gya being perhaps at least 800 feet, and Amooah 500 feet above the level of Calcutta,—the storm had already been lifted by the intervening hills, and thus received an upward impulse.* We know of no force to propagate it again downwards, particularly as having discharged so much of its rain, and meeting the warm air of the N. Western Provinces after the dry season, it was probably thereabouts less dense than the lower strata. The whole seems, from Mr. Batten's graphic report from Almora, to have been driven *en masse* against the flanks of the hills to the N. W., producing the thunder storms and the phænomenon described at the intervening stations.

The situation of Gya should also be mentioned with reference to this phænomenon. It lies, as marked on our Chart, in latitude 24° 49′ N., longitude 85° 5′ E., and is thus 125 miles to the W. by S. of Bhaugulpore. Before reaching Gya, however, in a direct line from Calcutta, the range of the Ramghur hills, which bounds the valley of the Damooda on the North side and at Hazareebaugh rises to 1100 feet in height, has to be passed over, after which the ground descends before rising again from the hills, forming the valley of the Sone river, so that we may suppose this part of the storm to have been raised by the Hazareebaugh range, high enough to allow it to pass over Gya.?*

* The following is an extract from a private letter of Mr. Redfield's to me, relating to this view of the subject:—

"It will not be surprising, if we find that the regular exhibition of the gale or hurricane on the surface of the Bay of Bengal, and the adjacent coasts, is more or less disturbed or interfered with by the influence of the wooded countries, and particularly the *high lands* to the East and North of this arm of the sea, over which elevations the wind must pass before it can be felt upon the Bay or the Peninsula. In most other countries this sheltering influence appears to be great, often lifting one side of the gale, or a part thereof, above the surface of the sea; so that this side of the gale is only noticed by its influence on the Barometer, or by the rain which may attend it. Much irregularity also prevails in this and other cases in the *extent* of the quiescent centre of the gale, and in the strength and shifts of the violent winds near to the borders of this centre, and they have been known to shift backward and forward in fitful and irregular changes."

Amooah may be considered as situated at the foot of the *glacis*, which descends from the secondary ranges of the Himalayas, and at a point about which the circular storms from Calcutta upwards, and the *gale* blowing from the Eastward along the foot of the hills may have met, and thus have occasioned the "whirling about" noticed in the report.

The most remarkable of the results of our enquiries is the explanation which is afforded us, by the clear and exact reports from Soorajegunge and Bhaugulpore, and by the curious accounts of the whirling and driving about of the clouds at Gya and Amooah of a phænomenon which is often puzzling to account for; that of "winds continually veering," which happens so often in furious tempests, not only at the centre, where it may well be looked for, but also at the *circumference* of storms. It is clear, or at least in the highest degree probable, that this arises from the interference of two storms, the currents of which, perhaps variously affected in their course, meet at certain points, and thus cause the continued veering or vibrating of the wind. In the present memoir, we have in the log of the *Algerine*, at p. 978, an instance of this occurring at sea, which may have been the effect of the monsoon, and on shore at Monghyr, and at the factory on the banks of the Jaboona, at which places, as to the two last, we *know*, that this cause existed.*

I have adverted, p. 1087, to the influence which the Cachar hills, (the ranges to the Eastward of Dacca,) may have had upon the Soorajegunge storm, but there is another consideration to be borne in mind here, which is, that both from the effect of the S. W. monsoon, as well as that of the storm, the winds would necessarily become more Southerly along the Eastern limits of the plains, which for our purpose we may take to be marked by the course of the Burrampooter to lat. 26° N., and more Westerly along the foot of the Eastern and Western ranges of the Nepal hills, or parallel to the line of the stations of Rungpore, Dinajepore, and Purneah. We may indeed, from Dacca to Purneah, consider

* Supposing their cause to have operated with less intensity, and in more time as at the circumferences of great circles of 500 or 1000 miles in diameter, we should probably have the same phænomenon, then called "variable winds, with a cross swell for the last 48 hours," which we so frequently meet with in Log books. See also Col. Reid's Chapter V. on Variable Winds.

that the *gales* experienced were *as much* owing to the monsoon as to the local effects of the hurricane. In my first Memoir, I have given a Chart fully explaining how this should occur, and really *did* occur on these same days in 1839, (3rd to 7th June,) at the setting in of the S. W. moonsoon of that year, which I find has been quoted by Professor Dove of Berlin, as exactly tallying with his theory of the causes of these atmospheric disturbances.* The object of our present researches is not so much to trace out the *causes* of storms, as to chronicle exactly the facts and other evidence; but I allude to this as necessary to be held in remembrance by those who may follow me in the attempts which I make to shew the causes of apparent anomalies when they occur.

Result.

To those who may not have the time to go through the foregoing details and summary of our evidence, the following brief notes of the Results of our inquiries relative to this remarkable storm may be acceptable. I have endeavoured to distinguish in them clearly the degree of certainty to which I think each separate head is entitled. It appears then that,——

1. From the 28th to the 31st May there seems to have been, in the S. Eastern and Eastern parts of the Bay, some considerable atmospheric disturbance, probably accompanying the setting in of the S. W. monsoon; but as far as we are informed, nothing which could be certainly called a rotatory storm, though it is highly probable that the *John William Dare* experienced on the 30th May the Eastern quadrant of the *Cauvery's* storm noticed in the next paragraph.

2. But on the 31st May, by which time the Barometer at Calcutta, where the weather was fine, had already fallen 0.14 below the average, the H. C. P. Vessel *Cauvery* had a true rotatory gale increasing to a hurricane at midnight of between that day and the next, and moderating at noon of the 1st June. This storm, which I have called

* See Scientific Memoirs by Taylor.

"the *Cauvery's* storm," veered with her from N. E. by N. to S. W. in about 36 hours, or nearly a point an hour. It was perhaps felt by the Light Vessels to the N. E. and N. of her, and certainly by the *Augustus* and *Panthea* coming up from the South, but was of no great extent. It may *possibly* have originated with the *John William Dare* on the 30th, about four degrees to the W. S. W. of False Point, but we have no distinct proof of this. It did not reach the shore about Pooree except as heavy rain.

3. The *Cauvery's* storm was moderating at noon on the 1st and to midnight when it had wholly ceased, and it was noon of the 2nd June, before we can say that the Calcutta storm had fairly commenced with the Light Vessels and partly at Calcutta. It was met at sea this day to the S. E. of the Light Vessels by the H. C. P. V. *Coleroon*, which had parted and stood to sea from the outer Light Vessel's station.

4. The Light Vessels' and *Coleroon's* Log fix the place of the centre, (for the Calcutta storm was then on the 2nd a true rotatory one,) very well, as being at noon about 60 miles to the S. E. of the Light Vessel.

5. The passage of the hurricane over Calcutta, fixes the place of its centre for the 3rd at about $12\frac{1}{2}$ miles to the S. S. E. of Calcutta at noon that day. It determines also pretty exactly its line of track from the 2nd at noon to the 3rd, and its rate of travelling at about 128 miles in 24 hours, or 5.3 miles per hour. Its diameter seems to have been about 180 or 190 miles.

6. About the same time that the centre of the Calcutta storm passed that city, the centre of a separate storm passed also over the station of Midnapore, about 70 miles to the W. by S. of Calcutta. This was of small extent, and not violent enough to do any considerable mischief. It seems to have been a sort of eddy storm, occasioned by the combined influences of the False Point storm, and the monsoon and the outer verge of the Calcutta storm.

7. That there were on the 4th two more vortexes or circular storms blowing, the one to the Westward about Bancoorah and Purulia, and the other between Soorajegunge factory and Dacca to the Eastward. The Calcutta storm is still traceable on this day, making in all three distinct rotatory storms, and these storms, with the general Easterly gale caused by the combined effect of the Northern quadrants of the storms, and of the S. W. monsoon deflected from the ranges of hills

on the Eastern frontier along the base of the Himalayas, was felt along the line of the Northern frontier from Dinajepore to Purneah; but not to so great an elevation as Titalayah, which is about 1,000 or 1,200 feet above the level of Calcutta, and 50 miles farther North than Dinajepore.

8. That on the 5th, there were also three distinct revolving storms, one at Soorajegunge, *over* which a centre passed between 8 and 9 A. M., and two others at Bhaugulpore and Jungypore, close to which centres must also have passed. The Bhaugulpore one was *not* that of Calcutta, and that of Jungypore may be supposed to be made up of this last and the influence of the Soorajegunge storm.

9. On the 6th, the storms were all breaking up and moderating.

10. That where the circumferences of the various circles met, and particularly on the 5th, there was a continual "veering about of the wind," though blowing a full storm.

11. That at some places, as Gya and Amooah in Tirhoot, the storm though not *felt* as one at the surface, was distinctly *seen* overhead, driving the clouds about in all directions.

12. That at the line of stations along the base of the Northern hills, the storms felt were not rotatory ones, but *probably* composed of the Northern quadrants of these circular storms to the South, and the great Easterly current formed by the deflection of the S. W. monsoon from the Arracan, Cachar, and Bootan hills, as shewn in my first Memoir for the storm of June, 1839.

13. That the greatest intensity of the various storms was that at Calcutta, for they are no where spoken of, nor are any facts recorded, which would lead us to suppose, that they were at any place the furious hurricane, which during some hours the storm undoubtedly was at Calcutta.

Conclusion.

I will not omit here one remark, to which I request the attention, as well of those who have kindly assisted our researches as those who might, but have not done so; and this is, that all will consider how much has here been demonstrated, and inferred from evidence literally collected piecemeal, and of which each separate part would have been comparatively valueless, if not aiding to form the whole. There can

be, I think, no stronger proof than this of the utility of every man's notes and remarks, how little important soever *he* may imagine them to be, and (a notion which I fear yet prevails sufficiently to deter many from assisting us, though well disposed to do so,) *the value of every plain common sense account of the weather, whether within or without the limits of a storm.* I repeat here again, that *all* observations are of value to us; that scientific ones are of course the best, but that the plain ones are often quite as useful at certain points, and that as our science is as yet in its infancy, our main business is to collect and register evidence. It will be observed, and it is a striking proof of what I have just said, that two of the most important deductions we have obtained in this investigation, have been proved by three simple unscientific statements of this kind. Mr. Martin of Sooraje-gunge factory, and Mr. A. Pinard of Kunjirpore factory near Bhaugul-pore, with the Newspaper notice from Jungypore, the author of which I do not know. From these we have been enabled fully to establish the highly curious fact, that a violent hurricane, with a strong monsoon setting in at about right angles to its course, sometimes breaks up into several smaller storms, none of them equalling the main one in fury, *but all obeying the law of rotation.* These reports also explain a phænomenon, the cause of which we suspected before, but of which we had no distinct proofs. I mean those instances in which what is usually described both at sea and on shore as "wind continually veering" takes place, though we have full evidence, that the places are at a distance from the centre of the storm, and this again leads us to the strongest confirmation of Col. Reid's theory of the variable winds. I trust it is unnecessary after such instances to repeat, that *all* observations may be of use.

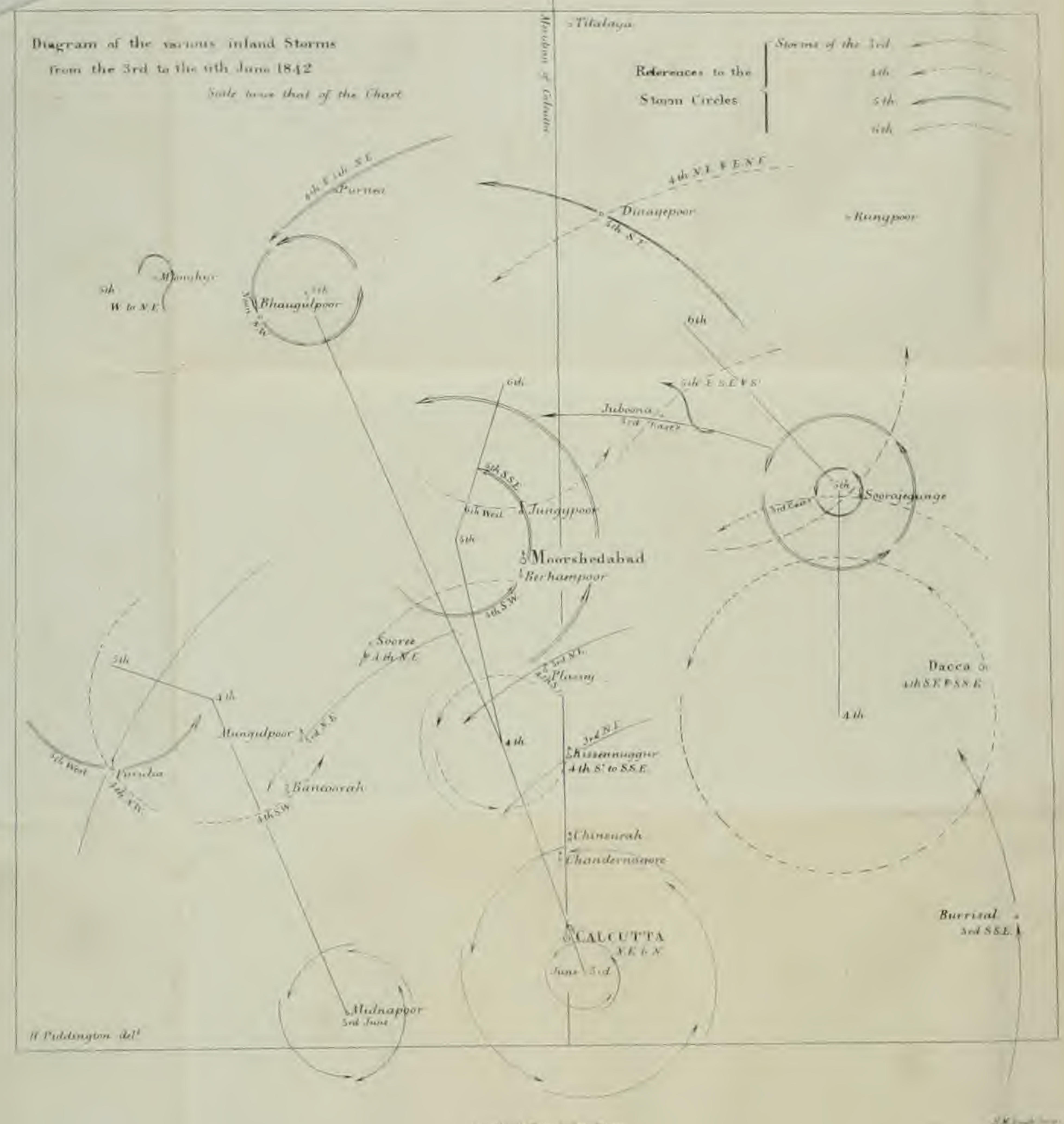
Diagram of the various inland Storms
from the 3rd to the 6th June 1842
Scale twice that of the Chart
References to the
Storm Circles
Storms of the 3rd
4th
5th
6th
Meridian of Calcutta
Titalaya
Purneea
Dinagepoor
Rungpoor
Bhaugulpoor
Juboona
Jungypoor
Moorshedabad
Berhampoor
Soorajegunge
Dacca
4th S.E. & S.S.E.
Sooree
Plassey
Kissennuggur
4th S! to S.S.E.
Mungulpoor
Bancoorah
Chinsurah
Chandernagore
CALCUTTA
N.E. & N.
June 3rd
Midnapoor
3rd June
Burrisal
3rd S.S.E.
H Piddington del!


Chart
To the Seventh Memoir
on the
Law of Storms
in India
being
The Calcutta Hurricane
of 2nd–3rd June
1842.
By Henry Piddington
References to the Storm Circles
Lucknow
Allahabad
Benares
Patna
Gya
Purneah
Moosufferpoor
Titalayah
Darjeeling
Dinagepoor
Rungpoor
Jumalpoor
Bhagulpoor
Moorshedabad
Berhampoor
Plassey
Dacca
Calcutta
Chittagong
Midnapoor
Balasore
Cuttack
Akyab
Chaduba
Andaman Is.
Madras
Pondicherry
Tranquebar
Masulipatam
Samulcotta
Juggernathpooram
Coringa
Pt. Palmiras
Samhulpoor
H. Piddington del.

A Monograph of the Indian and Malayan species of Cuculidæ, or Birds of the Cuckoo family. By Edward Blyth, *Curator of the Asiatic Society.*

[Continued from p. 928.]

25. *Ph. longicaudatus,* Nobis, *J. A. S.*, X, 923; perhaps *Ph. Crawfurdii,* Gray, mentioned in Mr. Eyton's catalogue of a collection of Malayan birds, *P. Z. S.*, 1839, p. 105; or it may be the *Melias Diardi* of Lesson, which I have reason to suspect is allied. (Long-tailed Malkoha.) Length of a fine specimen twenty-three inches, of which the middle tail-feathers occupy sixteen inches and three quarters, the outermost ten inches less; wing six inches, the tertiaries overpassing the primaries half an inch more; bill to forehead (through the feathers) nearly an inch and three-eighths, and an inch and a half to gape; tarse nearly an inch and three-eighths. General colour dark greenish-grey; the wings and tail shining dark green, with a white tip to each tail-feather; front of the neck and breast, paler, passing into whitish on the throat and immediately around the naked space encircling the eye, these whitish feathers having dark shafts, which terminate in a slightly prolonged hair-like bristle; small anterior portion of the lores black, and the bare orbital space moderately developed, and papillose. Beak bright green, and legs apparently have been greenish. This bird is common in the Tenasserim provinces, and always seen in pairs. It would appear also to be not rare in Nepal, and from the *M. S.* name *monticolus* applied to it by Mr. Hodgson, may be presumed to affect upland forests. Should it be the *Ph. Crawfurdii* of Mr. Gray, of which I have seen no description, it would also inhabit the Malay peninsula.

26. *Ph. Jerdoni,* Nobis: *Xanclostomus viridirostris,* Jerdon, *Madr. Journ.* XI, 223, — not *Ph. viridirostris,* Eyton, *P. Z. S.* 1839, p. 105, which is the *Rhinortha rufescens (?)* of this Monograph. (Fork-feathered Malkoha.) Length about fifteen inches, of which the tail is nine inches, its outermost feathers four inches and a quarter less; wing five inches and three-eighths; bill to forehead (through the feathers) an inch and one-eighth, and to gape an inch and a

quarter; tarse an inch and a quarter. "Irides fine blood-red; small naked eye-spot cobalt-blue; bill beautiful apple-green; legs and feet greenish-black." Upper-parts coloured exactly as in the preceding species, but less greyish on the head, which is distinctly though faintly glossed with green, nor is there any whitish towards the nostrils or bordering the contracted naked orbital space above: under-parts dusky-greyish, stained with ferruginous about the breast, and the feathers of the throat and fore-neck dusky at base, and furcate, from having their terminal webs much longer than the shaft, this lengthened portion being pale greyish, contrasting with the rest.

In most particulars this bird agrees with Dr. Latham's description of his *Madagascar Cuckoo, Gen. Hist.* III. 270, (the *Serisomus cristatus*, Swainson, or *Coucou huppé de Madagascar* of Buffon,) which Lavaillant states is also found in some parts of India, and in Senegal; Dr. Latham adding, that "I find a similar one among the drawings of Mr. Daniell, found in Ceylon, and there called *Handee Kootah*." No doubt the present species is alluded to in both cases.

Mr. Jerdon informs us that it "is found all over the [Indian] peninsula, but it is an uncommon bird, except in some few localities. I have seen it in thick bamboo jungles at the bottom of the Conoor pass, in thick hedges and trees in the Carnatic, and in bushy jungle in the Deccan. It wanders about from tree to tree, or works its way through the thick hedges, and feeds on various large insects, such as Grasshoppers, *Mantides*, and the like; also on caterpillars and other larvæ. It makes its way with great adroitness through the thick prickly hedges and bushes it delights to frequent."

These are all the Asiatic species of Malkoha which I am able to offer any description of, though aware of the existence of others, of which some, perhaps, may be identified with certain of the foregoing. Such are *Ph. Crawfurdii* of Gray, and *Melias Diardi* of Lesson, both of which are not improbably my *longicaudatus*; and Mr. G. R. Gray adds, among his *Phœnicophainæ*, a *Calobates radiceus*, Temminck, *Pl. Col.* 538, and a *Taccocua Leschenaultii* of Lesson, one or both of which may be exclusively African, though more probably inhabiting the Malay countries. There is also a *Phœnicophæus lucidus*, Vigors, mentioned as an inhabitant of Sumatra in Dr. Horsfield's list, *J. A. S.*, X. 56.

Next in order ranges a remarkable form, which combines the general contour and short and curved inner hind-claw of the preceding, with the beak (and, in at least one instance, the spinous plumage) of the Coucals *(Centropus)*. It is the *Zanclostomus* of Mr. Swainson.

27. *Z. Javanicus: Phœnicophœus Javanicus*, Horsfield, *Lin. Trans.* XIII, pt. I. p. 178, and figured in the *Zoological Researches in Java; Coccyzus rubrirostris*, Drapiez, *Dict. Class. d'Hist. Nat.* IV, 558; *C. chrysogaster*, Temminck, apud Horsfield, "Catalogue of Javanese Birds" prefixed to *Zoological Researches in Java; Chalybeate Cuckoo*, Latham, *Gen. Hist.* III, 304, but not the Var. *A.*" appended to this.* (Bay-breasted Sirkeer.) "Entire length eighteen inches, nearly eleven of which are occupied by the middle tail-feathers. The upper parts generally are greenish-gray, having a metallic lustre, which is stronger on the upper part of the tail, and on the extremity of the wings, where the tint is saturated inclining to black. The head is of a lighter tint, inclining to plumbeous, and without any lustre; having a small naked mamillary space surrounding the eyes. The base of the bill is surrounded with vibrissæ, straggling, and pointing forward and backward. The cheeks, the throat, the neck anteriorly, the vent, and the thighs, have a ferruginous-chestnut tint, which on the latter is darker, inclining to rufous; the lower part of the breast and the abdomen have the plumbeous colour of the head more diluted, and slightly variegated with chestnut. The bill is red and shining; the naked space about the eyes yellowish, and the feet are black. About half an inch of the extremity of the tail-feathers is tipped with white: and the irides have also a whitish hue.

"This bird is found in the society of different Coucals, at the confines of large forests, in plains covered with low shrubs and solitary trees. It resembles the *Phrenotrix Temia* [*Crypsirina varians*] in its habits and manners. The shortness of its wing permits only of interrupted flights. It is not found in great abundance in Java, being chiefly observed about noon, and it is remarkable for the beauty

* "Length sixteen inches. Bill long, rather bent, and black; plumage above brown; spurious wing white; beneath, with the under wing-coverts, from the breast to the vent, pale rufous; quills and inner webs white, from the base to the middle; tail cuneiform, the two middle feathers four inches long [evidently a mistake], the outer one two inches and a half, all of them tipped with white, and the inner webs barred with the same." Very doubtful as appertaining to the present genus.

of its form." (Horsfield.) This species has also been received from Borneo, and from the Malay peninsula; the presumed female differing in having the breast-patch brownish instead of plumbeous.

28. *Z. Calorenchus (calorhynchus?); Phœnicophœus calorenchus*, Temminck, *Col.* 347. (Red-headed Sirkeer). Thus briefly noticed in Griffith's English edition of Cuvier's *Régne Animal*, VII, 465, and there placed next to the preceding species. "Black; head and neck, red; crown, iron-grey; bill yellow, red, and black"—the admixture of the last perhaps an indication of immaturity. Inhabits ~~Java~~ Celebes.

29. *Z. Sirkee*, Jerdon: *Eudynamys (!) Sirkee*, Hardwicke and Gray; *Sirkeer Cuckoo*, Latham, *Gen. Hist.* III, 267; *Centropus cuculoides*, C. W. Smith, *J. A. S.*, X, 659, (Indian Sirkeer). The only specimen of this I have to describe from is probably a female, rather small in its dimensions, with the buff plumage of the under-parts almost confined to the lower part of the breast. Length about fifteen inches, of which the middle tail-feathers measure nine inches, and the outermost two inches and a half less; wing six inches; bill to forehead (through the feathers) an inch and a quarter, and an inch and a half to gape, its greatest vertical depth seven-sixteenths of an inch; tarse above an inch and a half. General hue of the upper parts ashy-brown, with a gloss of green, the shafts of the feathers dark-coloured and spinous, more especially on the head, neck, and breast: under parts paler, slightly tinged with fulvous on the throat and fore-neck; the lower part of the breast, with the thighs, wholly fulvous or buff; vent and lower tail-coverts dusky glossed with green; the middle pair of tail-feathers coloured like the back, and the rest successively darker and more largely tipped with white: on the tertiaries, upper tail-coverts, and tail-feathers, are numerous cross-rays which appear or not according as the light falls on them: bill coral-red, tipped with yellow, and some black at the lateral margin of the upper mandible. Mr. Jerdon describes the bill of the fresh bird, as "cherry-red yellowish at tip; feet plumbeous; irides reddish-brown. Length sixteen to seventeen inches; wing six inches and a quarter; tail nine inches and a half." The entire under-parts are represented uniform fulvous in Hardwicke and Gray's figure; and the black remaining on the sides of the upper mandible in the specimen before me (presented by Mr. Jerdon) is doubtless a sign of nonage.

Mr. Jerdon remarks having "seen this bird in bushy ground on the top of the Neilghierries, but in no other locality till lately met with in a hilly and low jungly district, near Jaulnah. It has the same wandering habits, and the same kind of food," as the *Phœnicophœus Jerdoni*. Mr. C. W. Smith records having "met with this species at the Bherah lake, in the Gorruckpore district, where it appeared to be pretty common, but I have not," he remarks, "seen it elsewhere. It greatly resembled the *Mahooka (Centropus Phillipensis)* in its manner of running and flying."

There now only remain the Coucals *(Centropus*, Illiger, v. *Corydonyx* Vieillot, v. *Polophilus*, Leach), which are at once distinguished by their long and straight inner hind-claw and rigid spinous plumage, though of one species *(C. affinis)* Dr. Horsfield writes—"*ungue hallucis arcuato*," which would seem to intimate its true station to be in the preceding group. The structure of their feet indicates ground-habits, and they are mostly seen walking upon the ground. One species appears to be very common throughout India and the adjacent countries to the east and south.

30. *C. Phillipensis*, Cuvier: *Corydonyx pyrrhopterus*, Vieillot; *Cent. bubutus*, Horsfield, *Lin. Trans.* XIII, pt. 1, p. 180, and *Cuculus bubutus*, Raffles, *Ibid*, pt. II, p. 286; *Chestnut Cuckoo*, Latham, *Gen. Hist.* III, 243, on which is founded *Cent. castanopterus*, Stephens' Shaw's *Zoology*, XIV, 215; *Polophilus Sinensis?* Shaw's *Zoology*, IX, 51. (Common Indian Coucal.) Length of a fine male eighteen inches and a half, by twenty-three inches in extent; wing eight inches; and middle tail feathers nine inches, the outermost three inches shorter: bill to forehead (through the feathers) an inch and a half, and tarse two inches, the long hind-claw above an inch. Irides crimson: bill and feet black. This handsome bird has the mantle and wings bright rufous, and the rest of the plumage black glossed with purple and greenish, the latter prevailing on the ear-coverts and tail, and the former elsewhere: its feathers are but slightly spinous, and chiefly so on the crown and fore-neck; sexes alike. The young in first plumage vary remarkably, as illustrated by two specimens with imperfectly developed feathers which I have recently obtained. One is essentially similar to the adult, but the feathers are shorter and of flimsy texture, the colours dull, the black or dusky

fading to brown on the lores and chin, there is no rufous on the middle of the back, and the scapularies, tertiaries, and wing-coverts, are suffused with fuscous; irides pale dusky; this proved a male, and on no part of it is there a single cross-band. A female of the same age accords in size and in the texture of its feathers, but in colouring is widely different; the irides are dull blue, and the bill flesh-coloured, except the upper half of the superior mandible, along its ridge, which is dusky; the other young specimen having the beak almost wholly dusky, except at the lower part of the under mandible at base: general colour of the upper parts black, barred with bright rufous; of the under parts greyish-dusky, barred with white; tail glossy green-black, with narrow white bars: the crown spotted with rufous, paling and merely tipped with rufous on the occiput and neck; and the wings in particular very beautifully barred black and rufous, the latter becoming obsolete on the exposed portion of the tertiaries: lores and above the eye whitish. Another female moulting from this barred dress into the adult livery has such feathers as remain of the former different from those of the last described specimen; its unchanged scapularies being rufous-brown without barrings, much duller rufous than the new ones; the primaries, secondaries, and tertiaries, that remain, are barred with lighter dusky than in the other; and the only unchanged tail-feather (one of the middle pair) is crossed with eleven undulating narrow pale fulvescent bars. This specimen had been intermediate in colouring to the two others. In this barred dress it is the *Centropus fasciatus*, C.W. Smith, *J. A. S.* X, 659, and also Dr. Latham's alleged variety of his *Antiguan Cuckoo*, (*Gen. Hist.* III, 247), upon which Shaw has founded his *Polophilus Sinensis;* but while Dr. Latham correctly describes the form, plumage, and habits of the present species, under the designation *Chestnut Coucal*, he gives an alleged representation of the latter, evidently copied from one of Gen. Hardwicke's drawings, which may possibly represent a distinct species described as follows:—

"One of these [Chestnut Coucals] in the collection of drawings of Gen. Hardwicke, was eighteen inches in length; the head, neck, and under-parts ash-coloured, streaked with white as far as the breast; over the eye a whitish stripe; belly and thighs marked with transverse lines of white; tail plain black, not greatly cuneiform, though much

rounded; wings as in the others. This was met with at Cawnpore in April, and is said to be a bird of the first year," which I greatly doubt.*

The *C. Phillipensis* is common to all south-eastern Asia and its islands, but has been suspected not to occur in western India, though, in the peninsula, Mr. Jerdon describes it as " a common and universally spread bird, frequenting wooded and cultivated grounds, in all parts, and found also in the more open spaces of thick jungles. It is often seen in thick hedges, also in woody nullahs, and in low bushy tracts. It feeds on the ground chiefly, walking and running with great facility,† and picking up various large insects, centipedes, lizards, and even scorpions and small snakes. It may often be seen walking along the bank of a dry tank, a bund of a paddy-field, and being a remarkably slow and stupid bird, and of slow flight, it is occasionally run down, or even caught by the hand, in sufficiently open ground. A good Shikra *(Accipiter Dussumieri)* will also easily strike it down.

" The *Mahooka* has a deep sonorous call, something like '*whoot whoot, whoot,*' which is often heard in a thick bush or hedge, while the bird itself remains unseen"; — a dull, heavy sound, which, as Dr. Horsfield remarks, has suggested nearly the same name for the birds of this genus in many distant countries: it is *Bubut* with the Javanese; *Houhou* in Egypt; and *Toulou* in Madagascar;" to which may be added *Kooka* in Bengal, and *Mahooka* in southern India. The young bird almost constantly repeats a strange hoarse sound like a person choking (a sort of '*Guk, koh-koh*',) which is not pleasant to hear. It is common in the vicinity of Calcutta, and Dr. McClelland remarks, that it is " very common in villages and cultivated rice-fields in Assam, and in low inundated lands along the banks of rivers. It delights in humid climates, as is proved by the vast numbers of them which occur in the Soonderbuns; but I question

* It both steps with alternate motion of the feet, and hops in a rapid and scrambling manner.—E. B.

† From specimens obtained since the above was transcribed, more or less barred on the upper-parts and mottled with whitish below, having also an ill defined superciliary streak, I now much incline to regard this Cawnpore specimen as a variety of *C. Phillipensis*.—E. B.

if they are to be found in India further northwest than Bengal." Certainly no figure of it occurs in the late Sir A. Burnes's collection of drawings of the birds inhabiting the Indus territory, which is tolerable proof of at least its rarity on the banks of that river. In Burmah, China, and the Malay countries generally, it is very abundant.

31. *C. viridis : Polophilus viridis*, Shaw ; *Cuculus Ægyptius*, var. γ, Latham, *Ind. Orn.* I. 213. *Le Coucou Verd d'Antigue* (of the Philippines), Sonnerat, *Voyage a la Nouvelle Guinée*, p. 121. (Green Coucal.) Described as nearly of the size of the European Cuckoo. The head, neck, breast and belly, obscure deep green, verging upon black ; the wings of a deep reddish-brown ; and tail long and black : bill black ; and feet tinged with the same. Irides black (?). Plumage generally rigid, with the barbs of the feathers disunited (Sonnerat). Apparently much allied to the last species, but of inferior size, and differing somewhat in its colouring.

32. *C. lepidus*, Horsfield, *Lin. Trans.* XIII, pt. 1, p. 180 : *Cuculus Tolu*, apud Raffles, *Ibid*, pt. II, p. 285. (Pale-breasted Coucal.) In the catalogue of Javanese birds prefixed to his *Zoological Researches in Java*, Dr. Horsfield marks this species as " to be cancelled"; yet in his enumeration of the species procured by Dr. McClelland in Assam, this name for one of them is retained, with the remark, that " Mr. McClelland's specimen is comparatively of a large size, but agrees in all particulars with the *Cent. lepidus* of Java." (*Proc. Zool. Soc.* 1839, p. 166.) Now, in a note to the *Researches in Java*, the same naturalist writes — " I consider this small group to consist of the following species, agreeably to M. Cuvier's arrangement, as given in the *Régne Animal*, I. 426, in the note : — 1. *Cuculus Egyptius* and *Senegalensis*, which are united by M. Cuvier, — 2. *C. Phillipensis*, Cuv.,—3. *C. nigrorufus*, Cuv.,—4. *C. Tolu*," (which is far from being a complete enumeration of the extra-Indian species now well ascertained) ; and it may be, therefore, that at the period of writing this, Dr. Horsfield followed Sir Stamford Raffles in considering *lepidus* as identical with *Tolu*, and certainly the description of the latter accords so nearly with a specimen before me, that I should not be surprised at their being identical, though, if so, it is remarkable that Dr. Horsfield should formerly have marked

the name *lepidus* as to be cancelled, without (as in other cases) placing the prior specific name in the opposite column. With regard to Dr. McClelland's Assamese bird, of which but one specimen was obtained, an excellent coloured figure of it is now in his possession, which has enabled me to identify with it, beyond doubt; a specimen procured at Chyebassa by Lieut. Tickell. The following is the original description by Dr. Horsfield: "Length twelve inches. The crown, neck, scapularies, and secondaries, dusky, the shafts longitudinally margined on each side with white: wing-coverts dusky or of a bay colour, with white shafts: primaries also bay, and tipped with dusky: the tail-feathers black, with a whitish terminal band, and with their coverts barred with ferruginous: throat, fore-neck, breast, and belly, white." Sir Stamford Raffles remarks that—"the colours of this bird vary considerably at different ages. When young it is of a greenish black, with rufous wings. As it becomes older, the belly becomes whiter, the shafts of the feathers on the head and back acquire a light colour, and the upper feathers of the tail become barred with grey. It lives on insects, is chiefly observed on the ground, and has a weak flight."

The single specimen before me is fortunately in a transitional state of plumage, which enables me to assert that its changes are analogous to those of the preceding species. The dark first plumage is mentioned by Raffles, and the present specimen is a young male exchanging its barred dress for the adult garb, which latter is far advanced towards completion. Length fourteen inches, of which the tail measures eight inches and a quarter, its outermost feathers four inches less; wing six inches; bill to forehead (through the feathers) an inch, and to gape an inch and a quarter; tarse an inch and five-eighths, and long hind-claw an inch and one-eighth, being (as Sir Stamford Raffles notices) proportionally longer than in *C. Phillipensis*. Bill pale horny, darker along the ridge of the upper mandible; and feet dusky-leaden: irides carmine. Wings rufous-chestnut, less dark than in the preceding species, and tipped with dusky; the tertiaries suffused with fuscous, and such among them and of the secondaries as remain unchanged, are brighter ferruginous barred on both webs with black; the new greater wing-coverts are each slightly margined with a dusky line; the tail-feathers which have been renewed are wholly

glossy greenish-black, with obscure cross-striæ appearing at particular angles of reflection, but those which have not been shed are barred with rufous, for the terminal half in the middle pair, and on a successively smaller portion to the outermost; the upper tail-coverts are remarkably long, have a bright green gloss, and are more narrowly barred to near their base with rufous; the exposed whole upper surface of the partially spread tail thus appearing barred, while the unbarred part of the feathers is concealed by those which overlap them: the head, neck, and sides of the breast, are fulvescent-brown, with dusky lateral margins to the feathers, and rigid whitish stems, which thicken a little towards the extremity; scapularies similarly white-shafted, as also the fore-neck and breast, whereon the dusky lateral margins disappear; throat and middle of the breast and belly whitish; the flanks dusky; and sides, thighs, and lower tail-coverts, pale fulvescent with numerous blackish cross-rays: the new unbarred tail-feathers retain a whitish tip.

This appears to be a species of rare occurrence in India, as Dr. McClelland's Assamese specimen, and that here described from Chyebassa in Central India, are the only instances of its having been obtained with which I am acquainted. It would seem to be more common in the Malayan Archipelago.

33. *C. Bengalensis*, Latham, *Ind. Orn.* II, 114, — *Gen. Hist.* III, 248. (Pygmy Coucal.) Another rare species which is thus described by Latham. "This is a trifle larger than a Lark [eight inches long, Drapiez]. Bill dusky; head, neck, back, and wing-coverts ferruginous, marked with short white lines, bounded by black, pointing downwards; belly yellowish-brown; quills reddish-brown, the first and second primaries plain, the rest barred with black; tail very long, and cuneiform; its outer feathers dusky, with brown tips, the other marked with bars of black, and narrow ones of brown; legs black; the inner hind-claw straight. Inhabits Bengal". In this brief description may be recognised, with little hesitation, a transitional state of plumage analogous to that described of the two last species, and style of marking similar to that of *C. lepidus*. Mr. Jerdon, in his *Supplement*, remarks— "On the authority of Mr. Elliot, I insert this as a peninsular species, that gentleman having observed it in the Southern Mahratta country."

34. *C. affinis*, Horsfield, *Lin. Trans.* XIII, pt. 1, p. 180. Length fourteen inches and a half. Plumage black, wings ferruginous; the scapularies soot-coloured, with white shafts; outer tail-feathers having a white terminal band; hind-claw curved. Inhabits Java, and is there termed *Bubut-allang-allang*". Horsfield.*

I have now analysed, to the best of my ability, and to the full extent of the means at my disposal, the formidable array of names presented to the consideration of the student of oriental *Cuculidæ;* and I trust that I have effected something towards reducing the supernumeraries to the rank of synonyms: aided by European libraries and collections, I could of course have rendered the monograph more complete, but, as it is, I think, I have been fortunate in verifying the species of my predecessors, and particularly those of Latham, nearly all of which assigned to this region of the globe have, I think, been satisfactorily here identified. In every practicable instance, I have drawn up original descriptions, sufficiently detailed, I trust, to ensure the recognition of the species without doubt or difficulty; and this much required pioneering accomplished, it remains for those, who have the opportunity, to verify and enrich our knowledge of this interesting group of birds, by observing and recording their observations on their habits, distribution, &c., but especially on all that concerns their propagation, whether they incubate their own eggs, or to what other birds they consign the charge of them, and a variety of curious particulars connected therewith. I had long been of opinion, from various

* Here may be noticed the *Cuculus Sinensis* and *C. paradsieus* of Latham, respectively founded on *le Coucou bleu de la Chine, en langue Chinoise, San-hai,* and *le Coucou à longs brins,* of Brisson and Buffon, described by the former of these two naturalists from drawings by a M. Poivre, wherein there can be no doubt that the reversed outer toe was a fancy of the artist, and that the species delineated were *Pica (Cyanocorax) erythrorhynchus,* — which Dr. Cantor saw at Chusan,—and one of the Racket-tailed Drongos, probably *Edolius grandis.* Dr. Latham also describes a three-toed *Asiatic Cuckoo,* "supposed to inhabit India, and in the collection of Lady Clive. I find it also," he adds, "among the drawings of Gen. Davies taken from one in the collection of Mr. Thompson. Length eight inches or more. Bill nearly an inch, brown-black; nostrils scarcely conspicuous, being in great part covered by a membrane: general colour of the plumage dirty brown-black, inclining to lead-colour on the rump; sides of the chin, and throat, grey, mottled with black in short dashes; belly lead-colour; tail-coverts nearly black; tail the same, with a blue grey tinge, the outer feathers black on the inner web; on the outer white, with a black serrated streak indenting the white like a saw; shape of the tail cuneiform. It has only three toes, *two placed forwards* and one backward: legs brown."

data, that much more than the usual period intervened between the successive deposition of the eggs of the European Cuckoo, and that this was the reason it did not incubate its own, when the idea received confirmation, while the inference based upon it fell to the ground, on learning the remarkable circumstances connected with the propagation of the nearly allied Piayas (*Cureus*, Boié, *Erythrophrys*, Swainson,) of North America, wherein it has now been ascertained that the eggs are, *for the most part*, incubated by the parents, though so long a time elapses between the successive laying of them, that a newly laid egg, a hard-set one, a callow nestling, and another ready to fly, may be found together in the same nest, while other more advanced young ones still keep to the neighbouring branches. The whole account is, indeed, so strange and surprising, that I shall follow Mr. Yarrell in quoting the details from Mr. Audubon's fifth volume.

"Whilst at Charlestown in South Carolina," narrates Mr. Audubon, "in the early part of June, 1837, I was invited by J. S. Rhett, Esq., residing in the suburbs of that city, to visit his grounds for the purpose of viewing the nest of the yellow-billed Cuckoo [*Cur. Americanus*]. This I did in company with my friend Dr. S. Wilson, and we found ourselves highly gratified, as we were enabled to make the following observations:—

"A nest, which was placed near the centre of a tree of moderate size, was reached by a son of the gentleman on whose ground we were. One of the old birds, which was sitting upon it, left its situation only when within a few inches of the climber's hand, and silently glided off to another tree close by. Two young Cuckoos, nearly ready to fly, scrambled off from their tenement among the branches of the tree, and were caught by us after a while. The nest was taken, and carefully handed to me. It still contained three young Cuckoos, all of different sizes, the smallest apparently just hatched, the next in size probably several days old, while the largest, covered with pen-feathers, would have been able to leave the nest in about a week. There were also in the nest two eggs, one containing a chick, the other fresh or lately laid. The two young birds which escaped from the nest, clung so firmly to the branches by their feet, that our attempts to dislodge them were of no avail, and we were obliged to reach them with the hand. On now looking at all these young birds, our surprise was indeed

great, as no two of them were of the same size, which clearly shewed that they had been hatched at different periods, and I should have supposed the largest to have been fully three weeks older than any of the rest. Mr. Rhett assured us, that he had observed the same in another nest placed in a tree within a few paces of his house, and which he also shewed to us. He stated that eleven young Cuckoos had been successively hatched and reared in it, by the same pair of old birds, in one season, and that young birds and eggs were to be seen in it at the same time for many weeks in succession.

"On thinking since of this strange fact, I have felt most anxious to discover how many eggs the Cuckoo of Europe drops in one season. If it, as I suspect, produces, like the American bird, not less than eight or ten, or what may be called the amount of two broods in a season*, this circumstance would connect the two species in a still more intimate manner than theoretical writers have supposed them to be allied. Having mentioned these circumstances to my friend, Dr. T. M. Brewer, and requested him to pay particular attention to these birds while breeding, he has sent me the following note:— 'The fact you intimated to me last July I have myself observed. The female evidently commences incubation immediately after laying her first egg. Thus I have found in the nests of both species of our Cuckoos one egg quite fresh, while in another the chick will be just bursting the shell; and again, I have found an egg just about to be hatched while others are already so, and some of the young even able to fly.'" It is well known that domestic pigeons will not unfrequently lay again, before their previous pair of young are fit to leave the nest, in which case, I believe, they generally oust the latter as soon as they can, though continuing to feed them: but a more analogous fact to that presented by the North American Cuckoos was announced by myself in 1833, as cited by Mr. Yarrell, respecting the propagation of the common Barn Owl (*Strix flammea*), — a bird common here, as well as in England and North America, where Mr. Audubon has

* A pair of Blackbirds on the large islet of St. James's Park, London, being the only ones at the place, and the hen so remarkably tame, that there could be no doubt of her identity throughout the season, reared and brought off four broods of young in one year, the three first consisting of five each, and the last of two only, seventeen in all; as many as in a Partridge's single brood, the latter only laying a second time when some accident had happened to the first brood.—E. B.

since observed the same of it, — and which, in like manner, continues to lay both while hatching and rearing its excluded progeny of different ages.

Moreover, what is still more remarkable, in connexion with the facts already stated, it appears that these Cuculine birds of North America do sometimes lay in the nests of other birds; while, like their European relative, they devour all the eggs they find: in opposition to which, may be cited a statement by Mr. Gray, that the European Cuckoo does not uniformly desert her offspring to the extent that has been supposed; but, on the contrary, "though she leaves the eggs to be hatched by another bird, sometimes at least she takes care of the young bird and feeds it after it leaves the nest, and teaches it to fly"*, as he declares to have personally witnessed in one instance. This much, however, is certain, that a large proportion of the young Cuckoos hatched in England do not see the light till after the parent-birds had left the country: and whatever may be the cause of the singularly early migration of this species, which retires southward at the hottest period of the year, while other migratory species (as observed in captivity,) are directly prompted by decline of temperature to undertake their long journey†, it has been plausibly enough suggested that it must be in reference to this that the Cuckoo is endowed with the instinct of burthening other species with the charge of its offspring; and it is worthy of remark (though I do not know that the analogy has been before adduced), that in the common British Swift (*Cypselus murarius*), which also quits for Southern climes remarkably early, though not so very soon as the adult Cuckoos, the migrative impulse is oftentimes sufficiently intense to impel the parent-

* *Proc. Zool. Soc.*, 1836, p 104.

† Having kept numerous migratory birds through the winter in England, I have repeatedly had opportunities of observing that the instinctive impulse to depart was thus incited, becoming moderate, in general, during mild weather, and enhanced with cold: the birds flapping and fluttering their wings, with beak pointed upwards, and often violently dashing against the roof of their prison, during the evening and night (being very rarely thus agitated in the day time), and continuing to evince this migrative restlessness, at intervals, throughout the winter. Food has nothing to do with it, and one of the most extraordinary circumstances connected with migration is, that the same individuals return to their exact former abode the following season, even captive birds turned loose having repeatedly been known to come back to their place of confinement; and this notwithstanding they travel by night, and perform aërial voyages of such vast extent!

birds to abandon their helpless later broods to starvation! Whether the instances adverted to by M. Audubon of the egg of the American Piayas being found in other bird's nests happened at a late period of the season, would be not uninteresting to ascertain.

But there is a remarkable genus of *Sturno-fringillidous* birds in the New World, the *Molothrus* of Mr. Swainson, consisting of one species in North America, and another (recently discovered by Mr. Darwin) in the Southern continent, both of which have been ascertained to resemble the typical *Cuculi* in entrusting their eggs to the care of other birds*; and a very interesting and minute account of the Northern species (*M. pecoris*, the "Cow Bunting" of Wilson,) by Mr. Ord, — the friend of Alexander Wilson, and continuator of his *American Ornithology*, — will be found in Loudon's *Magazine of Natural History* for February, 1836 (having been elicited, indeed, by some remarks which I formerly published on the habits of the British Cuckoo). From this article it appears, that Wilson was mistaken in his statement that "the Cow-bird continues to be seen so late as the middle of June; after which we see no more of them until about the beginning or middle of October". Mr. Ord asserting that they are common in Pennsylvania in July, from which I suppose may be inferred that after that time they disappear — it being just the period at which the adult Cuckoos quit England, and thus affording, if true, a remarkable analogy tending to support the hypothesis before noticed.

Conducted, however, to this result by studying the parasitic birds of temperate and Northern climates, it becomes desirable to ascertain how far the circumstances connected with the propagation of those of tropical countries may tend to confirm or overthrow such generalizations as are based exclusively upon the former; and in India especially, a wide field (in this as in everything else) is open to our investigation, hitherto quite unexplored, and certainly one which

* A strange oversight, in fact an abominable bit of careless writing, occurs in Mr. Swainson's notice of the habits of the Cuckoos, in his *Habits and Instincts of Animals* (p. 19), published in the series of Lardner's *Cabinet Cyclopædia*. Passing from the British species, whereof he iterates the current erroneous statement that it invariably selects the nests of *insectivorous* birds to deposit its egg in, he remarks — "the North American Cuckoos, however, being of a different species, more frequently lay their eggs in the nests of the Cow-pen birds (*Molothrus pecoris*)," &c.!!! Fine Ornithological doctrine this from *Magister Artis!*

from the variety of species and genera of *Cuculidæ* which have been here described, is very likely to disclose some new phases or modifications of procedure elucidative of the enquiry for what ultimate purpose do certain birds of this family, as also the American Molothrahs, consign the charge of their progeny to alien species. Already, it is well ascertained that the Coël — a permanently resident species — is parasitic, which is opposed to the hypothesis founded on the migratory habits of the Northern species, and I particularly recommend the study of all that relates to the propagation of this very common bird to those who may have the opportunity of making observations, as also that of another common species — the *Centropus Phillipensis*, besides which the *Cuculus fugax* appears to be everywhere abundant, and in Bengal the *C. (Oxylophus) edolius*. The Malkohas and their allies are much more common in the Malay countries than in India, and they are also particularly worthy of investigation: but the truth is that, in every instance, carefully recorded and trustworthy observations are needed, for their intrinsic interest as well as for supplying materials upon which to generalize; and I trust that by furnishing a Monograph of the known species, I remove one principal difficulty on the part of many willing observers, who may oftentimes have been discouraged and deterred by the difficulty of ascertaining what bird it is they have been noticing, apart from which knowledge there is comparatively little satisfaction in noting down traits of habit, whence numberless curious discoveries may be said to die still-born, which otherwise might be turned to account.

The strictly parasitic Cuckoos (at least the British species, and it may be inferred the rest), together with the American Molothrahs, do not pair, as no object would be attained by their doing so, nor are they polygamous in the ordinary sense of the term, but the sexes are promiscuous in their intercourse; whence a number of males may occasionally be seen chasing a single female at any period of the breeding season: and with regard to the Molothrahs, these are gregarious at all times, each female withdrawing herself from the flock and setting out in quest of other birds' nests when she wants to lay; the which I mention, to notice a very curious observation by Mr. Nuttall (which I give from memory), to the effect that in the nearly allied genus of Troopials (*Agelaius*, Veillot), in which the Molothrahs are still

often classed, and which also live in flocks, but construct a number of nests in society, the relative proportion of the sexes in the several breeding groups is extremely irregular, as if these birds also did not separate off into pairs. This alleged circumstance might be advantageously borne in mind when studying the habits of the Keelbills *(Crotophaga)* of tropical America, those very curious gregarious *Cuculidæ* of the West Indies and adjacent countries, of which the best account yet published is given in the *Annals of Natural History* for November, 1839.

Among the variety of curious phenomena presented in the Natural History of the European Cuckoo, it is remarkable that this bird devours what eggs there may be in a nest into which she introduces her own, so that any eggs that may be found together with that of the Cuckoo, have been laid subsequently to the deposition of the latter*: nevertheless, it appears that she spares that of her own species, or perhaps her own previous egg, as many instances have been recorded of two Cuckoo's eggs being found together, in general unaccompanied by those of the rightful owners of the nest. Hence, I incline to the opinion that she hastens to disburthen herself of her own egg, being very liable to be disturbed and driven from the nest by its legitimate possessors; and that then, if continuing unmolested, she picks out any other eggs there may be, but that when finding another laid by her own species, she is unable to distinguish that from her own, and so leaves both. From many experiments which I have tried with a view to elucidate this matter, I have found that, *generally,* in each case when a strange egg is put into a nest before the owner of it had begun to lay, that nest is deserted, — if it be placed along with the owner's eggs, it is very commonly ejected, — but, if substituted for the latter, then the duped bird will either incubate it alone, as the case may be, or lay other eggs to it, and sit on all. It is a question to be determined whether the egg of any Cuculine bird be ever found in nests with a domed top, as has been asserted, whereinto the bird could not have laid it, but must have placed it with the foot or bill; and what renders it unlikely that this should ever be the case with the British Cuckoo, and such others as resemble it in displaying

* See *Mag. Nat. Hist.* 1835, p. 334.

the same particular instinct, is that the young Cuckoo could not well in them eject its nest-mates, as described by Jenner and Montagu. What other parasitic species do this is also desirable to ascertain.

In physical connexion with the tardy development of the eggs of the European Cuckoo, and it may be presumed the North American Piayas, the remarkably small size of the parts subservient to generation in both sexes has been remarked, whence also the diminutive size of the egg (of at least *Cuculus canorus*, adapting it to that of the nests into which it is laid). Whether aught analogous occurs in the anatomy of the Molothrahs, I have not seen stated; and observations of the kind are needed as regards other *Cuculidæ*.

In fine, I may here remark that what knowledge we now possess of the general Ornithology of India, is particularly deficient in information concerning the nests and eggs of species, a knowledge of which is often of essential assistance in tracing the affinities of genera: and I would particularly recommend our few observers to bestow especial attention upon this department of Ornithology, and hint to them that a collection of eggs, with the species to which they belong very carefully ascertained, and of such nests as are conveniently transmissible, would be regarded as a valuable acquisition to the Museum which I have the honour to superintend.

THE AVATARS OF VISHNOO.

An abstract Translation from the Pudma Pooran. By E. C. Ravenshaw, *Esq. C. S.*

1st Incarnation of Vishnoo, or Mutch Avatar.

It came to pass in the Kreta Yug, (or Golden Age,) that Bramah sprang from the navel of Vishnoo, and was placed by the deity in Suttya-locum. Brahma being instructed in all things by Vishnoo, began the work of creation. He first called into existence the five elements: earth, air, fire, water, and ether (akash.)

2nd. The "nine Praja-puttee," (or nine Lords of the creation); viz. Broogoo, Mareechee, Uttré, Duksha, Kurdama, Poolastea, Poolaha, Ungerasa, (Ungeyra?) and Kruttoo.

Mareechee had a son, named Kaseapah, who took unto him four wives, alled Aditi,* Diti, Kurdooma and Venata. The first brought forth *Indra* and thirty-three krore of deotas. The second brought forth giants, (or Asooras) named Somak-asoor, or Hayagreeva, (meaning horse-face or centaur,) Jumbah, Miah, &c. The third wife brought forth serpents; viz. Adeeshaha or Ununta, (the 1000-mouthed serpent,) Tukshaka, Vasookee, Karkotaka, Padoomah, Maha Padoomah, Sunka, &c. The fourth wife bore two sons; viz. Arroon and Garrooda.

It came to pass that Somak-asoor, (the centaur,) rebelled against Brahma, and having come to Suttya-locum, forcibly carried away the four Vedas, and plunged with them into the sea. Owing to this loss darkness and confusion overshadowed the earth. Then Bramah arose, and assembling all the deities, proceeded to Tsherabdee, or the milky sea, where he offered up prayers and supplications to Vishnoo, that he would cause the Vedas to be restored. The deity rising from the milky ocean, promised to accede to their wishes. He immediately assumed the form of a large alligator and plunged into the depths of the ocean, where having killed Somak-asoor, he returned and delivered the four Vedas to Brahma.

2nd Incarnation or Koorma Avatar.

Uttré (the 3rd of the Prujaputtee) had a son named Doorvasa who, having performed his devotions for one year at Maha Meroo, ascended to heaven (Swurga-locum,) and blessing Indra, presented to him a garland of flowers called Parejatum. The deity having benignantly accepted the offering, placed it on the head of the white elephant called Iravut, who took it off his head with his trunk and trod it under his feet. Doorvasa at this sight became very wrath, and he cursed Indra and all rich people, because they regarded not the offerings of the poor. In consequence of this imprecation, poverty fell upon Indra and his court. The sky withheld its rain, and famine and pestilence stalked abroad.

Then Indra and all the deotas went to Brahma, the four-headed god, and beseeched him that he would take pity on their miserable condition. Brahma replied, that it was not in his power to assist them, but that he should be happy to accompany them to Vishnoo. The party accordingly proceeded to the sea of milk, and invoked Vishnoo, who hearing their supplications, appeared before them with four hands, and riding on the back of Garooda. He said, "The nature of your appeal is known to me, go

* Daughter of Duksha.

bring hither the mountain Mundara for a piston and the serpent Vasookee or a rope." The deities and giants flew to the mountain and removed it from its foundations, but were unable to convey it to the shore of the ocean. Then came Vishnoo to their assistance, and transported it to the centre of the milky sea, when he assumed the form of a Coormava, (or Tortoise,) plunged under the sinking mountain, and supported it on his back. Then the serpent Vasookee was twisted round the mountain for a rope, and the giants holding the head while deotas held the tail, they began to churn the milky ocean.*

It came to pass, that the venom of the serpent issued out of his mouth like a flame of fire, and the deotas and giants suspended their labour for fear of it. Then Roodra (Seva) spoke to them, exhorting them to fear nothing, and after offering up a prayer to the almighty Vishnoo, he swallowed the poison. The churning was resumed, and the following things were produced from the froth of the ocean. 1st A woman named Jaistoodevee or poverty, who on appearing asked, "Where am I to reside?" The deotas answered, "Go where people are ever quarrelling, and sleep in the morning and evening time." 2d. Another female named Varoonee then appeared, of exceeding beauty. Andeshaha, (the 1000-mouthed serpent,) immediaty carried her off to Naga-locum. 3d. The ocean brought forth the Apsaras, or celestial choiristers, named Remba, Woorvase, Manake, &c. who were ordered to repair to Swerga-locum to entertain the deotas with dancing and singing. 4th. A white Elephant called Iravatum. 5th. A Horse called Oocheestravas. 6th. A physician called Dunwantry. 7th. The flowery tree Parijatum or Kulpa Vrikookshan. 8th. A wishing Cow named Kamadanoo, who gave to her possessor whatever he wished. The latter six articles were appropriated by Indra on the eleventh day of the moon. On the morning of the twelfth day, Stremaha Lutchoomy, the goddess of plenty and good fortune, arose from the ocean. Her appearance was hailed with acclamation by the Host of Heaven. The angels struck their sitars, the Apsaras danced and sang, and the deotas poured flowers on her head, and a flood of light like moon-beams irradiated her person. The goddess enquired in what way she could serve them. Indra answered, "Oh, goddess dwell ever in the bosom of Vishnoo and exert your influence to preserve us from all evil and distress, and bestow on us the riches and abundance of the three worlds." The goddess intimated her acquiescence. Then Vishnoo rose from the ocean and accepted her for his spouse. The ninth and last product of the ocean was the amrootum, (or nectar.) The deotas and asoors began to quarrel about its possession, when Vishnoo

* Churning in India is universally performed by twirling the churn staff backwards and forwards with a rope.

having transformed himself into a beautiful damsel of sixteen years of age, called Mahany, appeared before them, and offered to divide the amrootum among them. On their consenting to this proposition, he commanded the deotas to be on one side, and the asoors on the other. She commenced by distributing to the deotas their share first. Rahoo, one of the asoors, had purposely neglected to obey the order to stand on one side, and had kept his place among the gods between the sun and moon; and thus received the share of a deota. The sun and moon, however, immediately informed Mahany, that he was an asoor. Upon which Vishnoo enraged at his deceit, assumed his proper form, hurled his *chukrum*,* or quoit, at the throat of Rahoo, and severed his head from his body. But having drunk the amrootum, or water of immortality, he could not die, and by way of revenge, he has since that time occasioned periodically the eclipse of the sun and moon.

3rd Incarnation, or Var Avatar.

There are four gates to the palace of Vishnoo in Vicoontum; at the west gate are stationed two heralds, named Jayau and Vijaya. It came to pass, that four penitents, called Sanaca, Janandanah, Sanotcoomara and Sanotsoojatah, arrived at the gate with the intention of offering up praises and thanksgiving at the feet of Vishnoo. The two heralds, however, refused to give them admittance, upon which the penitents cursed them, saying, "You shall be born again, and become asoors." The heralds enquired how long they were to continue in that form. "If you will be friends to Vishnoo, seven generations; if foes, three—choose!" The heralds preferring the latter, were born to the wife of Kascapah, named Diti, and were named Herunea-kasepoo and Herunea-aksha. The former became a mighty giant; he rolled the earth up as a mat, and went to dwell with the 1000-mouthed serpent in Patal-locum. Then Brahma, Indra, and all the deotas being terrified at his doings, came to the milky sea, and invoked Vishnoo, who appeared before them, and on learning what had happened, assumed the form of a wild boar, and penetrating into Patal-locum, killed Heranea-kasepoo with his tusks, raised the earth on the face of the waters, and restored it to its former condition.

4th Incarnation, or Nursingh Avatar.

Heranea-aksha enraged at the death of his brother, in order to revenge himself on Vishnoo, proceeded to the mountain Meroo, where he fasted

* Like that used by the Seiks.

and prayed 10,000 years to Siva. The god pleased with his devotion, promised to grant him whatever he wished. The giant replied, "Let me not be subject to death by the hands of deotas or asoors, of men or angels, (gundarva,) cows, etsha, (musicians,) animals, birds, siddas (penitents,) saddeas, vedevudarus, kinnarus, kimpoorooshus, by the sword, by disease, by the cursing of resheess, Siva answered—"Be it so." The giant immediately stalked to Swerga-locum, conquered Indra and all the deotas, turned them out of heaven, and became master of paradise and the earth. He then took unto himself a wife Siva, named Kalleyane, (the daughter of Ootanapada,) who bore him a son, named Plumahalada. When arrived at the proper age, the child was sent by his father to the learned Shookra-chary, to be educated in the sciences. When his education was completed, he was brought back to his father, and stood in his presence with becoming respect. The father pleased at his appearance and manners, received him very kindly, and having kissed him, and enquired what he had learnt. The young man replied, "By the glory of Vishnoo, who is the creator of all worlds, from whom I derive my being, and whose perfection is the object of my meditation, I will endeavour"—"Stop," vociferated the giant, inflamed with anger, "What means this? Bring me Shookra-chary!" On the appearance of the sage, he exclaimed, "Am I not master of the three worlds by the auspices of Siva, and have you not dared to teach my son to worship Vishnoo who slew my brother? Bind him hand and foot." Here Plumhalada interceded, saying, "Father! you do him wrong. He did not teach me to pray to the almighty Vishnoo, but to Siva, or you. The fault is mine, not his." Heranea-aksha admiring his answer, pardoned Shookra-chary; but said, "In future you must pray either to me or Siva." Shookra-chary also told him to obey his father. Plumhalada answered, and said, "Vishnoo is greater than Brahma, Sunkara, and all the other deotas, why therefore should I pay reverence to those who are only his servants? I who have obtained favor in sight of him, who is the Lord of Lords." Upon hearing these words, the enraged Heranea-aksha commanded his attendants to flay his son, cut him in pieces with their swords, and cast him into the fire. But neither the whip, the sword, or the fire had any effect; he stood unhurt, being supported by the glory of Vishnoo. Then Heranea-aksha asked his son, saying, "Where is Vishnoo? what is he? shew him to me, and I will overpower him, as I did all the other deotas." Plumhalada answered and said, "He is Narayanah, the spirit moving on the waters. He is Vausoodeva, the spirit animating all created beings. He is Vishnoo, (the anima mundi,) the soul which pervades the material universe." "If that is the case," replied the enraged Heranea-aksha, striking a pillar, "Shew me

Vishnoo in this pillar, or I will stab you to the heart with my dagger." Immediately a terrible noise, like that of the loudest thunder issued from the pillar, the giants were struck senseless and the stars of heaven fell down like flowers from the tree, and the deotas all trembled. The pillar was rent in twain from top to bottom, and from the midst thereof issued Nara-singha, a beast having the head and neck of a lion, and the body of a man. He had three eyes which sparkled like flames, very long teeth, and 1000 hands, each armed with a different kind of weapon. The eyebrows and eye-lids of Herunea-aksha were immediately consumed by the flames that issued from the eyes of the almighty Vishnoo. Though daunted and trembling, the giant defended himself with his dagger, but Vishnoo seized him by the head and feet, and laying him across his lap, tore open his belly with his claws, and made his entrails into a necklace. Then all the deotas poured flowers of the Parejatum on the head of the victorious Vishnoo. The Gundarvas, Kennaras, and Ethas played on various musical instruments, while the Apsaras danced. Luchmee brought the fruits of the earth to appease his hunger, and sat down upon his knee. Then Vishnoo sent for Plumhalada, and made him king over all the giants. He restored the deotas to Swerga-locum, from whence they had been expelled by Herunea-aksha, and disappearing, went to the milky sea.

5th Incarnation, or Vaman Avatar.

Verochanah, the son of Plumhalada, had a son named Boli, who was king of the three worlds; during his reign all was peace and prosperity; the corn grew spontaneously; the cows yielded their milk without pressing the udder; the trees produced fruit in all seasons, and Indra and the Asta-dik-palakas* (or lords of eight corners of the world,) attended at the gate of his palace. Caseapah and his wife being desirous to see their son Indra restored to the sovereignty of the three worlds, paid adoration to Vishnoo for 10,000 years. The deity pleased with their piety, told them to ask for whatever they wished. Caseapah replied, "I wish you to be born to me as a son by the name of Oopa-Indra, when you must conquer Boli, and deliver the three worlds to Indra." Vishnoo accordingly became incarnate as the son of Caseapah, and day by day increased in wisdom and in stature. It came to pass, that Boli held a yoga, or burning sacrifice; upon the celebration of this ceremony, the son of Caseapah transformed himself into a dwarf, called Vamana, and walked before the king, who being pleased with him, told him to ask a favor. Vamana replied, "Be pleased to give me three steps

* Vide separate account of these.

of ground on which to make a burning sacrifice." Shookra-chary, the priest, observed," "Oh, king! this is not a Brahmin, but is the Almighty God in disguise; therefore do not grant his request, he will cause you to repent the gift." Boli rejoined, " If as you say, he is indeed the Almighty, it will be better to propitiate him with this small charity, than to refuse his request. I who am lord of the three worlds can well afford so trifling a gift." He accordingly gave Vamana permission to measure three steps of ground, upon which the body of the dwarf began to expand, and his stature increased to the height of 75,000 laks of leagues, one foot covered the whole earth, the other filled the sky. Vamana then asked Boli, " where shall I place my other foot." " On my head," said Boli. Accordingly the foot that was in the sky was placed on the head of Boli, and Vishnoo pressing it downwards, descended with Boli through the earth to Patal-locum, where leaving Boli, he returned and re-instated Indra in the sovereignty of the three worlds.

6th Incarnation, or Parasoo-Ram Avatar.

Brugoo, (the first of the nine Prajaputty,) had a son named Jamadugny, who having paid his devotions for 1000 years to Indra, found favor in his sight, and was permitted to ask for any thing he wanted, Jamadugny then requested that he might be put in possession of Kama-danoo, (the wishing cow, which was produced from the churned ocean.) The cow was accordingly brought to him, and by her aid he acquired great wealth and happiness. He took unto himself a wife named Ranooka-devy, who was the daughter of Ranooka. In order to obtain a son, Jamadugny prepared a pootra-kaumastey ag, or burning sacrifice to Indra. The deity pleased with the offering, promised him that Vishnoo should be born to him as a son; accordingly his wife conceived and brought forth a son, and called his name Rama. At ten years of age, he was sent to Salagram, for the purpose of being consecrated to the worship of Vishnoo. He there met with Kaseapoo, one of the nine Prajaputty, who being pleased with his attentions and piety, gave him a prayer called " *Vishnavee.*"

In the mean time a king named Karteveerean Arjoon, the son of Hahaya, reigned in the city of Joteshmate on the banks of the Narmada, (Nurbudda?) He had 1000 hands, and a wife called Madooravane. One day he went with his wife and concubines to bathe in the river Nurmada, and placed 500 of his hands as a wall in the water, while with the other 500 hands he played with his women. It came to pass, that Ravanah a giant, arrived at a place lower down the river; after bathing, he erected in the river an image of clay, and began to worship it. Owing to the sports of king Arjoon

and his women, the waters of the river swelled and became troubled, so that the idol, with the flowers and incense, were upset and carried down the stream. Ravanah sent messengers to ascertain the cause of this commotion of the waters; on hearing the cause, he was inflamed with anger and went up to fight against Arjoon, but the latter overcame him, and put him in prison for 10,000 years; after the lapse of this period, Arjoon was ordered by Brahma to release him.

It came to pass, that the king paid a visit to Jamadugny, who received him very kindly, and served him and all his retinue with rare and excellent food. The king inquired, whence he procured such delicious provender. The penitent replied, that the Kamadanoo furnished him with every thing. The king then begged the penitent to give him the wonderful cow, but Jamadugny replied, that it belonged to Indra, and that it was not therefore in his power. Then the king forcibly seized Kamadanoo, but she resisted, and with her horns and feet killed many of the royal retinue. The king enraged at his failure, stabbed Jamadugny with his dagger, and returned to his capital.

Ramah, the son of Jumadugne, having finished his education at Salagram, and having received an axe from Vishnoo as a reward for his piety, returned to his father's house, where he beheld his corpse. Hearing the manner in which he had been slain, he shouldered his axe and went to the city of Joteshmati, and standing upon the gate, sent word to the king, that a Brahmin was come to fight with him. The king hearing this, sent 100 kinkaras to chastise him, but he killed them all with his axe. The king then came out himself, but Parasoo-Ramah, (or axe-bearing Ramah,) immediately cut off his 1000 hands, and then killed him with the axe; after which he laid about him right and left, declaring that he would not suffer the world any longer to be polluted with the Kshatrea caste. He performed the tarpenum, (or ceremony of anathema,) in the blood of the Kshatreeas, by mingling their blood with gingle (?) seed in the earth, and crying confusion to the nakedness of their fathers and grand-fathers. This ceremony was performed at Lamantaka Punchakum (or the five streams) near Kooroo-Kshatrum, where he also made a burnt offering called auroovamadum, and presented the 750,000 *kos* of land, which composed the country of the Kshatreeas, as a charitable gift unto the Brahmins. He then prepared to offer up his thanksgiving to Vishnoo, but was prevented by a Brahmin, who said, "You have given this land to the Brahmins, and have no title to make use of that which is no longer your own, go, and appear not again within its limits."—Parasoo-Ramah enraged at this treatment, cursed him, and said, "You will not be able to retain

dominion over this land." He then departed to the mountain Badaricastreeamun.

7th Incarnation, or Ram Avatar.

Aditi, the daughter of Duksha, and wife of Caseapah had a son, named Viouswatah, who was one of the twelve suns. The latter had a son named Swaembhoo Munoo, who worshipped Vishnoo 10,000 years on the banks of the river Goomtee. Vishnoo then appeared to him, and told him to make a request, Swaembhoo Munoo accordingly besought him that he would be born to him as a son for three generations; Vishnoo consenting, disappeared.

It came to pass that in the Tretu Yoog, Swaembhoo Munoo was born to king Ujan in the city of Ayodeea, (Oude,) and was named Dasarada. He married Cosilliah, the daughter of the king of Cosala (Cosillah*) and Soomitry, the daughter of the king of Maugada, and Kykae, the daughter of king Kikiah. Not being blessed with a son by any of his wives, he, by the advice of Vasista, the penitent, made a burning sacrifice, called Pootra-kamasty, (son-wishing.) During the ceremony, there appeared in the midst of the flames a very handsome youth, with a golden cup in his hand full of panes (?) or rice milk. He spoke to Dasarada, ordering him to divide the contents of the cup among his three wives, who accordingly each drank their share of the celestial liquor, and immediately became pregnant. After ten months, Cosala brought forth Rama. Soomitry had two sons, Luchmun and Satroogna; and Kykae Bharata, they were all named by Vasistah. It came to pass when they were grown up, and were educated in the arts and sciences, that there came to Dasarada a penitent, named Vesoova Mitra, who requested him to allow his sons, Ramah and Luchmun, to attend at a burning sacrifice, in order that the giants might be deterred from interrupting the ceremony. The king ordered his sons to accompany the penitent, who taught them two arts, called bula and utte-bula.

The giants, of whom the penitent was apprehensive, were named Mareecha and Satbahoo, the sons of Tatakes, (the daughter of the angel Sookatoo,) and Sinda, her husband. After the death of their father, the two sons united together to mock and jest at a penitent called Ugusteah, who being very much provoked cursed them, and transformed them into giants. These giants to revenge themselves on the race of penitents, were in the habit of disturbing their devotions, and obstructing their

* There is a river of this name, which rises near Almorah, and unites with the Ram Gunga below Moradabad.

burning sacrifices. Vesoova Mitra being anxious to get rid of such troublesome neighbours, desired Ramah and Luchmun to kill them. The brothers accordingly sallied forth, and encountering the giants, slew them with the edge of the sword, and cast them into the sea.

Visoova Mitra then celebrated his burning sacrifice, after which he proceeded with the two brothers towards Mithoola Nuggur. It came to pass as they journeyed along, that Rama observing on the road-side a stone statue of a woman, asked the penitent what it was. Visoova Mitra replied, "Once upon a time there was a very handsome young woman named Ahiliah, who was the wife of the famous penitent Goutema. She committed adultery with Indra, and Goutema discovering her infidelity, transformed her into stone." Ramah on hearing this, touched the statue with his foot, and it immediately became an animated and breathing form. From thence they came to the city of Mithoola, the capital of king Janaka. It is necessary to premise, that this king having no children, ordered that a piece of ground should be dug up, and prepared for the burning sacrifice of Pootra-kamesty. The labourers on digging the ground, discovered a very curious golden bow, inlaid with nine sorts of precious stones, which they brought to the king, who opening it, found therein a beautiful virgin, by name Setah, who shone pre-eminently among the maidens, as the moon among the stars. *(Velut inter ignes. Luna minores.)* Janaka presented her to his wife, who treated her with great kindness. A few days after, the queen brought forth a daughter by name Oormulla. When the two virgins had arrived at a marriagable age, the king issued a proclamation, saying, that "Whoever is able to string the bow of Roodra Danoosoo, to him will I give my daughters in marriage."

Now the history of the bow was in this wise: "Visoova Kurmah, the carpenter of the gods, had a son named Miah, who aided the giants in constructing the three cities called the Trepooras, situated in the three worlds; viz. heaven, earth, and orcus, or upper, middle, and lower worlds. Then Miah and the giants began to annoy the deotas, kings and penitents, by interrupting their devotions and burning sacrifices, (Yogaus;) at last, all the gods went to Roodra, (Siva,) and solicited his aid. Roodra immediately destroyed all the giants excepting Miah, who made a well filled with the waters of immortality, into which he threw the bodies of the giants, who were thereby restored to life, and again waged war with the gods. As it was necessary to prevent the giants from again having recourse to the well, Vishnoo transformed himself into a cow, and ordered Brahma to assume the shape of a calf. Both then went to the spot apparently to graze, but when arrived at the well, the calf fell in, and the cow in apparent anxiety to rescue her offspring, tumbled in after it, and drank

up the living waters." This object being effected, Roodra converted mount Meroo into a bow, and took the serpent Vasookey for a string, and Vishnoo for an arrow. The sun and moon formed the wheels of his chariot, the four Vedas were his four horses, driven by Brahma as coachman, and the ocean was his quiver of arrows. Thus armed, he charged the giants, and fired the arrow Vishnoo into the midst of them, all fell dead in a moment. Roodra made a present of the bow to Davarat, grand-father of Janaka, and it has remained with the family ever since. Ramah being made acquainted with the terms of the proclamation, took the bow in his hands, easily bent it back, and adjusted the string, and fired the arrows in rapid succession. The conditions being fulfilled, Janaka gave his daughter Seta to Ramah, and his second daughter Oormulla to Luchmun; after the celebration of the nuptials, the brothers set off on their return to Oude. In the way they met Parasoo Ramah, who addressed Ramah, saying, " Your father Dasarada refused to fight with me, and ran away. I hear your prowess is great. Let me see if you can bend this bow." Ramah said he would do his best, he then took the bow and bent it, and discharged the arrows. Parasoo Ramah then said, " Oh Ramah,* you are indeed very powerful, he who can bend this bow, can build a staircase to heaven with the heads of kings."

The brothers then proceeded on their journey, and arrived safely at Oude with their wives, where they lived very happily with their parents.

Dasarada being now advanced in years, wished to place Ramah on the throne; upon which his wife Kikia observed, " Once upon a time when you and I went out in a chariot to hunt in the vicinity of Jountopoor, a giant named Sumbarasoor came to fight with you. If you remember well, you discharged your arrows and drove the chariot. In the midst of the fight, the linch-pin of one of the wheels fell out, and the chariot would have fallen had I not put my finger in the place of the linch-pin, and kept it there until you had killed the giant. For this service you desired that I would ask some favor and it should be granted. I said that I had nothing to ask for at that time, but that I would make a request at some future period, to this, if you remember, you assented. The time is now arrived, and my request is this, that you banish Ramah for fourteen years to the jungles, and appoint my son Bhurata as king during that period." Dasarada being bound to perform his promises, granted her request. Then Ramah and Luchmun with their wives departed from Oude, and came to the city of Chitrakoot. When Dasarada heard that they had left Oude, and gone into the jungles, he became exceeding sorrowful and died. Then

* Original obscure—supposed meaning.

Bharata went to Chitrakoot, and informed his brothers of the event, who returned with him and performed the funeral rites of the deceased. After the ceremony, Rama being sorrowful, lay down his head upon Seta's lap and fell asleep. Jauntah, a son of Indra, having quizzed the penitent Stootaseras about his huge head and uncouth figure, the latter transformed him into a crow, and since that time he was called Kauk-asoor. This crow being tantalised with the sight of one of Seta's breasts as she sat supporting the sleeping Rama, alighted on her shoulder, and began tearing the flesh with his beak. As Seta could not defend herself without awakening Rama, she bore it with resignation. Rama on opening his eyes, saw the blood flowing from her breast like a river. In his anger he prayed over the grass of the fields, and each blade became an arrow and flew in the direction of the crow, who seeing no escape from such a shower of missiles, threw himself at the feet of Rama and implored his pardon, which Rama at last granted. The party then arrived at a place called Purnasala, where they lived in a hut made of leaves during about thirteen years.

Visravas, the grandson of Poolustea, one of the nine Pruja-puttee, married Kakesey, the grand-daughter of Sookasa, and daughter of Soomaly. One night lying with her husband, Kakesey conceived and bore a son, and called his name Ravana. He had ten heads and twenty hands. Another night she conceived a son named Koombhakurna, and a daughter named Soorpanaky. On a third night she conceived Vebeshun, who became a devotee of Vishnoo. Ravana and Koombhakurna went to the mountain Himavunta to worship Roodra. To prove his devotion, Ravana cut off his own ten heads with his sword, and presented them as an offering to Roodra instead of fruits and flowers. Seva appeared before him and said, "Whatever thou askest, that will I give unto thee." "I pray thee," answered Ravana, "that I may not be subject to death by the hands of gods or asoors, angels or devils." Roodra replied, "Be it unto thee even as thou wilt." Then Ravana waged war against the gods and penitents, who being sorely pressed, went to Vishnoo and implored his assistance. In the mean time Soorpanaky, the sister of Ravana, went to Rama at Purnasala, and requested him to marry her. Instead of complying with her request, he cut off her nose and ears, and sent her away. She accordingly departed, crying aloud, to a place called Janakasthan, the residence of the giants Khara, Dooshana, and Treserus, who had an army of 14,000 strong. She shewed them her wounds, and solicited revenge. The giants then arose with one accord, and fought against Rama, who slew them with the edge of the sword. Soorpanaky then fled to her brother Ravana, and informed him of what had happened. Ravana immediately ordered the giant Mareecha to

transform himself into a deer, and to appear before Seta, Rama, and Luchmun. The giant obeyed. Seta on beholding the deer asked Rama to catch it, and bring it to her to play with. Rama said, "It is a giant and not a deer, however, I will try to catch it for you." Taking his bow and arrows, he followed the deer, which ran away as Rama approached. When out of sight of the hut, Rama shot the deer with an arrow, when the giant resumed his shape, and crying out "Oh Seta! Oh Luchmun!" gave up the ghost. Seta hearing this, and believing it to be the voice of her husband, desired Luchmun to go and see what was the matter. He said it was only the giant, crying out on being killed by Rama. Seta not being satisfied, again begged him to go; so he went. Ravana immediately appeared before Seta in the form of a dervise, (or kulundur,) and asked for alms; on her bringing him what he required, he seized her in his arms, placed her on his chariot, and carried her away to Lunka. On the road a large kite attacked Ravana, who, however, having placed Seta under a tree called Sensoopah, in the orchard called Usoka, succeeded in wounding the kite.

In the mean time Rama and Luchmun returned to the hut, and not being able to find Seta any where, they were overcome with grief. Coming to the place where the kite lay half-dead, the kite told them that Ravana had carried her off to Lunka. They then came under the shadow of a large tree, from the branches of which the giant Kubunda tried to seize them for his prey, but the brothers slew him. At last they arrived at the dwelling of a woman named Sabary, who offered them fruits, and hearing their tale, said, she would introduce them to her friend Soogreva, lord of the monkeys, who would be able to assist them in recovering Seta. On the appearance of Soogreva, Rama asked him why he lived in such a place where there were no people to be seen. Soogreva answered, "My history is this; Vrooksha Ragasoo my father, once went to Nymes-arenneam, where there are two tanks. There is one of them in which if any man bathe he will be transformed into a woman, and in the other, if a woman bathe she is transformed into a man. My father plunged into the first, and rose therefrom a beautiful woman. Indra and the Sun both descended from Heaven to make love to her; by the one she had a son named Vauly, and by the other myself. Soogreva, my father, then bathed in the second tank, and resumed his manhood. On arriving at Kiskinda, he appointed my brother Vauly king, and then went to the mountain Himavunta. My brother happened to kill a giant named Magavee, by cutting him in two pieces, which he threw at the penitent Muttunga Maha Moony, who with his eyes shut was praying on the mountain Reshia Mooga Purvatum. At this unpleasant interruption, the saint opened his eyes and cursed Vauly, saying, 'If he ever comes here, his head shall be broken in a thousand pieces.' After this it came

to pass, that my brother fought with the giant Doondoobhy, and entered into a large cave in a mountain. My brother ordered me to remain at the entrance until he came; I waited a very long time, at last seeing blood come out of the cave like a stream of water, and thinking Vauly had been killed, I was sore afraid, and rolling a large stone before the entrance of the cave, I returned to Kiskinda. My brother after having killed the giant came to the mouth of the cave, and kicked away the stone I had placed there. Not finding me on the outside he was very angry, and on arriving at Kiskinda, turned me out of the city; since which time I have lived in these mountains. Now if you will kill my brother Vauly, I will engage to recover your lost Seta." Then Rama went up against Vauly, and slew him and placed Soogreva on the throne of Kiskinda, (i. e. Bijanugur, according to the tradition of the Natives on the spot.) Then Soogreva summoned before him his prime minister Hunooman of the monkey tribe, gave him the signet ring of Rama, and commanded him to assemble the generals of the Vanoras, (or monkeys); viz. Ungada, the son of Vauly; Jambavunta, lord of the bears, who was born of a groan of Brahma; Neela, the son of fire, &c., and that he should march Southward, sending out parties of Vannoras to the four quarters of the world to seek intelligence of Seta, and return within one month, on pain of death.

Hunooman accordingly set out on his march to the south, but was unsuccessful in his search. At last he entered a cave which was very dark, but perceiving at the extremity a small light he advanced towards it, and found a woman named Swaemprabha, (angel of light,) making devotion. On telling her that he and his friends were very tired and thirsty, she shewed them a rivulet running through the cave, and gave them fruit; after they had refreshed themselves, she enquired who they were, and why they had been wandering about her cave for the last forty-five days. On being informed of the circumstances, she ordered them to shut their eyes, and not to open them until she permitted them, when they would find a large bird called Sumpaty, who would give them news regarding Seta. They obeyed her orders, and on opening their eyes at the appointed place, they discovered Sumpaty, who said, "Seta is at Lunka; I saw her with my own eyes. You are now on the shore of the south sea, and the island of Lunka is 150 leagues distant. If you can jump so far, you will see Seta sitting under a tree in an orchard." The party then consulted among themselves as to who was the best jumper. Neela said he could only jump seventy-five leagues. Nola thought he could accomplish 105. Jumbavunta said, that being now advanced in years, he could not be sure of clearing more than 135. Ungada believed that he could jump there, but was afraid that he would not be able to jump back again.

This being the case, Hunooman took upon himself to perform the feat, and accordingly sprang from the shore into the air, cleared the sea, and alighted safely at Lunka, but he was immediately attacked by the goddess of the island; however, he gave her such a violent blow on the breast that she fell senseless; on recovering half an hour afterwards, she exclaimed, "You have struck me as the thunder-bolt cleaves the earth, so will you strike and conquer Lunka!" Then Hunooman transformed himself into a small cat, and entering the capital of Lunka searched about everywhere for Seta; at last he found her sitting under a Sensoopa tree in the orchard Usoka, as Sumpaty had said. He then resumed his own shape, and prostrating himself at her feet, delivered to her the signet of Rama, and acquainted her with the measures that had been taken to restore her to liberty. Seta gave him an emerald ornament called Seromany to deliver to Rama. The next day Hunooman began to tear up all the trees in the orchard. The astonished gardeners fled to Ravana, and told him that a wonderful monkey was tearing up trees by the roots, the leaves of which even had defied the blast of the tempest. Ravana hearing this, sent one lak of giants to kill him, but Hunooman slew them all. Ravana then sent the sons of his eight prime ministers with a large retinue, but they shared the same fate. He next sent five generals with a large force of disciplined troops, but with no better success. Ravana's second son, Ukshaya-koomar, a valiant hero next entered the lists, but he also bit the dust. At last the eldest son, Indrajit, went forth to battle. He aimed many arrows at Hunooman without effect, finally he aimed the sacred arrow Bramhastrum, which overthrew Hunooman, who was immediately seized, and carried to the presence of Ravana, who enquired who he was, and why he came there. Hunooman replied, "I am a servant of Rama, who sent me to see Seta." Ravana then asked him, why he had destroyed the orchard. He answered, "I did it in order to obtain an interview with you; in order to tell you that if you do not deliver up Seta, you will be slain by Rama, who has pledged himself to the penitents to kill you with his own hand; otherwise I should have killed you myself." Ravana enraged at hearing these words, ordered his attendants to execute him; but Vebeshun, the younger brother of Ravana, stepped forward, and represented that it would be unjust to slay an ambassador, but that some more lenient punishment might be inflicted. Ravana admitting the propriety of this advice, ordered his attendants to bring tar, wax, camphor, and oil cloth, and having twisted them round the tail of Hunooman to set fire to it, and after carrying him through the town, to thrust him out of the gate of the city. These orders were immediately carried into execution; but no sooner had they lighted his tail, than he

whisked it about from house to house, and set fire to the whole city, and escaping from the gate ran to the sea shore and jumped back to the place where he had left the army of the Vannoras. He then returned to Kiskinda, and prostrating himself at the feet of Rama, acquainted him with all the circumstances of his journey, and delivered the emerald he had received from Seta.

The next day Rama, Luchmun, Soogreva, Hunoomon, Ungada, Neela, Nala, Jumbovanta, Sooshana, (the doctor of the Vannoras,) Gajau, Gundamadana, Gavantsbha, Vrooshabha, Sarava, &c., with their respective Vannora forces, marched from the mountain Reshia Mooga Parvut to the shore of the south sea. Vebeshun hearing that Rama had arrived at the opposite coast, advised his brother Ravana to give up Seta, and make his peace with Rama; but Ravana offended at his advice, turned him out of the city. He sought refuge in the camp of Rama, who promised to place him on the throne of Lunka.

Nala, the son of fire, then commenced to make a bridge over the sea. He prayed to his father that all the great stones and other heavy articles that were necessary for the work might be deprived of their weight, and float on the sea. This prayer being granted, he soon completed the bridge over which the troops marched to Lunka. Then the giant generals of Ravana, named Dhoomraksha, Ukumpana, Vugra Dumsthraw, Prahusta, Utteka, Mohakawe, Koombha, Nikoombha, &c., came and fought against them, but were all slain in one day. In the night, however, Indrajit attacked them furiously, with frequent discharges of all kinds of arrows, and by hurling mountains on the heads of the Vannoras, great numbers of whom were killed and wounded, so that Indrajit reported to his father that he had killed them all.

Jumbovanta consulted with Sooshana, the doctor, what was to be done. The latter replied, "There is a mountain near the North sea* called Sunjeevy, on which grow three kinds of shrubs named Sunjeevy-kurney, Sandane-kurny, and Souselia-kurny; send Hunooman to fetch them, otherwise we shall all die." Hunooman flew to the mountain, but after searching on the four sides of the mountain, he was unable to find the shrubs, on account of the darkness of the night, so he took up the mountain in his arms and brought it to Lunka before sunrise, for he was the son of the wind. Then Sooshana, the doctor, gathered medicinal herbs and applied them to the wounds of the Vannoras, who immediately awoke from the sleep of death, and began to hurl the mountains on the houses of the enemy. Koombhakurna, the youngest brother of Ravana, came out with a large

* Polar Sea, or Arabian?

force to attack them, and fought for twenty-four hours without intermission, when the battle was terminated by the death of Koombha-kurna, who was killed by an arrow from the bow of Rama.

On hearing the news of his brother's death, Indrajit came forth with an immense army, and waged such a war as never before had been witnessed by deotas or giants; the arrows, mountains, trees, and all kinds of missiles fell upon Rama's army as the rains descend in the season of the monsoon. At last Indrajit fell by the hand of Luchmun. As soon as the intelligence reached Ravana, he sallied forth with his principal ministers and disciplined troops, and fought seven days and nights with Rama, who riding on the shoulders of Hunooman, discharged quivers of arrows at the giant, and cut off several of his heads and hands, but they immediately grew up as before. In the mean time Rama was growing faint in the exertion, from the pain of a wound from one of Ravana's arrows, which had pierced through, and was sticking in his side, from which blood flowed as fast as the water of the Red river. At this critical period, a rut or chariot descended from heaven, sent by Indra, driven by Matully, a skilful charioteer. Vebeshun at the same time informed Rama, that Ravana could not be slain until the cup of nectar which he carried in his breast should be destroyed. On hearing this, Rama ascended the car, charged the enemy, and aimed an arrow of flaming fire, called agnia-astrum, which flew like a thunderbolt, and split the breast-plate of Ravana to pieces, and crushed the cup. He then aimed 101 arrows to cut off the heads and hands of the giants, but again and again they grew up before until all the nectar was dried up, which had been spilt over his body. Then Rama discharged the arrow brumahstrum, which put an end to his existence. The war being thus concluded, Vebeshun was placed on the throne of Lunka. For the purification of Seta, a large fire was prepared with camphor, tar, wax, sandal-wood, &c. Then Seta bathed herself in a stream, and adorning herself with ornaments and flowers, walked three times round the blazing fire, and then on a signal given by Rama, threw herself into the fire, which, however, was immediately transformed into a man, who caught her in the palm of his hand, and presented her uninjured to Rama, who having accepted her, they mounted the car Poospoca Vemanum, and with Luchmun, Soogreva, &c., returned to Ayodeanugur, (Oude,) where Rama dismissed his allies with numerous presents, seated himself on the throne of his fathers, and ruled over the kingdom for 10,000 years, when he departed to Vicoontum, his celestial abode.

8th Incarnation, or Krishn Avatar.

MSS. Imperfect.

9th Incarnation, or Boodh Avatar.

The giant Tarukasoor had three sons, Viddoonmaly, Tarukaksha, and Kamalaksha. In a battle between the gods and giants, Tarukasoor was killed by Indra. The sons fasted and prayed for 1,000 years to Brahma, who pleased with their devotion, told them to ask for whatever they wished, and it should be granted. They replied, "We wish in the first place, for three moveable cities completely furnished with every article of luxury; and secondly, that we may not be subject to death by the hand of Gods, Danavas, Yekshas, Rakus, Gandurvas, Sidda Saddia, Kinnara, Kimpoo-roosha, Ooroga, &c."

Bramha granted their request, with this proviso, that if the cities should ever come in contact with each other, they should all be killed by a great man. The three brothers then repaired to Mya, the architect of the giants, who made for them three cities: one of gold, one of silver, and one of iron; each city was 150 leagues square, adorned with palaces, gardens, and every thing conducive to pleasure. The golden city was in the centre, the silver one in the sky, and iron one on the earth. Thus by the blessings of the Trinity and Mya, the giants enjoyed themselves exceedingly, and amused themselves with tormenting the gods, penitents, &c. To complete their power, the son of Tarakaksha obtained from Brahma a nectar well, in which if a dead body were plunged, it would come out alive with ten others equally powerful. By these means, the three brothers were enabled to fight the gods with impunity, and overthrow them. Reduced to extremity, they petitioned Brahma to save them from the effects of the power he had granted to the giants. Brahma told them to go to Roodra, who on their supplicating him, attacked the giants with such force, that the field was covered with their dead. However, their wives came and touched them with their hands, sprinkling water over their persons, and they awoke from their sleep, for their wives being very virtuous women, could give life to the dead. The giants on their recovery, renewed their attacks upon the gods, who were again obliged to supplicate the aid of Roodra. The latter replied, "Unless the virtue of their wives be corrupted, it is useless to kill them, because so long as their wives remain virtuous, they will be able to restore them to life." The gods then proceeded to Vicoont, and entreated Vishnoo to lend them his assistance, to which he consented. It came to pass, that the wives of the Trepoora-soors were dancing round the Uswuttum, which is the king of trees, and endeavouring to obtain the fruit which hung from its lofty branches. Vishnoo assuming the form of a priest, told them they would not be able to procure the fruit unless they danced round the tree naked. On

their obeying his injunction, Vishnoo pervading the tree as he pervades all things in heaven and earth, shook it with a noise like thunder; the women being frightened clung naked round the tree, which immediately assumed the form of a naked young man, in whose embraces they enjoyed the fruit of their desires, but lost that virtue which gave immortality to their husbands. Roodra immediately availed himself of their fall to attack the giants, whom he destroyed together with their three cities.

Vishnoo incarnate as a naked man is called Boodda, who established the science called Boodda Sastrum, which taught the abolition of the worship previously paid to the deota under the names of Vishnoo, Seva and Brahma, and prescribed the adoration of the godhead under the name of Boodda, and the observance of the new commandments contained in the Boodda Sastrum. Vishnoo after the promulgation of this new covenant, told the gods to rejoice and be glad, as their enemies had been destroyed, and then disappearing, returned to Vicoont. Since that period, the religion and science of Boodda have become prevalent in the world.

10th Avatar.

At the end of the Kalee Youg, Vishnoo will be born as a son to the Brahmin Dhurman-bhooshum. He will have the face of a horse, and will appear riding on horseback with a dagger in his hand, with which he shall smite the wicked, but the good will be rewarded.

JOURNAL

OF THE

ASIATIC SOCIETY.

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*Specimens offered to the Asiatic Society of Bengal.** *By Captain* Newbold, *F. R. S. &c., Madras Army.*

EGYPT.

No. 1. Crystallized gypsum, from the desert of Benihassan; occurs in thin layers and seams in the marls and loose sandstones immediately below the gravel and sands composing the surface. It is also found in the nummulitic limestone, and generally associated with muriate of soda.

2. Egyptian pebble, (variety of jasper), among the rolled pebbles of quartz, chert, flinty slate, limestone, intermingled with a few of the plutonic and hypogene rocks, that constitute the gravel of the Egyptian desert.

3. Silicified wood, from the fossil forest near Cairo. Specimens which I took thence to England were kindly examined for me by Mr. Robert Brown, who pronounced all those, the characters of which were distinguishable, dictotyledonous, and none coniferous. I have however since found, on a recent second visit to the site, specimens of decidedly monocotyledonous wood. The beds of loose and compact sandstone, and sandstone conglomerate imbedding the silicified wood of the Egyptian and Libyan deserts strongly resemble those of Pondicherry, where the wood is also fossilized by silex, and both monocotyledonous and dicotyledonous. They rest alike on marine

* This valuable collection has been duly received and placed in the Society's Museum.—Ed.

fossiliferous limestone; in the age of which there may probably be some difference; though neither of them can be very ancient.

4. Variety of Egyptian pebble.
5. Nummulites, limestone of the Mokattem, used in the construction of the Pyramids. It is singular that the oldest monuments reared by the hands of man should be built chiefly of a rock of yesterday, in a geological point of view. Besides these nummulites, which are exceedingly numerous, and noticed by Herodotus, who mistook them for petrified lentils eaten by the workmen, there are embedded echini, spatangi, crabs, ostrea, fishes' teeth, hippurites, turrilited shells, and numerous others, both bivalved and univalved. From the back of the great sphinx, itself excavated from the limestone of the Libyan range in situ, was quarried a block imbedding a fossil reed, hollow, jointed and striated exteriorly, nearly half an inch diameter. Rows of flint, resembling, in the manner in which they are imbedded, those of our chalk formations, and beds of fossil ostrea, occur in the limestone of the Thebaid; and the celebrated crystalloid, the morpholites or occellated stones of Ehrenberg are scattered on the chalk-like soil of Upper Egypt. Crystallized sulphur, bituminous lignite, mineral bitumen and petroleum are found in the calcareous beds of Ezzut. Sulphate of barytes near Cairo. Rock crystal, selenite, and rock salt, arragonite, calc spar and stalagmite are pretty generally distributed. The largest and finest known deposit of the latter, called oriental alabaster, is situated near Benihassan.
6. Iron slag from the ruins of Arsinoe; curious, as indicating that this metal was reduced in Egypt, if not in the time of the Pharaohs, at least during the Roman sway.
7. Red porphyry—Mount Sinai.
8. Iron ore from Hammamet—Desert of Thebaid.
9. Shell limestone, tertiary, of Malta.
10. Cellular basalt, from Aden. The whole of Aden, except a few recent calcareous deposits, is a mass of lava passing into trachyte, claystone porphyry, and pitchstone, penetrated by dykes of a more recent lava. The town itself stands on

the floor of an extinct crater, surrounded by an irregular fringe of black jagged peaks, save where a great gap on a level with this floor, opens upon the sandy shore of the Arabian sea. Another but narrower, gap cleaves the wall from summit almost to its base in a North and Southerly direction, affording a communication, jealously guarded, with the harbour of Back Bay. It is stated that native quicksilver has been found in the basalt of Aden by Dr. Malcolmson, in the reddish vesicular lava which is seen at Steamer Point, and which prevails pretty generally on the peninsula. It occurs in minute globules, adhering to the side of the cavities of the rock. Native quicksilver is found in primitive rocks, dark fossiliferous slates associated with Jura limestone and trap in the carboniferous series in small quantities. Its appearance therefore in a volcanic rock, so recent as that of Aden, is novel and interesting. I found abundance of rock salt, and a little sulphate of lime in the basalt of one of the islets in Back Bay, and pitchstone, calcedony, incrustations of carbonate of lime, kunker or travertine in that of Aden. In some places, the basalt is thinly coated with a powdery mineral of a sulphur yellow colour, resembling the chloruret of iron, seen tinging the lavas of Etna and Vesuvius near the summits. The basalt of Aden resembles strongly the newer basalts of the Puy de Dome, in Central France.

11. Granite, peninsula of Mount Sinai. This peninsula consists of a central cluster of granite and porphyritic rocks, of which the peaks of Sinai, Horeb, and St. Catherine are the nucleus, rising through uplifted hypogene schists, penetrated and altered by countless basaltic dykes; the whole are set, as in a framework in the sandstone and limestone, which fringes the coasts. Of the former is composed the celebrated mountain bell, *Gebel Nakhús;* the latter appears identical from its fossil and mineral resemblance with that of the Mokattem and Libyan ranges of Egypt, from which it is now separated by the coral bedded waters of the Red Sea.

Indications of volcanic agency are said to exist near Ras Mahommed at the South apex of the peninsula; and I have traced them from the

shores of the Red Sea by Gebel Ezzeit, and the semi-active volcano of Gebel Tir, through the Straits of Babel Mandel to Aden. My friend Lieut. Cruttenden, I. N., informs me, that volcanic rocks occur on the opposite shore of Abyssinia.

The singular gulf of the Red Sea is on the direct line of this volcanic zone, the existence of which is doubtless connected with the profuse growth of its submarine zoophytic forests.

The limestone cliffs on each side, like those of Dover and Calais, bear a striking petrological resemblance to each other; and, if we suppose them to have been once continuous over the tract now covered by the waters of the Red Sea, and engulphed, like the centre of the Val del Bove, by some great subterraneous displacement of matter, we need not go far to search for the sub-marine quarries, whence were derived the materials of these curious and beautiful calcareous productions.

The beds of limestone extend easterly, far beyond the borders of the Red Sea into Arabia and the Holy Land, interrupted in a few places by volcanic and plutonic rocks, and probably into Syria; where, in the vicinity of Beyroot, I have seen a rock very much resembling the compact, buff, waxy limestone of the Gebel Ataka range, flanking the western shore of the Gulf of Suez. Mr. Weaver* states the compact limestone rocks in the North of Arabia to be, in the mass, composed of coral animalcules of the European chalk, of which Mr. Lonsdale found about a thousand in a pound weight of rock, chiefly fragments of minute corallines; others entire foraminifera and cytherinæ. These animalcules, however, Mr. Lonsdale informed me, were not confined to the chalk, but existed also in supra-cretaceous limestone; hence they cannot be received as deciding the question of continuity or identity of strata. A large portion of the sands of the Libyan desert consists of bryozoa, a marine animal resembling sand grains; marine shells also occur in it, which may be regarded as additional proofs of their pelagic origin: since they are distinct from those found in the rocks whence the sands were derived.

Mr. Bowerbank has found vast numbers of foraminifera in the Egyptian agate (Egyptian pebble, No. 2,) unequally distributed through the layers composing the stone; but could not detect, in any of the

* London Philosophical Magazine, for April, May, and June, 1841.

numerous specimens he examined, any traces of the spongeous remains found in the agates of Europe and jaspers of India. The Egyptian agate consists of small, irregular light coloured grains, imbedded in a banded siliceous matrix.

The granites of Sinai and Syene, have their types in those of Southern India: they are composed in general of felspar, quartz, hornblende and a little mica, the felspar usually pale rose-coloured. They pass from close grained to porphyritic. The rock said to be that struck by Moses, lying in the valley of the Forty Martyrs at the base of Horeb, is a mass of the ordinary granite, penetrated by a vein of smaller grained granite, in which I found the narrow apertures through which the monks of St. Catherine state the water to have gushed. The rock is evidently not in situ, but a dislodged mass from the granitic heights that overlook the valley.

I regret having left behind me in England, specimens of the celebrated breccia di verde, trap, hypogene schists, serpentine, slate, and sandstones that prevail in the Thebaid, between Cosseir on the Red Sea and the Nile: besides these and the formations already mentioned is a rock, more recent than all, and still in progress of formation, (No. 12,) found but as a littoral deposit, not only on the shores of the Red Sea, but on those of the Mediterranean, to a great extent, though superficial. On some parts of the eastern coast of Egypt, it has been elevated above 100 feet above the level of the sea, and imbeds many species of recent pelagic shells, corals, and, near the sea, bones of camels, grains of sand, pebbles, &c. cemented together, by carbonate of lime, into a rock varying from a friable mass loosely agglutinated, to a compact travertine. (No. 12?) It occurs from an inch to several feet in thickness. On the shores of Aden, fragments of lava are included; and on those of the Bosphorus; and at Smyrna, Mityline, and Rhodes, I found fragments of limestone and other rocks in the vicinity: at the last place also, pieces of ancient pottery elevated a few feet above the level of the sea.

In addition to the foregoing specimens there is also a series of more from Southern India, all of interest, and some highly instructive; but as the catalogue contains but few observations, it will be printed amongst those of the Museum.—Ed.

Report on a Route from Pakung Yeh in Ava, to Aeng in Arracan. By Lieut. TRANT, *of the Q. M. G. Dept.*

(No. 365.)

To GEORGE SWINTON, ESQ.

Secretary to Government, Political Department.

SIR,—I am directed by the Right Honourable the Commander-in-Chief to forward to you, for the information of Government, the enclosed detailed report, under date the 12th ultimo, from Lieutenant Trant, of the Quarter Master General's Department, on the route from Pakung Yeh in Ava, to Aeng in Arracan, pursued by a detachment of British Troops under command of Captain Ross, of the Madras Establishment, in March last.

When the document is no longer required, I have further to request, you will return it to me for record in this office.

I have, &c. &c.

Qr. Mr. Gen.'s Office, (Signed) R. STEVENSON,
Calcutta, 13th May, 1826. *Qr. Mr. Gen. of the Army.*

Amherst Harbour, 12th April, 1826.

SIR,—Hostilities between the British and Burman Governments having ceased, and the British Army being on the point of returning to Prome, Major General Sir A. Campbell, K. C. B., directed Captain Ross to proceed with the 18th Regiment M. N. I., 50 Pioneers, and the elephants of the army to Pakung Yeh, across the Irrawaddy to Sembeghewn, and then to march over the Arracan mountains to Aeng.

At the same time, the Burman authorities deputed the Thanduck Woon,* (a chief of some rank, who had commanded formerly the province of Thanduck,) to accompany us as far as Aeng, and afford every assistance in his power. Through his means, we were to procure boats to cross us at Pakeng Yeh, and he was therefore sent on, in advance, in order that no delay might take place when we should arrive there.

* Named Mounza.

On the 6th March we left Yandaboo, and arriving at Pakeng Yeh on the 13th, immediately commenced crossing the troops and baggage in a few small canoes, the best that could be procured, but which contained a very small load; the whole detachment could not therefore be passed over to the opposite shore until the ensuing day. The river was here about 1,500 yards wide, but the current not being very rapid, we were enabled to swim the cattle over by fastening five or six at a time to the sides of a boat; the elephants dashed boldly into the stream, and guided by their mahouts, reached the opposite bank in safety, after swimming more than a mile.

The spot where we landed was on a long flat below the level of the natural bank of the river, and consequently under water during the rainy season; it was now laid out principally in tobacco fields, which plant grows in this part of the country in great abundance and perfection.

The town of Sembeghewn is four miles inland, but on the banks of the river a long straggling village existed, inhabited principally by those whom the advance of the British had obliged to abandon their habitations, and who had not yet availed themselves of the opportunity offered them by the peace, of again returning to their habitations. From these people we received every assistance; they furnished us with boats, and the women with baskets of vegetables and fish came into camp and soon formed a little bazar.

Although we were ready to move on the morning of the 15th, the dilatory manner in which the Commissariat Conductor delivered our twenty days' provisions to us, detained us till evening, when we marched through Sembeghewn, and encamped on the opposite side.

Sembeghewn was once an extensive and flourishing town, containing 3000 inhabitants, but now not a single habitation existed, the Burman army when retiring having burned it to the ground. The inhabitants had not yet commenced rebuilding their huts; here and there they were prowling about among the embers of their houses, or from the road-side looking at the passage of the troops, after we passed; however, part of our Commissariat was attacked, and three bullock loads of rice taken; a musket was also taken from one of the Sepoys, but I do not believe any blood was spilt. The people in the neighbourhood of Sembeghewn are notorious for their thefts and robberies,

and it must have been by a band of these marauders that the outrage was committed.

The country round Sembeghewn is an open plain, very fertile and highly cultivated, principally with paddy; and in the neighbourhood of the town are many small gardens planted with plantain, mangoe and other fruit trees. Through the town runs the Cholain river, a stream, which during the rainy season, is of considerable size.

On the 16th, we marched to Cholain Mew, on a capital road made by the orders of Menderagie Praw; a brick wall about three feet high marked the breadth for a considerable distance, and over every ravine, however small, a bridge has been erected. The country on both sides was laid out in rice fields as far as the eye could reach, and thickly interspersed with inhabited villages; it is irrigated by means of the Cholain river, which the inhabitants dam up and cause to flow over the adjoining fields. Wells also are to be met with in great abundance, and sacred groves with superb kioums* and pagodas, are seen all along the road.

The suburbs of Cholain Mew had fallen a prey to the flames, as also the city itself, and the only buildings saved from the conflagration were the kioums, and other edifices appropriated to the purposes of religion. This wanton act is said to have been committed without the knowledge of the chieftains, by some of the disorganized bands of the Burman army. Round Cholain Mew, are the remains of a lofty brick wall, and in those places where it has fallen to decay, a capital teak wood stockade was erected at the commencement of the war. The situation of the work is very strong, and on two sides completely defended by large jheels, whence by cutting a small bund, sufficient water might be procured to form a wet ditch round the fortifications. The brick portion of the latter is well worthy of remark, as offering a more perfect specimen of ancient fortification in this country than any other of the forts we have passed. One part of the wall, which seemed to have suffered less from the ravages of time than the remainder, particularly attracted my attention. Its outer height was fifty feet, and inside it rose about thirty feet above the level of the town; and this must be about six feet below the original elevation, the turrets

* Monasteries.

which formerly adorned the summit having fallen down. This great height of brick work was only between three or four feet thick, supported by slight abutments every fifty yards, and it seemed quite extraordinary, that so much of it still remained in many places tottering on its base. Near the summit of the walls, were small apertures intended to receive the beams by which platforms whence the defender's fire was sustained, and on enquiry I found these walls to be long antecedent to the use of fire arms. The Thanduck Woon informs me, that Cholain Mew is said to have been built 1500 years ago, at the time Pagham Mew was the seat of Government, and that it used frequently to be honored with the residence of the sovereign. Menzaghee, the present Queen's brother, occupied this post for seven months, and only left it when the English army approached Pakeng Yeh.

Cholain Mew contained 10,000 inhabitants, and is the chief town of the district of Cholain, which consists of between five and six hundred square miles, and has a population of 200,000 souls. Sixty-four villages are scattered over this fertile tract, and furnished during the war, 10,000 men as their quota to the army, of whom only one-half returned.

The district of Cholain is governed by a Musghi. From Cholain Mew the road branches off to Talak, and as it was the wish of Sir A. Campbell, that Lieut. Bissett, Quarter Master General's Department, Madras, should proceed by that route with part of the force, I made every enquiry respecting the possibility of this measure being carried into effect, but the accounts were so very unsatisfactory, that it was deemed proper to give up all idea of attempting it.*

I was informed that a foot-path existed over the mountains to Talak, occasionally frequented by a few itinerant merchants, and that ponies and bullocks were the only beasts of burden by which the road could be traversed. A great scarcity of water exists for four marches, so much so, that those who went that way, used always to carry a supply of water in bamboos—the chance of finding crevices in the rocks, or pools of water being very precarious, and if found, would not prove sufficient for more than twenty or thirty men. The hills are very steep,

* There is a road from Phyng on the eastern of the Zooma mountains to Talak in Arracan, but it is even at this time so indifferent, as not to be much used.

and although the roads were naturally so very bad, the Burmans at the time they expected an attack from us in that quarter, determined on entirely destroying this medium of communication, and accordingly scarped part of the road, in others felled trees across it, and so completely closed the passage, that for more than two years not a single individual has passed that way. The Talak road was not followed by either of the Burman armies, the Maha Bandoolah having marched by Aeng, both in going to and returning from Arracan; and the Arracan army after its defeat was so totally dispersed, that the men which composed it striking into the mountains followed no regular track, but took their chance of going straight over the hills. Taking all these circumstances into consideration, as well as the risk a party would run of a party being obliged to return at a time when the British had left Ava, a circumstance, from the want of water and coolies by no means unlikely to occur, Captain Ross determined not to divide the detachment.

Many Mughs who had been forcibly seized by the Maha Bandoolah, and brought captives from Arracan, availed themselves of the opportunity offered by our passage of again seeing their native land; and I am told that a great number of Mughs are now scattered over Ava, victims of the oppressive system of the Burmahs, who invariably drive the natives of their conquered provinces from their country, and repeople it with Burmahs.

On the morning of the 17th, we left Cholain Mew, and leaving the high road to our right struck off considerably to the southward, in order to encamp in the vicinity of water, none being procurable on the main route at this season, except by making very long marches. For four months of the year, during the monsoon, water is to be met with, and it was at the close of that season the Burman army passed. Several thickly inhabited villages existed on both sides of the road, and we passed through one of considerable size called Paung-lahong, two miles beyond which we encamped, on the brink of a large jheel. It was most gratifying to remark the confidence now reposed in us by the villagers, so very different from the conduct hitherto pursued by them since our arrival in Ava. No longer forsaking their houses and flying with their families and effects into the jungle, they quietly pursued their daily avocations, and only noticed our approach by

running to the road-side when we passed, and gazing with astonishment at the first white faces they had ever seen.

The difference of soil between the east and west banks of the Irrawaddy at this part of the country is very surprising. The east barren, arid, and parched up, particularly in the neighbourhood of the Petroleum Wells, produces not the slightest vegetation; scarcely a blade of grass is to be met with; whilst the west is fertile, well watered, abounding with fine cattle, and excellent pasturage, and producing all the requisites of food. Sugar is extracted from the palmyra tree in considerable quantity, and saltpetre is also manufactured.

Our road next day lay for some miles over an extensive plain laid out in paddy fields, and bearing the traces of being completely inundated during the monsoon. Indeed, I was informed, that the whole country between this and the Irrawaddy, at that season of the year is one continued sheet of water. After marching eight miles, we came to the Mine river, a fine stream of water fordable about knee deep, and forming the boundary between the districts of Cholain and Sehdine. It derives its source from the Arracan mountains, and even at this season presents sufficient water for small canoes, many of which were plying up and down, mostly superintending the course of several rafts of bamboos which are cut in the mountains, and thence floated down to supply the inhabitants of the plains with materials for building houses. A large and populous village stood on the bank of the river, and we could discover many others lower down.

It being desirable that we should gain the foot of the hills as soon as possible, we made very long marches, and this day marched fifteen and a half miles. Our camp was pitched near a jheel at the town of Sehdine, chief of a small district of the same name, containing about 10,000 inhabitants. The town had been burned by some of the predatory bands, who had overrun this part of the kingdom.

On the 19th, we marched fourteen and a half miles through a highly cultivated country, embellished with groves of palmyra and other trees, and full of populous villages; these obtained their water from a small stream conducted by means of dams from the Mine river, and answering the two-fold purpose of supplying the wants of the inhabitants and irrigating the soil. At the village of Shoegoun, were many Shans, who came out and offered us toddy, and here for the first time we saw

some of the tribe of Kicaams.* The distances on the road to-day were marked off at every dine by small upright posts surrounded by a railing. I measured the distance between several, and found it amount to two miles and five furlongs; but this varies considerably, as a coss or dine in the mountain districts was often under two miles, whilst in the plains, it generally exceeded three. I rather suspect that the Burman distances are calculated rather by the time it takes to traverse them, than by any fixed rule; at least I have constantly found it to be the case, and in this instance particularly so. We halted at Kevensah near the Mine river, a stream of considerable magnitude, and here we for the last time saw the plains of Ava. Before us was wild jungle and forest, and in the distance, we could but just distinguish the blue summits of the Arracan mountains.

About two miles beyond Kevensah, after crossing the Mine river several times, we reached the lowest range of hills connected with the Koma Pokaung range, and commenced ascending. In a little valley at their foot, a post was stuck in the ground, to denote to the pilgrims and merchants who formerly frequented the road, that a chokey or a watch-house existed there, whence they would derive protection against the depredations of the robbers who infested the mountains. We had now regained the high road to Aeng, and in several places could see where it had been cut and levelled with no little trouble; it was in capital repair, and at certain distances, were houses for the reception of pilgrims going to worship at the Shoecotah Pagoda.† Many of these houses had been burned by accidentally catching fire from the long grass which had lately been in flames. The trees were scorched, and deprived of their foliage; and the whole appearance of these hills was as dry and as arid as could be. The jungle was not thick, and consisted principally of the male bamboo, and a few other stunted trees. Several small ponds, one or two containing a little muddy water, and the rest dry, were on the road-side, and near one of them the Burmahs formerly erected a small breastwork, the traces of which are almost quite obliterated. Emerging from the jungle on the summit of a steep ghaut, we at a mile distant perceived the Shoecotah; built on the peak of a very high and steep hill. The Pagoda and its Kioums had a

* So in MSS. † Shwézetto.

beautiful appearance, and seemed quite a delightful spot when compared with the cold but arid scenery around. At the foot of the hills, the Mine river wound about in the most circuitous manner, and enriched a little verdant space of ground where a village formerly stood; the only spot like vegetation we could see around us, and where we consequently pitched our camp. The Shoecotah* is held in the greatest veneration by the Buddists, as containing the impression of Gaudma's feet; one of these is on the summit, and the other at the base of the hill. These are railed in and covered over by splendidly carved and gilt temples, and attended by Phoongees,† who inhabit the Kioums,‡ at the side and foot of the hills. Pilgrims from all parts of the empire flock here to offer up their prayers, and as we entered the valley, the repeated tollings of the bells indicated that some suppliant was on the point of preferring his requests to the deity. The Burman Government derives some profit from the Shoecotah, by exacting a tax on the richer class of devotees, of from twenty to fifty rupees, according to their rank, and they are then allowed to pray within the railing which surrounds the foot. No tax is levied on those suppliants who content themselves with prayers outside the railing, but none are allowed to enter the sacred precincts without paying the fine. The unsettled state of the country of late has of course prevented the Pagoda being as much resorted to as formerly, and we found there but very few devotees. The ascent to the temple is by means of a flight of stone steps, 970 in number, and is covered from the weather by a wooden roof supported by numerous pillars.

During our march on the 21st, we followed the course of the Mine river for several miles, ascending almost imperceptibly the whole time, and after crossing a low range of hills, entered a delightful valley about a mile in width, watered by the Mine river, with numerous habitations on its banks, occupied partly by the Kicaam tribe, and a little further on stood Napeh Mew. The Thanduck Woon had been appointed to the charge of the district of Napeh a short time before, and had preceded us to take possession of his Government, and also to procure some rice for the troops, as we thought it best to provide against accidents by having a few days' provisions to spare.

* Shwézetto. † Priests. ‡ Monasteries.

Napeh Mew is a very pretty and neat town, though of but inconsiderable size. It is situated on a rising ground, commanding the whole plain, and rendering it a good military position; an old teak-wood stockade encircled it, and out-side other small works had existed, which until lately were occupied by a body of 3,000 men levied in the neighbouring districts, and forming a corps of observation. After the capture of Melloon, this force broke up, and part joined the enemy at Pagham Mew, whose defeat it shared.

The district of Napeh contains twenty-four villages and 4,000 inhabitants, of whom 300 were obliged to bear arms during the late war, but they limited their warlike efforts to the care of their own district. Napeh Mew is the last Burman town or village. Towards the mountains, a few hamlets exist further on; but are inhabited by those Kicaams who have placed themselves under the authority of the Burman Government. It was in the paddy ground belonging to one of these villages, called Doh, that we encamped near a small rivulet bearing the same name.

The inhabitants of the place at first were running off, but being re-assured, returned and gave us a good opportunity of remarking the difference between this tribe and the Burmahs.

In appearance the men are much inferior to their neighbours, their countenances being flater, and not so regular as the Burmahs; the dress also differs, and is very simple, a black cloth striped with red and white is thrown over the shoulders, a black cloth is worn round the loins, and a black jacket is occasionally used. They bind their hair with a fillet of black or white cloth, and with a spear, a cross-bow and a quiver full of arrows, a dah and a pouch to contain tobacco and betel, their dress is complete. The women merely wear a black petticoat reaching to the knees, and adorn their necks and the hem of their garments with cowries and glass beads; all the menial offices of the house devolve upon them; they procure water for the daily consumption, pound paddy and dress the food of the men, who are generally employed in fishing or tilling the land. The young Kicaam girls are rather pretty than otherwise, but a custom which has been handed down to them by their ancestors, stamps many of them with the brand of ugliness, and renders them most hideous objects. This consists in tattooing the whole face in segments of circles with a blue mixture,

leaving the neck its natural colour, and thus giving them the appearance of wearing masks, were it not that the deadly appearances of the white spaces round the eyes and the livid colour of the lips indicated the transformation to be indelible. These Kicaams* are a quiet, inoffensive set, and must be distinguished from the Kicaams of the mountains, inasmuch as they have placed themselves under the Burman Government, and are liable to be called upon for their quota of men in case of war, and pay taxes, whereas the others are quite independent. Residing in the most remote and unfrequented recesses of the mountains, the Kicaams hold themselves aloof from, and are entirely independent of the rest of mankind, whom they consider their enemies and lawful prey; and acknowledging no sovereign, they herd together in small parties of thirty and forty, and select some fertile spot in the neighbourhood of a mountain stream, sufficiently large to cultivate grain for their consumption. There they erect their miserable dwellings, and with the produce of the land, consisting of rice and turmeric, continue to subsist themselves. The rivers furnish them with abundance of fish, and they will eat any animal, however disgusting it may be. The origin of the Kicaams is lost in fiction, and of the details of their early history the present race know little except from vague traditions, verbally transmitted from one generation to the next. They, however say, that in former days the plains of Ava and Pegu were peopled by their race, and under the dominion of one of their kings, when a horde of Tartars made a sudden irruption from the northward, and overran the country. For some time the interlopers kept the appearance of friendship with the aborigines of the soil, but becoming daily more formidable, and having secured a footing in the land they threw off the mask, and electing a king amongst themselves, declared themselves independent of the Kicaam king. The Tartar chief then sent to the Kicaams and desired their allegiance, stating, that it was contrary to the dictates of nature that two kings should reign, or that two races of people should exist in the same land, and having deposed the Kicaam king, and put many of the chieftains to death, obliged the others to seek for refuge in flight. The remaining chieftains therefore with their attendant villages collecting all

* There are a great many of them in Arracan, who still observe the custom of tattooing the face. They are called Kaiengs.

their cattle and other valuables, availed themselves of the first opportunity of escaping from the thraldom in which they were held, and fled to the lofty and remote mountains on the frontiers of Siam, China, and Arracan, where they considered themselves safe from the persecution of their conquerors, whom they left in undisputed possession of the plains. With them went some members of the royal family, but in the course of time, from deaths and changes of residence, all traces of them were lost, and the Kicaams of this part of the country knew not whether any of the royal blood exist or not. Divested as they now were of a common head to whom they could look up for advice, they in each village selected from the community one, who either from age or experience, was deemed worthy to be their chief, and in this independent state they have since remained, each little hamlet considering itself as perfectly distinct from those adjoining.

These small republics have since resisted all attempts at much intercourse with their more civilized neighbours, and have preserved unsullied their innate love of liberty and freedom.

Only one trace still exists of supreme authority, and this in the person of the *Passive*, or head of their rude religion. This personage resides near the source of the Mow river, on a mountain called the Pyon, and by his descendants in the male and female line this office of prophet or soothsayer is filled. Writing being unknown, their mandates are delivered verbally, and implicitly obeyed; to them every dispute of importance is referred for arbitration, and in cases of sickness or marriage, they are always consulted. The tenets of the Kicaam faith are most simple; they have no idea of the Supreme Being, nor have they any tradition respecting the creation. They are the children of the mountains, and nature alone has any claim on their feelings. In consonance with this idea, they consider that every thing which is useful to them, or conduces to the luxuries of life, ought to be held in the greatest veneration. The principal object of their adoration is a thick bushy tree bearing a small berry, and called by them *Sabri*. Under the shade of its branches, they at certain seasons of the year assemble with all the members of the family, and offer sacrifices of oxen and pigs, on which they afterwards feast. Their cattle accompany them during these excursions, and partake in the respect paid to the tree, as being the most useful of those blessings which have been so sparingly

bestowed upon them. Another object of adoration is the thunder-bolt, or rather I should suppose the meteoric stone. Whenever a thunder-storm occurs, the Kicaams watch with the utmost anxiety the spot where the lightning strikes, and when the weather is again calm, they proceed to the place they had marked, and examine all the trees, to observe whether any had been scattered by lightning, or their branches broken. Should they be so fortunate as to find one, they immediately dig the ground under the injured bough, and commence searching for the sacred stone, which is generally about the size of the hand, and by them supposed to fall from heaven. This stone is supposed to possess the most supernatural qualities, and its appearance is hailed by the sacrifice of a hog and a bullock, ending in a feast; after which it is delivered over to the care of the passive, who keeps it as an infallible talisman against every sort of disease.

Their ideas of the difference between good and evil consist in supposing, that those who honour and respect their parents, take care of their children and cattle, and eat most meat, and drink spirits to the greatest excess, will be well provided for hereafter, and their souls transferred into the bodies of oxen or pigs; whilst those whose sensual appetites are not so great, and who do not enjoy to the utmost all the good things of the earth, which may be thrown in their way, are considered unworthy of a future reward, looked down upon and contemned. Although it is evident that the Kicaams partly profess the doctrine of transmigration, yet it seems most extraordinary that they should not only feel no compunction in killing their cattle, but deem it a meritorious act. It must, however, be observed, that the sanction of the *Passive* is necessary before an animal can be slain.

When any one dies, the event is hailed as a joyful circumstance, and the relations give a grand feast to which all the village is invited, when the degree of affection borne to the deceased is shewn by dancing, eating, and drinking in prodigious quantity. Then, should the defunct be a man of property, his body is burned, and the ashes being collected are placed in a basket, and either taken to the mountain of Keoungnatyne, near which we passed when marching from Shoecatah, or to the mountain of Yehaartoung, and there deposited. The latter mountain is very sacred and very lofty, "for (to use the words of my uncouth, uncivilized informant) from its summit the whole world

could be seen." Over the tombs of the chiefs a house is erected, and people are left to watch and defend it from malevolent spirits, and a log rudely carved to represent the deceased is laid there for the same purpose. The poor people, if not in the immediate neighbourhood of Yahaartoung or Keoungnatyne, are buried any where in the vicinity of their own village.

Matrimony with the Kicaams is purely a civil contract, unhallowed by any religious ceremony. The contracting parties proceed in the first instance to the *Passive*, whose advice is requested respecting the match; if his opinion is favourable, the bridegroom sends the parents of the damsel a present composed of a pig, an ox, a spear, a tom-tom, a dah, and calabash full of spirituous liquor distilled from rice. A grand feast is then given, at which all the relations attend, and the marriage is considered as solemnized.

Should the lady after marriage prove false to her marriage vows, and the gay deceiver be discovered, he is obliged to present a hog, an ox, and a spear to the injured husband, and a fine string of cowries to adorn the neck of the fair one, who after this peace-offering is considered quite exonerated from any blame, and is re-admitted to her husband's favour, without her reputation being in the least degree tainted.

In the case of an illicit intercourse being discovered between two young Kicaams, the man is obliged to pay a bullock to the girl; but if she becomes a mother, she claims him as her husband, and if he refuses, another bullock is the penalty inflicted on him; he takes the child into his own charge, and the damsel is restored to her fair fame.

The virtue of a chieftain's daughter is estimated at a much greater value, no less than three bullocks being the fine for leading her astray from the path of rectitude, and the same number, should the offender refuse to make reparation by marriage. Marriage is not permitted in nearer consanguinity than cousins, but incest, although a crime but seldom heard of, is absolved by paying only one bullock to the father. A divorce can be procured at the same expense.

If a murder is committed, the perpetrator is immediately seized by the village chief, who obliges him to give up three of his friends or relations as slaves to the family of the deceased, or ransom them at the rate of thirty rupees a man, thus estimating human life at the moderate sum of ninety rupees; but if the murderer is unable to pay

the fine, or produce his sureties, he is himself kept in servitude. Should he escape and take refuge in another village, the inhabitants of it immediately return him, if they have a proper sense of propriety; but if they do not, and refuse to send the Kicaam back when demanded, war is denounced against them, and their village destroyed. The murderer if taken is recommitted to slavery, it being expressly recommended them by the *Passive*, not to shed the blood of each other.

Theft is not considered a very heinous crime, but should corn be purloined, the offender is obliged to purchase his own freedom, either by finding a substitute, or paying thirty rupees.

The Kicaams have no knowledge of medicine, but on the contrary, appear to hold it in great contempt. When therefore a man is taken ill, he is taken to the *Passive*, who first partaking of a feast prepared by the friends of the invalid, recites incantations over him, and uses the meteoric stone as a charm against the ravages of the disease. If these do not prove efficacious, the man is left to his fate, and no further exertion made to save him.

Hospitality is a virtue which it is difficult to ascertain whether they would put in practice or not; shunning as they do all intercourse with strangers, the manner in which one intruding on their haunts would be received, seems rather problematical. They, however, state that if a foreigner was to fall in with one of their villages, he would not be ill-treated, but they did not recollect such a visit ever having taken place.

From the wild cotton growing in the mountains, the Kicaam women fabricate their own clothes, and even make enough to become an article of traffic with the lowlanders. Silver is not procure in the mountains, but iron ore is found in considerable quantity, and with honey and dried fish, form their principal articles of trade; these they carry into Arracan and Ava, and exchange for money, or such articles of food and clothing, as their own wilds have denied them.

With the use of fire-arms they are generally speaking unacquainted, and seem to hold them in great awe; their own weapons are the spear, dah, and the cross-bow with a quiverfull of arrows. The latter are made of bamboo, with the point hardened by fire, and doubly barbed. They are deeply poisoned, and the slightest touch inflicts

instant death. This poison is vegetable, and procured by making an incision in the bark of certain trees, and collecting the liquor which exudes.

The frightful custom of tatooing the faces of the women, derives its origin from a very curious story, and one that reflects much credit on the inhabitants of the mountains. At the period when the Tartars conquered the plains, and drove the Kicaams to the mountains, they imposed an annual tribute on this persecuted race, and in default of payment, used to seize the prettiest of the mountain beauties, and collecting a considerable number, present them to their despotic sovereign, who selected from the groupe those whom he deemed worthy to adorn his seraglio. To such an extent was this monopoly at last carried, that the Kicaams in order to save their race from extermination, persuaded all the servile women to sacrifice those personal charms which drew such a dangerous distinction on them, a proposition with which they immediately and cheerfully complied, and tatooed their faces.* When these hideous creatures were presented to the monarch, he sent them back in great wrath, and ordered a fresh search to be made for new objects to fill his haram. It, however, proved fruitless, all the young girls had undergone the test of freedom, and none remained unblemished, save old women and children. Foiled thus in his attempt to destroy the happiness of the inoffensive Kicaams, the tyrant turned his views elsewhere, and no longer molested them. The custom, however, still remained, and it is only latterly that it is falling into disuse, the women never tatooing till between thirty and forty years of age, and then it is a mere matter of choice.

From the little I have seen of the Kicaams, I should suppose them to be quiet, and entirely devoted to agricultural pursuits; but as those individuals I have met with were mostly all living in a comparatively civilized state under the British and Burman Governments, it would not be a fair criterion to judge the generality by them, particularly as all accounts agree in stating them to be savage, and addicted to plunder and rapine. To judge, however, by their simple code of laws, they are not by any means deficient in the knowledge of right and wrong, and are quite aware of the footing on which men stand with each other.

* The precaution is certainly superfluous with the present generation.

I therefore doubt not but with lenity and kindness they might be induced to mix with their more civilized neighbours, and become useful members of society.

Clearing the village of Doh, we followed the bed of the Mine river, and entered a deep Pass formed by the lofty mountains through which this stream runs. Rising almost perpendicular to a great height, they completely hemmed us in, and their summits and sides clothed with trees, now of a verdant appearance, shielded us from the rays of the sun, and rendered our march very pleasant and interesting.

On our road, we met several Kicaams with dried fish, which they catch and dry here, and then take to their families. With the exception of these straggling individuals we saw not a soul, nor the recent traces of any one during ten miles we marched through this dell. We encamped at the first spot we could find which afforded sufficient width to pitch a tent, and were so fortunate as to procure plenty of forage, although I had been told we should find nothing for the cattle but bamboo leaves. So far from that being the case, the vegetation as we advanced, became more and more luxuriant; the most delightful variety of brilliant foliage hung over the stream, rills of water abounded in the mountains, and large masses of rock, torn from their original site by the mountain torrents, lay here and there in the bed of the river, and occasionally damming the streams up, caused it to rush down in waterfalls, giving the whole scene one of the wildest and most romantic appearances imaginable. Our road this day, though far from good, hung over the rocks and loose stones in the course of the stream, and might in a short time, with but little trouble, be made passable for wheel carriages; but during the rains I should suppose the force and depth of the torrent would prevent a passage being effected.

After winding through the bed of our constant companion the Mine river for four miles, we arrived at the post of Kaong, where two or three good houses remained, which had been occupied by a Burman picket. At this point the river divides into two branches, and the road begins ascending the mountain, the ascent for a mile is extremely abrupt, as it runs up a tongue of land proceeding from the main range, and which is so very steep on the sides, that the road has necessarily been made almost strait up the hill. When we had ascended a couple of miles, we marched on the summit of the ridge, which was not more

than fifteen or twenty feet wide, and the declivity on each side exceedingly abrupt. Across this part of the road a small stockade had been erected, which completely enfiladed the path for a considerable distance. This work was called Keonkrias, and was supplied with water from a stream at the bottom of the valley; it may have contained about 100 men.

Pushing on as rapidly as possible, we, after marching four miles over a continued ascent, reached the fort on the highest point of the mountains, and here the road, which for some distance had been as good as could be wished, became very abrupt and much broken, the rain having forced away great part of it. We had been marching all day, and were it not for the refreshing shade thrown by the lofty trees under which we passed, should have suffered much from the heat, and want of water; as it was, we were not a little fatigued when we gained the summit of the mountains, and halted at a small stockade called Nariengain. Our labours, however, were amply repaid by the grand scene which opened on our view. Below in every direction, rose immense mountains beautifully wooded from the summit down to the very base, and giving rise to the Mine river on the East, and the Aeng river to the West, both of whose numerous sources could be distinctly traced in the ravines falling from the mountains. We were now exactly on our frontier line; on one side lay the British territory, and on the other the dominions of the king of Ava, and had it not been that the weather was hazy, I am informed the view would have comprised the sea, and the plains of the Irrawaddy.*

The little stockade of Nariengain is built on our line of demarcation, and in the event of future circumstances rendering it advisable to establish military posts on our frontier, would prove an excellent position, as it is the complete key of the Aeng road, and commanding the ascent both from the Arracan and Ava sides, would prevent the Burmahs availing themselves of many strong Passes, where they might annoy and impede the advance of our troops.†

* Chedooba, Ramree, and various other islands on the Arracan side are distinctly visible from this point, and is also the Irrawaddy river for many miles of its course.

† Every officer who has inspected this Pass, will testify to the correctness of this statement.

Nature indeed could not have formed a more formidable, or easier-to-be-defended barrier than the Arracan mountains, every step presenting a Pass or hill, which might be defended by a handful of men against hundreds, and the jungle offering a sure asylum to the vanquished.

The water at Nariengain was so difficult of access, that the cattle could not approach it; but it was of good quality, and in quantity sufficient for our consumption. It is quite a mistaken idea, that no water exists in these mountains, there being numerous springs in all the hills; but these rising about half way from the summit where the road runs, the difficulty of access to them is very great. This might be avoided by cutting paths to and from them; and digging reservoirs of sufficient size to water the cattle, would always ensure a supply, as the spring in a short time would replenish them.*

At night we were enveloped in a cloud, and the air became much colder, but having no thermometer, I could not ascertain the difference of temperature, and the want of proper instruments in like manner prevented my fixing the height of the mountains.

The great range is called the Komah Pokong Teoung,† and runs in a direction about S. 20 W., falling to the East in a succession of parallel ranges, and on the West more abruptly to the sea. The mountain on which Nariengain is situated is named Morang-mateng-toung. In early times the Kicaams used to prowl about this road in search of plunder, and attack and murder any traveller they might chance to meet with; but as their numbers were never very great, the merchants who formerly passed this way united their forces, and forming little caravans of from 30 to 300 men, placed themselves beyond the power of these savage marauders. A great trade was carried on before the war between Arracan and Ava, in which it is said 40,000 people were annually employed. The former country exported Indian and European manufactures; such as velvets, broad cloths, piece goods, silks, and muslins, and beetlenut, salt and other articles, the pro-

* This is most perfectly correct. For many years it was believed that Nariengain was devoid of water. Captain Pemberton and others failed to find it, but when Captain Bogle and a party visited it in January 1839, it was found in abundance, and of most delicious quality.

† In Arracan, these mountains are named Yeohmatoung.

duce of its own soil receiving in return ivory, silver, copper, palmyra sugar, tobacco, oil, and lacquered boxes.*

It was principally to further this intercourse that the late king of Ava, Mindraghee Prah, caused this superb road to be made, a work which reflects the greatest credit not only on the liberal mind of him who planned, but also on those who carried it into execution. The labour bestowed upon it has been immense, as for nearly twenty miles the road is cut out of the hill side to the width of between ten or twelve feet, and that with the most judicious attention to the different falls of the ground. The remains of a parapet formed of trunks of trees are visible in many places, and it would be very advantageous if something of the kind still existed, the precipices being most terrific, and of such a depth, that if any animal lost his footing and fell over, his loss would be inevitable. The Aeng road was first commenced in 1816, under the superintendence of the Thanduck Woon, and other chieftains, through whose territories it passed, the whole plans in the first instance having been laid out by the Engineers of the king. During the first two years, only 500 workmen were employed, but then the road having been completed nearly up to the summit of the mountain, 200 more were added, who finished it as far as Shoecatah, each man receiving seven rupees a month wages. But what contributed more than any thing to the completion of the road was, a most sensible rule enforced by the Burman Government, by which in lieu of taxes on their merchandize, they obliged all the travellers to carry with them working tools, and repair those parts of the road which might require it, or facilitate the access to the water.† Thus constant use, instead of spoiling the road, only improved it, and it is only owing to the stagnation of commerce during the last two years, and the consequent encroachment and the ravages of the monsoon, that any part of our route was bad,—for as the communication is closed between May and January, the damage sustained during that period must be annually repaired.

* The trade greatly increased after the peace, but has become almost extinct since the accession of Tharrawady.

† This road has within the last three years been very tolerably repaired, all the bridges which had fallen into decay restored, and a new road of upwards of twenty miles in length, has been constructed from the village of Aeng down the river toward the sea, so that troops, &c. may be landed below the shallows.

We were unable to leave Nariengain till 10 o'clock on the 24th, the road down the mountain having been completely blocked up by large trees felled across at every few yards; the descent for six furlongs was exceedingly rapid, and brought us to a small open spot used as a halting place by travellers, and named Koaronkire.* Here a fine stream of water issued from the hill, and being dammed up afforded great refreshment to our jaded cattle. A little further on, was another small stockade in a capital position, and defended by an abbattis extending some distance down the road, which for two miles more was much impeded by trees; and had it not been for the exertions of Lieut. Davinire and his detachment of Pioneers, would have impeded us considerably; as it was, we did not arrive at Jooadah,† though a distance of only six miles, until sunset. The latter part of the road was through a bamboo jungle, and as we passed along, we heard the screams of innumerable baboons, and observed the recent tracks of many wild elephants.

On the 25th, we still continued descending the same tongue of land, and after marching eleven miles‡ arrived at Sarawah, on the banks of the Aeng river. Thence to Aeng, where we marched on the 26th, was fifteen miles, the road occasionally crossing the Aeng river, and several other smaller streams; over the latter substantial wooden bridges had been thrown, of sufficient breadth to admit any species of wheel carriage, but time had so much impaired the wood, that they had all fallen to decay,§ whilst those which age had spared, had been purposely destroyed by the Burmahs. Six miles before entering Aeng, the road leaves the hills, and from thence is superb, being quite level, and about twenty feet wide.

Aeng when we entered it contained but few inhabitants, but formerly it was of considerable size, and was the emporium of all the trade between the two kingdoms.|| The tide runs past the village, but at this season of the year there is not water enough for boats of any size within six miles of the wharf. We had been informed on

* The road from this landing place to the frontier line, five marches, is probably much less difficult even for Artillery than the Bolan Pass.

† Wadait. ‡ This part is by far the mos t difficult of any.

§ Lately repaired.

|| It has since revived, and is now a place of some little consequence.

leaving Yandaboo, that a depôt of provisions had been formed at Aeng, and had consequently only brought twenty days' provisions with us from Pokong Yeh, which were nearly expended; but there were no signs of any thing of the kind, and a small detachment of sepoys who were stationed there, informed us they had only arrived ten days before, and knew nothing about it. Captain Ross, therefore, directed me to proceed to the nearest military station, and report our arrival. On the 28th, I arrived at "Amherst Harbour," just in time to stop the departure of a detachment under Major Auriol, European Regt., and the boats and provisions belonging to it, destined to reconnoitre the Aeng road, which being no longer necessary, Commodore Hayes and Lieut. Col. Garnham, directed the boats intended for their conveyance to proceed with provisions for the 18th Regt. at Aeng, and then bring them down to "Amherst Harbour," where transports would be ready to receive them. On the 5th April, the detachment left Aeng, having previously sent the elephants to Arracan, and on the 16th, embarked for Madras.

It is very satisfactory to observe, that although during our march from Sembeghewn we averaged more than ten miles a day, and were much exposed to the sun, we only lost one man by death; and that when we entered Aeng, only three men were sufficiently unwell to be carried in doolies. The loss in cattle only amounted to a few bullocks, already jaded when we started, by the long march from Prome to Yandaboo. We also lost four elephants, and one who was allowed by his *mahout* to stray away.

The advantages of this fine road leading in twenty-five or thirty marches to the capital of Ava, more than counterbalances the fatigue and trouble likely to attend the passage of artillery over the mountains, where in many places, from the great ascent, bullocks could be of no use in dragging the guns, which must therefore be necessarily pulled up by sheer force of arm. For the same reason, it would be impossible to convey the Commissariat or other stores in carts.

That part of the road which requires most actual making, is for eight miles in the bed of the Mine river, where the annual torrents are continually changing the position of the rocks and stones; but this could be easily remedied, as abundance of materials are at hand with which a road might be made.

Some parts of the road on the mountain require a good deal of repair and widening, and it would be requisite to sink tanks at the watering places and cut paths to and from them; but taking every thing into consideration, it is my opinion that a battalion of Pioneers sent one week in advance, would render the road quite passable for an army. The want of sufficient open ground to encamp in, would prove an inconvenience, but does not exist for many marches.

The importance of the new road we were exploring, the circumstances of the country we passed through, never before having been traversed by an European, and the manners of the natives we met with, being but little known, have induced me to make this unusually long report to you, in the hope that some of the information it contains may perhaps hereafter prove useful, should the Aeng road again be passed by British troops.

I have &c. &c.

(Signed) T. A. Trant,
Lieut. H. M. 95th Regiment,
Deputy Assistant Quarter Master General.

To the Quarter Master General of the Army, Fort William.
Judical Department, the 7th November, 1837.

(True Copies,)
(Signed) F. J. Halliday,
Officiating Secretary to the Government of Bengal.

Capt. Manson's *Journal of a Visit to Melum and the Oonta Dhoora Pass in Juwahir. Edited by* J. H. Batten, Esq. *C. S. for the Journal of the Asiatic Society.*

In our Proceedings for March 1842 will be found an account of the recovery of a part of Captain Herbert's Journal of the Mineralogical Survey in the Himalaya, and in those of August the kind offer of our most zealous and able associate Mr. Batten, Assistant Commissioner in Kemaon, to edit Captain Manson's Journal, which forms part of Captain Herbert's papers, which we need not add was most gratefully accepted by the Society. The following paper is the one which he there alludes to, and the reader, or the intending traveller, will peruse it with the satisfaction of knowing that its details and its experience are fully confirmed by two more travellers in those dangerous regions.

The scientific geologist and naturalist will perhaps at first regret that they do not find more details falling in with their studies, but we must beg of them to reffect that the writers and editors of such papers, though they may lay no calm to scientific qualifications (so difficult to acquire in India,) are nevertheless rendering a service of first rate importance to the cause of science; and this is the important service of *pioneering* We could say much on this subject, for few remember, and many keep out of sight, what they owe to the humble and often forgotten labours of those who have undertaken the thankless work of chronicling a first exploration, or their first labours in a new branch of science: but we may comprise it all in a single question. What will not some future Humboldt, with guides like these ready to mark out his path, be able to accomplish amongst the yet hidden wonders of the stupendous mountains of India?—H. P.

15*th September*.—First march beyond Booee* up the bed of the Raálim torrent; fall of the torrent very great; direction of it about N. and by E. About six miles up, another stream falls into it, whose course is about E. N. E. when the former turned a little to the west of North.

Specimens 25 to 41.

N. B.—Crossed the stream over a snow-bed at the Sábá (or Great) Oodear. A specimen of red raspberry, ripe, and very pleasant to the palate. Marched at 7h. 50m. and reached our ground at 4h. 5m., distance about twelve miles, road pretty good. No tent up; slept under a large rock (or Oodear†); heavy rain during the night. At 6 P. M. thermometer 50°.

16*th September*.—7 A. M. thermometer 45°; barometer 20.250; t. m. and air 52°; m. t. 45° 5′. Marched at 10h. 36m. A. M. The road continued for a mile up the bed of the torrent, the rock chiefly gneiss, little or no granite; ground on the right bank sloping, steep on the left, strata generally dipping to the N. E.; commenced a short but steep ascent from the torrent, passed through a few birch trees, (the only ones on

* In Webb's map, (Indian Atlas, No. 66,) Bhooee on the left bank of the Goree river is noted, above which to the north are also marked the Snowy Peaks, Nos. XVI, XVII, and XVIII of the Kumaon Survey, on the same side of that river; but no mention is made of the Raálim river which joins the Goree opposite the Pass called Leepooke Than, or Hurdol, and beneath the Peaks XVI and XVII. When the route by the Goree, owing to the loss of bridges or an unusual fall of snow, or the carrying away of the road is closed, the Juwahir Bhootias proceed to Raálim along the torrent of that name, and so on towards Melum.—J. H. B.

† Odhéar is a *cave*, or any arched recess in the rocks, and used by the Bhootias for the shelter of themselves and sheep with their loads.—J. H. B.

the road); the path then continued along the sloping side of the mountain, ascending occasionally, with a little descent here and there. Ground covered with the wild strawberry? (or potentilla.) Little or no rock visible; gradually changing from gneiss to a kind of mica slate, and from that into a greywacke and talcose clay slate. Arrived at our tents at 2h. 45m. P. M., distance about five miles. The village of Raálim, about two miles further on, consists of about twelve mows (families.—J. H. B.) The torrent to this had a northerly course, and from this as far as visible to a large snow bed; its course* is about N. E.—4h. 15m. P. M. barometer 19.207; t. m. 54, air 50; m. t. 49°.

N. B.—Could procure only twenty-one coolies from the village. A road leads from this up the bed of the torrent, four days' journey for loaded men, to the village of Sheebooh† in Dhurma, but very bad and dangerous.

17*th September*.—8 A. M. thermometer 42°. Marched at 9h. 32m. A. M., and commenced a very steep ascent; the rock to the top of the Pass of Bircheegung, clay slate, talc slate, and greywacke, and near the Pass, a few blocks of quartz. The whole ascent occupied three and half hours; the higher we ascended, we felt the difficulty of breathing greater, and consequently the fatigue of walking; found I could not walk more than from ten to twenty paces, according to the steepness of the ascent, my legs feeling as if they would drop off. When two-thirds up the ascent, a snow storm came on, (but the snow melted as fast as it fell to the ground,) when the thermometer immediately fell to 32°. At the top of the Pass, at 1 P. M. it was 30°. As we ascended, vegetation gradually decreased, and towards the summit of the Pass, wholly disappeared, and nothing but broken fragments of clay and talc slate and quartz presented themselves to the eye. The Pass, judging from the time taken to ascend it, and from all vegetation ceasing, must be at least 15,000 feet; but owing to the lad who carried part of the apparatus belonging to the barometer having preceded me some distance, I was unable to

Specimens 50 to 54.

* From the sketch and the text, it appears that the writer does not mean by *course* and *direction* of the Raálim, the course of its current (for, that is in a southerly direction,) but the line of ascent along its bed, and towards its sources.—J. H. B.

† Seeboo.—J. H. B.

set it up. The vegetables up the ascent consisted chiefly of a species of potentilla and dwarf juniper, which did not rise more than six inches from the ground. On the descent, the rocky fragments continued much lower down than on the opposite side without vegetation. The descent occupied two and half hours near the bed of the Goree river, whose course* here, towards Melum, is about N. W. and by N., when it takes a direction more to the N. Crossed a small torrent near its junction with the Goree on a *sanga*. The temperature of the water was 46°, air 51°, and moist thermometer 48°. The snow continued to fall for about two hours from 12 to 2 P. M., and for about three-quarters down the descent, when thermometer rose to 40°; towards the bottom of the descent, the neighbouring mountains covered with birch jungle and a species of dwarf rhododendron. Arrived at the village of Tola, consisting of from thirty to forty houses at 4h. 25m. P. M., being about seven hours on the road; being one of the most fatiguing marches I ever made. The rock down the descent, chiefly clay slate. The sides of the mountains near Tola have a very shattered and precipitous appearance.

18*th September*.—A halt, a fine clear day, 9 A. M. thermometer 49°; 2 P. M. air 62°, in sun 66°; moist thermometer 51°. In the sun covered with wool (black,) and laid on a dark soil, it rose to 117°. Nunda Debee visible, bearing West. Two days journey from this village, a good deal of level ground, well cultivated, in the neighbourhood of Tola. The inhabitants dirty and ill-looking, and the village surrounded by filth; demand one rupee for six and half seers of attah, which at Munsaree, six days' journey the direct road, was procured at the rate of twenty-four seers per rupee. They have here fine Tartar sheep, for which they ask two rupees each; they have nearly twice the bulk of a Plain sheep, and have long twisted horns.—4h. 15m. P. M. barometer 20.235, air 765.5, moist thermometer 47°.

N. B.—Purchased three large Tartar sheep for two rupees each, two of them a male and one female for breeding.†

* Vide note marked † preceding page—J. H. B.

† Lieut. J. A. Weller, Executive Engineer and Officiating Assistant to the Commissioner of Kumaon, has just arrived from a tour to Juwahir, and has kindly added some side notes to this Journal in addition to my own; besides very handsomely placing parts of his own Journal at my disposal for the use of the Asiatic Society.—J. H. B.

19*th September.*—7 A. M. thermometer 43° 5′, moist thermometer 39°. Very fine clear morning, towards noon became cloudy, and it rained gently all the afternoon.

Specimens 55 to 61.

Picked up near the village specimens No. 55 to 61, most of them containing copper (?) Some disseminated, some in small veins, and some in pyrites. This ore seems to occupy very generally the rocks up the bed of a small stream which runs close to the south of the village; it does not appear in any of the soft friable, slaty rock, which is the general rock, but in that of the harder kinds, and in quartz.

20*th September.*—Halt; morning cloudy, gentle rain during the forenoon, cleared up a little towards 4 o'clock. At 2 P. M. thermometer 52° 5′, moist thermometer 48°. The ooah jhow* is just ripe here, and is being cut. It is sown sometime in the month of May. Turnips are grown here, but they are small and strong; they say they were brought from Dhurma.

They say it is two days' journey from Melum to the Pass, and from thence four days to Neetee; two alternate days no village to encamp at, the whole road within our own boundary.†

They travel for five days from the bottom of the other side of the Pass, before they come to any Tartar habitation. There is no chokee near the Pass at present, to prevent any traveller approaching the opposite side. There is a road from the Pass through the Tartar frontier to Branse, fifteen days journey.

21*st September.*—Halt; morning fair and clear, fresh snow on all the high neighbouring peaks. 10 A. M. thermometer 46°, thermometer in sun 52°, hoar frost in the shade at this hour. Observed the hour of noon to-day, and found our watches a quarter of an hour too fast. The people here say, they are not subject to be visited by severe storms at this season, (the Equinox,) and that only a little rain and snow fall. There has blown, however, every day since our arrival here, a very unpleasant cold wind, which sets in about 12 or 1 P. M., and continues till near sunset. The Bhoteeahs here reside in the hot

* Ooa Jow, Hordeum cœleste.—J. H. B.

† Not if Oonta Dhoora is our boundary; as that Pass has to be crossed to reach Gertee, which is intermediate between Oonta Dhoora and Neetee. See Sketch No. 1. —J. A. W.

season at Saeen, and the Pudhán,* (an old man,) is a regular Jew in all his dealings, even endeavouring to find out what will be offered for an article before he himself will fix any price, even to the smallest trifles. 1h. 45m. P. M. ther. in open air 50° 5′. moist ther. 43° 5′, since 12 A. M. it has gradually become cloudy and windy, and is now raining, but not heavily. The grains, &c. grown here are ooah jhow, phāpher,† turnips, sursōn.‡

22d September,—Fine day, but snow falling on the highest peaks. Marched at 1 P. M., the road partly level along the side of the mountain; numerous slips, and some parts precipitous and dangerous. The rock between Tola and Boōnpēr has a much less slaty structure than that near the former village, but continues very metalliferous to within about a mile of Boōnfer; some of the specimens picked up contain rather large crystals of copper (?) very well defined, but rather scattered through the rock. The general character of the rock is (I think) graywacke, some very hard, and specimens broken off with much difficulty. A good deal of quartz was also observed along the road, &c. No. 67 is chiefly composed of felspar. Some specimens procured in this march have attached to them some well defined crystals of quartz, &c. The sides of the mountains, whence all the rocks from which the specimens were procured, have a very shattered appearance. There can be little doubt of their containing some large deposits of ore, which might be discovered, I should think, without much difficulty. On the road about half way, found a large deposit of decomposed felspar, some veins of it beautifully white.

Specimens 61 to 75.

Plants Collected.

Two species of juniper, one in seed, the other just coming into flower. A shrub very like the sweet-briar, but with no smell. A small herbaceous plant differing in appearance, but with the same scent as the plant well known by the name of "old man," or southernwood. The gooseberry, just ripe. The currant, (no fruit.)

* Head of the village, Malgoogar—Lumberdar.—J. H. B.
† A species of Polygonum.—J. H. B.
‡ Sinapis dichotoma—J. H. B.

The Bis.

The natives here have an idea, that people passing through a jungle of this plant, (wolf's-bane,) are subject to illness, becoming at times wholly insensible; but I was inclined to think this illness arose from the quick circulation of the blood in the fatigue of ascending in a rarefied air; and this day my supposition is apparently verified, for in trying my pulse by a watch with a second hand, I found on standing still after a little bit of steep ascent, that my pulse beat at the rate of 160 in a minute. A seapoy's, (a hill man,) who was with me, beat at the rate of 172. I found also, that in walking on level ground, my pulse beat about 130. It is therefore most probable, that the great fatigue experienced in climbing ascents at this height, is owing to the increased circulation of the blood.*

N. B.—Arrived at the village of Boōrfēr, about five miles, at 4h. 40m. P. M., (forty or fifty houses) situated in an open part of the valley with numerous fields about. The valley of Mertolee† on the opposite side of the river about half way. Crossed on a *sanga* rather a large stream close below the village, the bed of it very wide, five or six punchakies‡ in the course of it.

23*rd September*.—Thermometer at 10 A. M. 56°, moist thermometer 41°. Early in the morning hoar frost on the ground, and a film of ice, the thickness of a shilling, on the water in the *suraee*. Night and morning beautifully clear; not the smallest speck of

* It is singular that on the 29th May 1842, I walked nearly all the distance from Doong across the Oonta Dhoora Pass, including the whole ascent and descent of the Pass unaided, without feeling any unusual fatigue. Two Booteas walked up the Pass with me; five other Booteas, a hill servant, and a Mussulman of the plains, accompanied me (on jooboos,) and no one of the party complained of, or appeared to feel unusual oppression. I recrossed the Pass, walking, on the 5th June, with exactly a similar result.—J. A. W.

Lieut. Weller is not singular in his exemption from suffering in rarefied air; as during a six years' residence in the hills, I have found that the European travellers to great heights are affected by, or free from, the painful effects of rarefaction in about equal numbers. I myself am a great sufferer. The generality of those affected find their powers of motion and muscular exertion extraordinarily paralysed. The natives do not attribute the effects indiscriminately to 'nirbisi,' or aconite—and indeed the worst oppression is felt above the reach of all vegetation. 'Bish ke howa' (The poisoned air) is the general expression for the cause of the oppression, though it is true that certain plants are often quoted as the root of the evil.—J. H. B.

† Meaning below Murtolee village.—J. A. W.

‡ Water mills.—J. H. B.

cloud visible. Marched at 11h. 30m. A. M., descended to the river over a *sanga* immediately below the village; the *sanga*, or rather the stream, was seventeen paces wide, or about forty feet; near the banks of the stream the turf was very thick and short, and delightful to walk on. About two miles came to a small village; five or six houses, (Mápari,) close to which the gooseberry was growing, of which there were two species, one with a smooth stalk, the other rough and bristly; saw no currant bushes.* The rocks, clay slate and greywacke, with a good many masses and fragments of quartz, and as I approached the village of Pāchoo, the rock became of a reddish brown clay on the weather surface, but grey in the fracture; many of the fragments contained ore in some quantity; all the fragments and masses have descended from the height above. There are two villages called Pāchoo† on either side of a large stream which comes down from the direction of Nundee Debee,‡ and which are crossed on a small *sanga*. There are six or eight mows§ in the first, and ten or twelve in the second, (which I was told paid forty rupees a year to Bijjee Sing.) These villages‖ are about three miles below Melum. Arrived at Melum at 4h. 45m. P. M., stopped a good while on the road.¶ Recrossed the Gooree immediately below Melum, which is situated in an open spot of ground of some extent on the opposite side. At about half a mile runs in a N. E. direction the Goonka, up which lies the road to the Pass; the other stream, they say, was the shortest course, being only one day's journey.

Specimens 76 to 89.

N. B.—This stream below Milum, was only thirteen paces, or about thirty-two feet across, having diminished in its breadth about eight feet. The Goonka joins it about a mile below this.

* I saw currants at Melum on the 25th May, the young fruit just out. Plants strong and flourishing.—J. A. W.

† Pachoo on the north bank is rent free in "suda-burt" tenure, for the feeding of pilgrims to Manessurouwer.—J. H. B.

Gānaghur on the south, Pachoo on the north bank of Pachoo River. A fair is held here annually one day, in the rains.—J. A. W.

‡ The Peak of which appears (West) magnificently grand and near; from the north bank of Pachoo River in ascending.—J. A. W.

§ "Mowasahs," or families.—J. H. B.

‖ Have a very good extent of level culturable land along the right bank of the Goree.—J. A. W.

¶ i. e. *From* the N. E.—J. H. B.

Since leaving Tola, nothing like a tree has been visible, and the general aspect of the country is consequently very barren. A very unpleasant strong southerly wind blew all day, and seems to be the prevailing wind here, as the open parts or fronts of the houses here have generally a northern aspect. There is a high mountain at the back of the village, which separates the two streams, which defends it perhaps from the northerly winds, and on either side the mountains descend within a quarter or half a mile, and the only opening is to the south.

The crows in this part appear to differ from the common crows; they fly in pairs, are few in number; their note resembles that of the sea-gull more than the crow,* to which in fact it bears not the slightest similitude. There are a good many of the common† blue pigeon, which fly in flocks near the villages. Saw one large snippet about half way, and passed over a good deal of swampy ground, when I expected almost to have flushed a woodcock,‡ as they are found sometimes near Almora in the winter, and descend probably from this quarter. One of our party, Mr. —— purchased a sheep with five horns at the village of Boōrfēr, for two rupees and twelve annas; the owner asked one rupee per horn for it.

Plants.

1. Dwarf juniper with ripe berries, (black).—2. Ditto a few, not in flower or fruit.—3. The shrub resembling the sweet-briar in fruit.—4. The gooseberry in fruit, (two species).—5. A species of barberry with leaf, not in flower or fruit.

24*th September.*—Halt 8 A. M., thermometer 37°; moist thermometer 31°. Hoar frost on the ground, sun just on Milum, (fine morning.) 12h. 20m. P. M. barometer 19.900, thermometer, moist 69° thermometer, air 66° 5′, moist thermometer 42°. Bare thermometer held in the hand to the rays of the sun 69°. 12h. 45m. thermometer covered with black wool and laid on the ground in the sun rose to

* This is I believe the English chough. I saw them high up in the snow, and again about 15 miles across Oonta Dhoora; some have red, some yellow feet and beaks. The plumage is very soft, and of a deep purple black.—J. A. W.

† Far more like the wood pigeon. Black and white, and grey and white plumage. But blue pigeons are also met with even higher than Melum.—J. A. W.

‡ I constantly looked for woodcock, but never flushed one. From November to March they are (some years more than others) very abundant round Almora, Petoraghur and Lohooghaut. Fifty brace have been killed in a season by one Officer.—J. A. W.

122°. A party came in from Bhote, (or Tartary,) this forenoon, bringing with them five ponies, three jubboes* and a flock of sheep. As they approached the village, a party of musicians with tom-toms went out to meet them, and serenade them in; four of the ponies had riders, the fifth led. The party has been eighteen days coming from Gurtope. They say the snow on the Pass is mid-deep.† In the afternoon strolled up the Goree, and at the distance of a mile and half, or perhaps a little more, saw the snow-bed whence issues the Goree; it has a large high bank with a complete earthy appearance, which stretches across the valley from one range of mountains to the other, (some hundred feet,) and the river (the people say) is not seen above this; but at the distance of perhaps about four or five miles, there is a small pool of dark water which is very deep, and where the people sometimes resort to bathe, (as a religious act.) One man who accompanied me in my walk had bathed in it, but did not go deeper than his middle. To this pool of water, of forty or fifty haths or cubits in extent, the bed of snow continues uninterrupted, with an unequal surface, having numerous undulations. No water is visible beyond the pool above mentioned. There is a very small stream 2 or 300 yards on this side the snow-bed on the right bank of the river, to which the snow-bed

* The *cross* breed of the Thibet yak and Hill cow, pronounced jooboos.—J. H. B.

† *Extract from Lieut. Weller's Journal, May 25th*, 1842.—"I went to see the source of the Goree River, about a mile N. W. from Milum. The river comes out in a small but impetuous stream, at the foot of apparently a mass of dirt and gravel, some 300 feet high, shaped like a half moon. This is in reality a mass of dark coloured ice, (bottle green colour,) extending Westward to a great distance, and covered with stones and fragments of rock, which in fact form a succession of small hills. I went along this scene of desolation for a long space, but could not nearly reach the end. Here and there were circular and irregularly-shaped craters (as it were) from 50 to 500 feet diameter at top, and some of them 150 feet deep. The ice was frequently visible on the sides; and at the bottom was a dirty sea-green coloured pool of water apparently very deep. Into one of these craters I rolled down numerous large stones from off the edge, and in a few seconds huge masses of ice rose from below, seemingly detached by the agitation of the water. The bases of the hills on either side, and frequently far up their faces, are one succession of landslips, but from their distance I do not believe it possible that the debris in the centre of the snow-bed valley can have fallen there from the side hills. *Query?* May not a separate hill at some remote time, have been gradually reduced by landslips, the Goree River and torrents in the rains carrying down the fallen earth and stones, and reducing the mass to what we now see? Nagoo Boorha tells me, that his father (who lived to 98 years) remembered the source of the Goree nearly opposite Milum, and Nagoo himself has seen the recession of the snow-bed some 3 or 400 yards in the course of 40 years."

reached in the memory of some of the oldest men of the village, but it has gradually broken away, which may perhaps indicate some amelioration of the temperature in this quarter.—The river runs past Milum in a N. W.* direction, and towards the snow-bed nearly North.†

The man who came in from Gurtope, wore round his neck a pair of goggles,‡ made apparently of black horse hair, worn when crossing over snow. For the coarse broad cloth which is carried to the fair at Gurtope, they say they receive generally 25 rupees for the length of two breadths, which ought to be about 3 yards; allowing the cloth, which is generally the case, to be $1\frac{1}{2}$ yard wide, little more than 8 rupees per yard; but it must be of the coarsest kind, and such perhaps as is sold in Calcutta for 3 rupees per yard. The bones§ which are brought by the Bhoteahs for sale at the fair held at Bageswur, it appears they purchase at Gurtope, and consequently they are not found amongst the Himalaya, which had formerly given an interest to these productions, but which must now, if the above account prove true, cease altogether.

25th September.—Halt; employed in getting a lesson from Herbert in the use of the theodolite, and in preparing for our visit to the Oonta Dhura Pass. Herbert and Cole too unwell to accompany Conway and myself. Procured our bottle of gooseberries, which I boiled in the hopes of preserving them.

26th September.—Marched at 11h. 20m. A. M. Our own coolies having refused to proceed with us to the foot of the Pass, procured people and jubboos from the village. Our people were frightened I imagine at the exaggerated account of the Bhoteahs regarding the snow.

Crossing the Goonka on a *sanga* opposite Milum about a quarter mile distant; it is about the same breadth as the Gooree, but the body

* i. e. *From* the N. W.—J. H. B.

† *From* the North.—J. H. B.

‡ These horse hair goggles are far more cool, and they more protect the eye from the effects of snow-glare, than green or blue glass spectacles, or wire goggles.—J. H. B.

§ Fossil bones, *Bijlee ke Hár*, nearly always procurable in the Almora bazaar, and used as medicine! I am told, in a pounded state. I have rarely been able to obtain teeth or other *characteristic* specimens. The bones are chiefly those of ruminants, and are found in the hills immediately adjacent to the Sutlej, in the first part of its course through Thibet. The village of *Doompoo* is one chief site.—J. H. B.

of water appears greater; the level ground on which Milum stands, seems to be made up from the crumbled fragments of the neighbouring mountains; as the steep bank of about 150 feet, down which we descended to the Goonka, is composed of a large quantity of earth, in which are imbedded both rounded and irregular stones.

Ascended the river on its left bank, road passable, but not very good, the footing in some places very bad; no grass, nothing but loose earth and small masses of rock. Clay slate and grey silicious rock* in masses and fragments; the general appearance of the mountains extremely barren, precipitous, and shattered, the dip not procurable. The river in three or four places on either side is bounded by masses of earth and stones, (which are no doubt the debris of the overhanging mountains,) which rise in numerous places in sharp peaks, and are, in miniature, the resemblance of some of the more lofty points. Lying in the bed and sides of the river, are some huge masses of breccia or conglomerate.† The rock has not that general metallic appearance it assumed the two preceding marches, but I picked up some specimens with pyrites, some crystals (apparently dodecahedrons.) At about two miles from Milum, saw a few stunted birch trees.

At 2h. 28m. P. M. arrived at our ground of encampment at the mouth of a stream which runs nearly due East, called the ————? The general direction of the Goonka is from N. E., but inclining in its windings more from the North than from the East; from this however it comes from a due North direction for some distance. There are near this a few withered looking birch trees, and on the opposite side some dwarf juniper; but the general look of the country is extremely bleak and barren. The Bhoteeas who accompany us, are sleeping in the open air (with fires,) having brought no tent with them, and the *cave* being occupied by the few servants we have brought with us. The thermometer at sunset was 47°,

* A sandstone.—J. H. B.

† During a fall of snow or a thaw, the descent of stones is almost constant from the earthy precipices over head, and the whole of the Goonka glen at such times is a very dangerous route. Rain is never violent here, but whenever any falls, down come avalanches of stones. Some of the latter (as in Manson's sketch) are suspended on the top of the ravine precipices on little pointed peaks, and their appearance on an avalanche day is any thing but pleasant to the traveller underneath. See Sketch No. 4.—J. H. B.

and a very cold wind blowing, which has been the case from the time we marched; which, added to the glare from a light colored soil and clouded sky, made the march very unpleasant.

Beyond this, they say there is no firewood procurable, and that we must carry from this what we may require. The distance of to-day's march is, I should suppose, about five miles.*

We fell in with a party who were returning with borax, who said the snow in the Pass was not more than enough to cover the shoe, instead of covering half the body. The Bhoteeas with us also begin to say the ascent is very easy the greater part of the way, it being only steep towards the top, and that it is not so steep as the one we crossed between the Ráalim and Tola. They gave us a very different account when at Melum, thinking no doubt to deter us from visiting it.

27th September.—7h. 45m. A. M. ther. 41°, moist ther. 32.° Marched 9h. 10m. A. M., and reached our new ground at 12h. 33m. A. M. distance about six miles. Found some clay slate with varieties, and beds of harder rocks. The road continued along the left bank of the river, the (downward) course of which varied from N. E. to N., the general direction of the river from Melum to the Doong cave close to the junction of two streams, (one called the Ootah, E. from the Pass, which comes down from the N. W.; the other Lusser river, which seems to vary from the N. E. to the East,) is about N. N. E. The fall of the stream to-day is much greater than yesterday; saw the juniper growing a little beyond our old encampment; but soon lost all signs of vegetation, excepting when we approached the junction of the two streams, when we came to one or two open spots,† where the ground was pretty well clothed with a

Specimens 91 to 103.

* An ordinary march for a party with loaded sheep is five miles per day in the Passes, and eight or ten miles in the easier ground in Thibet.—J. H. B.

† Called "Mulla" and "Tulla" (upper and lower) "Sulong." The Booteas generally halt here either for the day, or for a few hours.—J. A. W.

Near this, I found on my way up to Doong in May 1841, in *situ*, a specimen of siliceous sandstone intersected by a vein of crystalline carbonate of lime, containing impressions of bivalve shells. As far as I can judge, the shells are terebratulæ, similar to some found by Gerrard in Chinese Tartary beyond Kunawur. This ground will be re-examined with care. Capt. Boys, 6th Cavalry, recently discovered on the range South-east of Mularee in the Neetee Pass, beautiful specimens also *in situ*, of shells, (either *Avicula* or *Pecten*) in secondary limestone. Both Doong in the Juwahir Pass and Mularea in the Neetee Pass, are considerably on the south side of the Boundary Pass. In 1837, (Vide Asiatic Society's Journal, 1838,) I stated my confident belief, that

short grass, and two species of moss (new to me) here and there under the lee of a rock.

Having been told by a man of Almorah, a Brahmin, in the morning, who had descended the Pass the day previous, that it was not more than two hours' ascent, and being anxious to return to our two sick companions at Melum, in spite of what the people who were with us said (having been deceived by them before,) we set off with the intention, if possible, of reaching far enough at all events to see where the Pass was, as we were told it was visible a little further on; but after ascending for one half hour, and no signs of its appearing, we returned much fatigued. The jubboos we had with us were unable to carry us. We slept under the *oodear*, there being no spot on which to pitch our tent; the night was very cold. The party we saw this morning, had been only ten days from Gartope, two of which they had halted. They had with them sheep laden with salt and borax, five or six ponies, and some jubboos.

28*th September*.—Time 5 A. M. ther. 37°, moist ther. 32°, very cold. Soon after sunset last night, thick clouds collected all round the surrounding heights, which did not disperse till the sun rose this morning.

Marched at 9h. 25m. A. M. and commenced the ascent, crossing the river over a bridge of stones, which were piled on nearly a natural bridge of rocks; at about half a mile, came to a huge bed of snow, from whence the river issued, being I suppose about twelve feet wide; the snow-bed I should think 300 feet thick, covered with fragments of rock from the neighbouring mountain. The road, if it can be so called, very bad, and in many places the footing very insecure; this snow-bed continues for about half a mile or perhaps a little more; it has numerous fissures in it, and from the edges many large icicles, three feet long, were hanging in some places. It had a regular stratified appearance, and dipped to the S. W., just the reverse of the neighbouring mountains. Now and then the stillness of the scene was disturbed by the

fossils would be found on the hither side of the Passes, in the tract of country which lies north of the Himalayan granite peaks, and the gneiss and mica slate strata; but south of Thibet, its rocks being apparently of the same secondary character as that of the oolitic (?) series in Europe, and being quite different from the great primary chain of the Himalayan peaks, the central mountains, and the tertiary strata (so rich in terrestial fossils) of the Sub-Himalayan Ranges.—J. H. B.

falling of small fragments of rock, dislodged by the melting of the snow. After completing the ascent of the snow-bed,* saw the stream flowing over a small valley at a very placid rate, and entering the snow-bed at a similar opening to the one where it has its exit. The road continued along the base of the mountain on the left bank, all the mountains on the opposite side, being the north-face, were covered with snow to their base, as well as those at the head of the small valley which had beds of snow in the hollows, or rather glens, and from one of them the river appeared to take its course. The road continued in this direction N. W., very good for a mile and a half with very little ascent, we then turned to the N., and commenced rather a steep ascent over a mass of white siliceous rock, the debris of the mountain above. On reaching the summit, we came to another rather level piece of ground, but covered with large fragments of a darker rock and a blacker soil. We then had another ascent over the same kind of rock and soil, and on reaching the top came in sight of the Pass. A little further on, crossed two snow-beds; one, the 1st, from two to three hundred yards; the 2d, not more than sixty or seventy yards wide; it appeared in some places to be fresh snow. After crossing these, the last ascent to the Pass presented itself, and appeared easy enough, being quite free from any snow; but owing to our present elevation, we found the difficulty of ascent so great, that we were obliged to have recourse to the jaded jubboos; but finding mine quite unable to carry me up, I dismounted and made another attempt to ascend on foot, but had not taken more than six paces, before I found myself quite unable to proceed from excessive weakness in the limbs and loins. I therefore made the guide,

* At or near this point on the 28th May 1841, my own further progress to the Pass was rendered quite impossible from the depth and softness of the snow, which was falling heavily in a thick mist. It was not without great difficulty, and some danger that I got back to Doong on a jooboo's back. There also the snow was so heavy, and the appearance of the atmosphere so threatening, that the Bhooteeahs recommended an immediate flight to Milum, Doong being a very dangerous place for avalanches, and the road to Milum likely to become more and more unsafe every moment. I accordingly moved, and my whole party arrived the same day safe, but in a miserable plight, at Milum. On the 29th May 1842, Lieut. Weller found the whole route almost entirely bare of snow, and he was able to penetrate more than twelve miles beyond Oonta Dhoora to Bulcha Ghat, without difficulty. The last winter was very mild in the Himalaya, and the usual bad weather in the spring months was quite absent. In general, June and not May, is the earliest month for the opening of the Passes.—J. H. B.

who was with me, tie a cloth round under my arms, and then fastened it to the jubboo's tail, by which means I ascended to the steepest part with very tolerable fatigue, and was relieved from that insupportable weariness of the limbs.

From the top of the Pass ran a small stream of water.* Long before we reached this part of our journey, all signs of vegetation had disappeared, and here the mountain was covered with small fragments of rock, clay slate, &c. The strata of the heights to the right and left of the ascent were very much contorted in all directions. We were one hour and twenty-five minutes in accomplishing this last ascent, which we afterwards descended in twenty-five minutes.†

On reaching the summit of the Pass,‡ an immense sea of mountains lay before us, gradually diminishing in size from the N. W. to the North, in which latter direction our guide told us lay Gertope, to which place two roads led, the nearest one, by which two other ranges were to be crossed by Khylas, the other by Doompoo, by which only one other range, in fact a continuation of the range on which the Pass is situated, was to be crossed. The people, with their sheep laden, cross these ranges in one day. The mountains to the N. W. were partially covered with snow, (and the Pass on the northern face completely

* On 29th May last, nearly the entire side of the Pass had water trickling down it.—J. A. W.

† On the 29th May last, I walked up it with ease in one hour and fifteen minutes. —J. A. W.

‡ This account as to routes and general geography is based on incorrect information. Moreover, from Oonta Dhoora no view is obtainable into Thibet, though this Pass has been usually considered the frontier of the two countries. The range visible to the North from Oonta Dhoora is Bulcha, the real termination of the Cis-Sutlej, Himalaya and the sea of mountains visible to the North-west is within, i. e. Southward of, the prolongation of the above mentioned Bulcha range to the Westward. Whenever the water from the Northern slopes of the Himalaya flows into the valley, (or rather series of plateaus divided by ravines,) through which the Sutlej takes its early course, the last range of the Himalaya may be said to be passed. Whenever, as at Neelung, beyond Gangootree and Topeedoonga and Lufkel, beyond Oonta Dhoora, (the Juwahir Pass,) the streams rising even on the North face eventually flow Southward, and join the great Cis-Himalayan rivers, that country is properly, (i. e. geographically, not geologically) within the Himalaya chain, whatever elevation may have been crossed to reach it, and, however, nominally the said chain may have previously terminated in a political frontier. Compare with Captain Manson's account that now appended from the Journal of Lieutenant Weller, Engineers, and my own observations from the crest of the Neetee Pass, published in the Asiatic Society's Journal of 1838.—J. H. B.

so and very steep,) but it gradually disappeared to the N. E. and the mountains diminished in size. No sign of vegetation was visible in any direction even with the help of a telescope.

There is a road leads from this Pass to the westward to Neetee, which, according to our account, is four days; and towards three days' journey at each alternate stage, there is a village.*

The summit of the Pass is very rounded, and in some places the strata of clay slate crops in nearly a vertical position, but dipping a little to the W. S. W. Many, indeed almost all the fragments of rock up the ascent, were very much intersected with veins of felspar.

To the Westward, were seen some very lofty snow peaks, but none were visible which were known to any of the people; which added to the circumstance of the collection of numerous thick clouds about, and the want of time, prevented my taking the bearings of any of them. There was a sharp piercing wind blowing from the South, and not the slightest shelter procurable, and it was with some difficulty that I set up the barometer, my hands being benumbed with the cold. The height of the Pass is about 17,500 feet. The barometer and thermometer being as follows :—

Time 3h. 10m. P. M., barometer 15.550, temp. of air 34°, temp. of mercury 39°, moist ther. 32,° the water freezing immediately it was exposed to the air. The thermometer covered with black wool laid on the ground, sheltered pretty well from the wind, and exposed to the sun's rays, only rose to 64°. During the greater part of the ascent my pulse did not rise above 150°, the last part of the ascent I did not time the beats. We were five hours in ascending, remained on the top about 1h. 20m., and accomplished the descent in two and half hours; the first part of the descent, about four miles, we came down in an hour, which in ascending had occupied us three, of which we halted about ten minutes near the foot of the last ascent. The jubboos we had with us, we found had had little or no food the two preceding days, which prevented their being of that use they might have been, for they are certainly fine animals for such a country, and are very sure footed. Soon after we commenced our descent, snow began to fall, but fortunately not in any quantity, although the clouds were dark and

* No names given to halting places.—J. A. W.

threatening, and we reached our quarters under the rocks at 6h. 20m. P. M., after an absence of about nine hours. Near this *oodear* on the opposite side of the river, we were told that about eight or nine years ago in this same month, two parties of Bhoteeas, with 200 or 300 sheep coming from Tartary were lost in a snow storm, and that at this season snow constantly falls; but they say there has been very little snow the last two years.

N. B. Learnt that the fossil bones* which are brought by the Bhoteeas for sale at Bageswur, are not found in the Himalaya, but purchased by them at Gertope. Neither are the Saligrams† found among them, but are brought from the same place. On our return towards Munsaree, picked up specimens of the latter, and some quartz crystals on the top of the peaks above Saeru, which had been left as offerings by travellers, and which may possibly account for those found in a Pass to the westward by the Gerards.

29*th September*.—At the Doong *oodear*, time 10h. 35m. A. M., barometer 18.190, temp. of air 44° 5′, mercury 45°, moist ther. 34°.

N. B. Water boiled at 185° of Far. Marched at about 11h. 20m. A. M., and reached Milum a little before 6 P. M., but stopped for some time on the road, sketching and picking up specimens, the road nearly one continued descent, and on numerous places the footing very precarious; the descent being much more difficult than the ascent in that respect, but of course not nearly so fatiguing. Found our invalids very little improved, and very anxious to leave Milum, and resolved marching back towards Munsaree the following day.

Specimens 104 and 106.

30*th September*.—Milum. Marched 12 A. M., and arrived at the village of ——— about 6 P. M., but loitered a good deal on the road; the road pretty good, excepting immediately below Pachoo, when after crossing a small *sanga* over a stream which comes down from the direction of Nundee Debee, there is a very difficult steep ascent for some hundred feet, composed of earth and

Specimens 107 ard 110.

* In regard to the fossil bones, this observation is quite correct, but not so in regard to the shells.

† Vide preceding geological note.—Ammonites are plentiful, and were found by me three miles beyond the Neetee Pass, with their usual accompaniment of belemnites. Lieutenant Weller found at Lufkel, beyond the Juwahir Pass, vast quantities of these fossils, all in situ in black clay slate with limestone.—J. H. B.

stones. In one part, observed signs of stratification, and on examining it closely, found it consisted of fine earth, alternating with beds of small gravel, but quite safe.

Found fragments of granite* and gneiss in the bed of the stream. The general formation to-day continues to be clay slate. Purchased several fine Tartar sheep for one rupee eight annas to one rupee twelve annas each; they are beautiful animals, and have very fine wool.

1*st October.*—Marched at 12 A. M. and arrived at Luspa at 3h. 20m. P. M., road very indifferent. Formation, clay slate as we approached Luspa. There was a very steep ascent from the river, the width of which is very much increased, as I could not throw a stone across it. A little before we came to Luspa, the road passed under some very lofty and precipitous rocks, a perfect wall for some distance, where a slip had occurred about four years ago; the footing in some places rather bad. A little beyond this, came suddenly on a fine open space or valley, up which, at about half a mile, is situated the village of Luspa on a rising piece of ground.

Specimens 111 and 112.

Vegetation† has been rapidly increasing every step we took from the village of Reelkote, and the whole face of the country is losing the barren and naked appearance of the upper part of the valley.

2*d October.*—Ther. 9° 45′, barometer 20.035, air 55°, moist ther. 46°. Marched at 12 A. M., arrived at Bodar, (on the right bank of the Gooree, no valley); at 5h. 50m. P. M. moved very slowly, distance from ten to eleven miles, road execrable, crossed the river twice, once over a large *sanga*, and recrossed over four small ones, more like ladders thrown

* The higher peaks hereabouts are all of granite and gneiss; soon after, below Luspa, these rocks become the exclusive formation, and the Tartaric series are left behind.—J. H. B.

† Nothing can be more striking than the passage from the extreme barrenness of the upper Passes to the gorgeous vegetation of the lower, where first the birch and dwarf rhododendron, then the ragha firs and yews, then sycamores, horse chesnuts, oaks, alders, box, &c., and then all these intermixed with the most rich under-wood and innumerable flowers in turn delight the eye. To a Thibetan all these things are novelties, a willow being the only tree larger than a juniper bush, which he has ever seen. The Lama of Toling, when a refugee at *Almora*, where the country is bleak from want of trees, though fertile, said, "Ah! *this* is a proper country like my own. The tree forests between this and the Snowy Pass are very *bad* indeed, and spoil the scenery!"—J. H. B.

from rock to rock, where the river has a very great fall a little below a very lofty precipice, and where the whole mountain forms a complete wall from the summit to its base, which is washed by the stream: besides the ladders across the stream, there were several others along the road, which would have been impassable without them. Passed snow-beds, one with a very singular appearance, having a complete archway through which a stream passed which fell from a great height over a steep precipice immediately behind it; the front part of the arch had melted away. Below Luspa, about a mile near the bed of the Gooree, large blocks of granite. Formation to Boodur, gneiss with granite veins.

3rd October.—9h. 45m. A. M. barometer 22.545, air 64°. mercury 65° 5′, moist ther. 57°. Marched at 11h. 20m. A. M. Arrived at Rārra at 3h. 45m. P. M., stopped about an hour or so on the road to sketch; road very bad over rocks and ladders. General direction of river, N. Gneiss the whole way, no granite blocks beyond the commencement of the march. Trees of various kinds growing, day warm, found white pantaloons pleasant. Rārra* lies about half an hour's ascent up the mountain after crossing a small torrent over a *sanga*, which comes from the West, and which has a precipitous fall. The fall† of the Gooree is also great, and I regret I was unable to ascertain the fall from Boodur, owing to the man with the barometer having preceded me some distance.

Passed numerous parties of Bhoteeahs on their road to Munsaree, with sheep and goats laden with salt and borax. They were halted near this, and started about the middle of the night, and kept up such an incessant noise, as to keep me awake nearly all night.‡ Heavy showers of rain fell during the evening, and early part of this night. Formation gneiss.

4th October.—Fine morning and cold wind blowing; 8 A. M. ther.

* The waterfalls up the Rarra glen are some of the grandest in the hills.—J. H. B.

† Near Boodur, or more properly Bugdoar, the fall of the Gooree is tremendous, in some spots at the rate of not less than 800 feet per mile. The Aluknunda in some parts of the road to Buddrinath has an ascertained fall of 650 feet in a mile, and the descent of the Mundakinee river, below Kedarnath, is one continuous cataract for about two miles. Such are the Himalayan torrents.—J. H. B.

‡ The sheep and goats cannot travel in the day time after the sun becomes hot; hence these night marches.—J. H. B.

54° 5′. Marched at 10h 18m. A. M. Arrived at the top of the Pass* at 11h. 12m. A. M. ascent tolerably easy, but slippery in many places, in consequence of the rain and the flocks of sheep which had Passed over it; ascended the whole without being obliged to stop to take breath. Pulse never exceeding 140 in a minute, nor the number of inspirations 32 ther., 11h. 30m. A. M. barometer 21.645, air 62° 5′, mercury 64°, moist ther. 57°.

A very little below the Pass, tried the heating power of the sun on the thermometer exposed from 12 A. M. to 12h. 15m. P. M., the one with the black wool rose to 125°, the plain one without it to 95°; they were laid on a book with red leather cover, the bulbs being about an inch above it, sheltered from the little air that was stirring by two tin boxes, the sun shining on one, by which of course some heat was reflected on the thermometers. A slight cloud passed over, which put a stop to the experiment; however, they rose very little the last five minutes. Arrived at our old encamping ground on the bank of the Saëen, near its junction with the Gooree, at 3h. 45m. P. M., descent very long and tedious, the first part very steep† down numerous flights of steps; the road lying in many places just round the brow of the mountain, overhanging the stream below. The whole road composed of gneiss, little or no granite observed. Numerous and various trees growing on the northern face of the mountain, the point to which the strata dip.

Passed numerous parties of Bhoteeas halted on the road, either on their way to, or returning from Milum, mostly the former, their sheep laden with grain. Our party had received for the salt they carried down four measures of *dhan*, (rice in the husk,) for one of salt and two of wheat.

* Hurdol or Leepoo-ke-than.—J. H. B.

† The Hurdol Pass separates Upper or Mulla, from Lower or Tulla, Juwahir, and is the most difficult mountain to cross which I have ever seen. The banks of the Gooree are so steep, that the road cannot keep near the river, and this Pass becomes unavoidable. To a person ascending from the South, while loaded sheep are descending the steps, the danger of being 'extinguished' by the fall of a rock on his head, is imminent. A pony belonging to one of my party, being alarmed by the sheep, started and fell over the precipice, and was dashed to pieces. It took a man one hour and a half to walk down to the spot where the poor animal lay! The man went for the saddle, but the article had no longer form, and scarcely material, and his labor was lost.—J. H. B.

Picked up on the top of the Pass various specimens of Saligrams, which had been left as offerings by the Bhoteeas and others on their way to and fro. A little rain fell in the afternoon, and it continued very cloudy the whole evening. Fell in with a party from the neighbourhood of Loah Thull, carrying up grain, &c. for sale. They say they receive a measure of salt for one of rice. On enquiring of two Bhoteea lads of the village of Luspa, who were with me, learnt that the usual rate of exchange throughout all the villages in Upper Jowahir, (or Bhote as some call it,) is one measure (or quoin) of rice, two of wheat, three of attah, and three of barley for one of salt. Now we purchased the latter articles at the rate of sixteen seers of eighty-four sicca weight for one rupee.

5th October.—Marched at 7h. 10m. A. M., and arrived at the village of Jult, the residence of the Bhoteeas in Milum in Munsaree; the ascent from the river is very steep and rocky, and not rideable for more than a few hundred yards. Arrived at the village at 10h. 15m. A. M. It contains some of the best houses I have seen,* much superior to those at Milum, or in any of the villages in Upper Juwahir. The people here when we were encamped at Kantee, about one and half mile off on our way up, refused to give us any supplies or coolees, and said they would not obey a dozen purwanahs of the Judge's, should he send them, which was the cause of our now encamping at this village, which is somewhat out of our way. The day since noon has been cloudy, and some heavy showers of rain have fallen. Passed within the distance of a mile this morning about 700 sheep and goats on their way to Milum, and I suppose as many more passed me before I commenced counting. The sheep used for carriage are bred in Dhanpoor and Gurhwal, and are small. The large Tartar sheep is not so employed, not being capable, I imagine, of bearing the heat; for I have observed that a flock of these sheep we have with me, during the last two days, appear to suffer very much from the change of temperature.

6th October.—(Jult.) A halt, time 11h. 35m. A. M., barometer 24.065, air 72°, mercury 72°, moist ther. 63°.

* Jult, Gorpata, Looring, Duratee, &c. contain not only the best houses in Juwahir, but excel in size and appearance the greater part of the Almorah houses, and are decidedly the most substantial and handsome villages in the whole hills from the Sutlej to the Kalee. The wood-work and the masonry are both admirably carved in the principal houses.—J. H. B.

1h. 15m. P. M. ther. 74° 5′, moist ther. 64°.
3h. 50m. „ „ 73° „ 64°.
5h. 50m. „ „ 70° 5′ „ 62°.

7th October.—Marched at 7h. 40m. A. M., breakfasted about two-thirds up the ascent, and reached the Kalee Moondee Pass in forty minutes from thence, in all two and half hours from Jult. Kalee Moondee Pass, time 1h. 30m. P. M., barometer 21.725, air 70°, mercury 81° 5′, ther. moistened with milk, (no water procurable,) 63°, ther. (black wool) in the sun 123° 5′; reached our tents in one and a quarter of an hour from the Pass, pitched near a beautiful waterfall,* at the foot of which was a fine pool of water beautifully clear and deep enough to bathe and swim in, the centre of it being upwards of six feet deep; jungle very thick the whole way down the descent. Observed a new variety of pitcher plant; in all I have seen on the range six varieties, one yellow, one large white, one small ditto, one large pink, one small ditto spotted, and one blue.

On approaching the Pass, the rock changed from gneiss to mica slate, which rock continued some way down, and it then changed to gneiss with beds of white talc slate. Ther. 60° at about 6h. 30m. P. M., evening cold, dew beginning to fall; a few clouds, no shelter for our servants and coolies. Observed the raspberry plant, (the one with runners) near the waterfall, and the blue cowslip† or oxlip growing without the usual long footstalk.

8th October.—6 A. M. ther. 51° 5′. Marched at 6h. 50m. A. M., and reached the top of the ascent in forty minutes; road very bad, unable to ride over any part of it. Gneiss white talc slate, and at the summit mica slate. A little on the descent, gneiss again; descent very steep, and road bad. Arrived at the village of Gheergaon in one hour and fifty-five minutes, whole distance completed in two and three-quarters of an hour; several small villages in this neighbourhood. This Pass‡ is somewhat higher than the one we crossed yesterday.

9th October.—Fine morning. Marched 7h. 8m. A. M., arrived at Kantee, (the cypress village,) at 9h. 30m., on the road 2h. 20m.,

* Ayar Panee.—J. H. B.
† Primula purpurea.
‡ Called Betoola Ghatee.

road pretty good along the course of the stream, which falls into the Ramgunga at Teejum. Rock near Geergaon, gneiss; a little below, the white talcky rock,* and limestone with blocks of gneiss.

10th October.—Marched at 6h. 40m. A. M., fine morning. At the *Sanga*† a little below Ramarree, ther. 9° 40′ A. M., barometer 26.595, air 65°, mercury 69°, moist ther. 61° 5′. Road to the *Sanga* generally very good along the side of the stream; a few places very bad for the ponies, ascent to Ramarree very steep, occupied only half an hour. Arrived at Ramarree at 10h. 30m., halted nearly an hour on the road, which would make the marching distance about three hours; rock generally limestone. The cheer tree‡ first made its appearance near the junction of the Jukkeela, N. with the Ramgunga.

11th October—6 A. M. ther. 55° 5′, moist ther. 52°, fine morning. Marched 6h. 20m. A. M., arrived at Sania 10h. 40m. A. M., halted on the road about half an hour, time in marching 3h. 50m., ascent (steep) of half an hour from Ramarree, descent thirty-five minutes to stream, which falls into the stream Muhgaree, from thence to the Pass along the side of the stream which we crossed four or five times, occupied 1h. 50m.; rock limestone, (silicious). The high Pass above the village of Punneealee is called —? Time 9h. 25m. A. M., barometer 23.635, mercury 75°, air 59° 5′, moist ther. 54° 5′. Stopped about twenty minutes, and reached Sama in about one hour; rock limestone, some with talc. Up the ascent a good deal of jungle, and some parts of the road very slippery; on the descent to Sama, hills bare of trees.—5h. 10m. P. M. slight shock of an earthquake, accompanied by a noise like thunder (pretty loud,) no clouds visible, sound appeared to travel from East to West.—5h. 25m. P. M., moist ther. 56,° ther. 62° 5′. Sama is a very pretty place, with some very fine horse chesnut trees; the houses are scattered; the *Pardan* and people very attentive.

Specimens 116 to 122.

12th October.—6 A. M. ther. 53° 5′, moist ther. 49°. Marched at 6h. 30m. A. M. Arrived opposite Nakoree in an hour, at Bureth in

* Talcose limestone, with the dip of the strata remarkably distinct, (steep and to N.E. generally) is the prevailing formation of the Kaleemondee Range.—J. H. B.

† Over the Ramgunga river.—Here the travellers entered the Pergunnah of Danpoor and left Juwahir.—J. H. B.

‡ Common pine —J. H. B.

two, and at our breakfasting ground in 2h. 47m. Road along the side of the stream,* which we crossed ten or twelve times. At Nakoree, there is another stream which joins the one from Sama. Rock generally a species of limestone, with conglomerate and very frangible; another rock nearly black,† which breaks into numerous small angular fragments. At 12 A. M. in the tent ther. 79°, cool breeze blowing. 2h. 30m. P. M. marched, sun rather hot, arrived at Kubkote at 4h. 15m., road good generally, forded the river,‡ stream wide, but not deeper than half way up the thigh; encamped on a fine level spot near the bank, some little way below the houses.

13*th October*.—6h. 10m. A. M. ther. 49°, moist ther. 48°. Marched about 6h. 30m. A. M, thick fog in many parts of the valley, road along the right bank of the stream pretty good for some distance; did not overtake our servants, who had gone on with our breakfast things till about 12 o'clock; before reaching them, crossed a stream which comes down from Lumcholee; the ford rapid and bad, the bottom being very uneven, the depth about up to the middle. Marched again about 3 P. M., and arrived at Bagesur§ at about 4h. 45m. P. M. On the road to-day, about seven and a quarter hours. The river at Bagesur barely fordable in one part, being up to the chin of the people, whom I saw passing; current not very strong.

14*th October*.—Marched about 6h. 50m. A. M., and arrived at about 9h. 45m. at our tents at the foot of the flight of steps, road very good, the first steep ascent occupied only forty minutes. Marched from thence in the afternoon to Suttralee, about two hours march; a bad ascent on the road has been much improved, since we last passed it, by a native, who has made an excellent road rideable all the way. Found it very difficult to procure any supplies from the village of Suttralee

N. B.—Suttralee is the name of the *valley*.

* The Raiputtee river.

† A kind of clay slate.—J. H. B.

‡ Surjoo river.

§ Bagesur is the mart at which the Bhooteeas winter, and where the fairs are held for the sale of Thibetan, and Hill and Plain merchandize. It is a sacred place, being situated at the junction of the Goomtee and Surjoo river. In the hot weather and rains, the climate of the Bagesur valley is unhealthy, and the place is deserted.—J. H. B.

15*th October.*—Marched at 6h. 50m. A. M., and arrived at Jak-by-toolee at 9h. 20m. A. M. To the foot of the ascent is nearly four miles, we were rather more than a half an hour in reaching the top of it, without halting, the descent occupied about half an hour also; marched at one o'clock, and arrived at Almora at 4h. 20m. P. M. Distance from Jak-bytoolee between ten and eleven miles; total distance to Sattralee from sixteen to seventeen miles, but road good from the top of Kalee Muth* to our house, one hour and twenty-five minutes, distance full five miles.

* The high peak at the Northern extremity of the Almora ridge.

On the Wool of the Bactrian, or two-humped Camel, (CAMELUS BACTRIANUS,) *being a Copy of an unpublished Paper forwarded to the Royal Asiatic Society of London. By Capt.* THOMAS HUTTON.

SIR,—Having lately seen a letter from Captain Arthur Conolly, regarding some specimens of wools obtained in Armenia and Koordistan, I do myself the honour to transmit samples of the "hair and wool procurable from the two-humped, or Bactrian Camel."*

The animal is so thickly clothed during winter with this wool, and its quality appears to me so much superior to most of those shewn to me by Captain Conolly, that I should expect the article, if imported, to form a valuable commodity in the European markets. Of this, however, you will be better able to judge than I am.

I shall do myself the pleasure to preface my remarks on this article, by a few observations on the animal from which it is obtained.

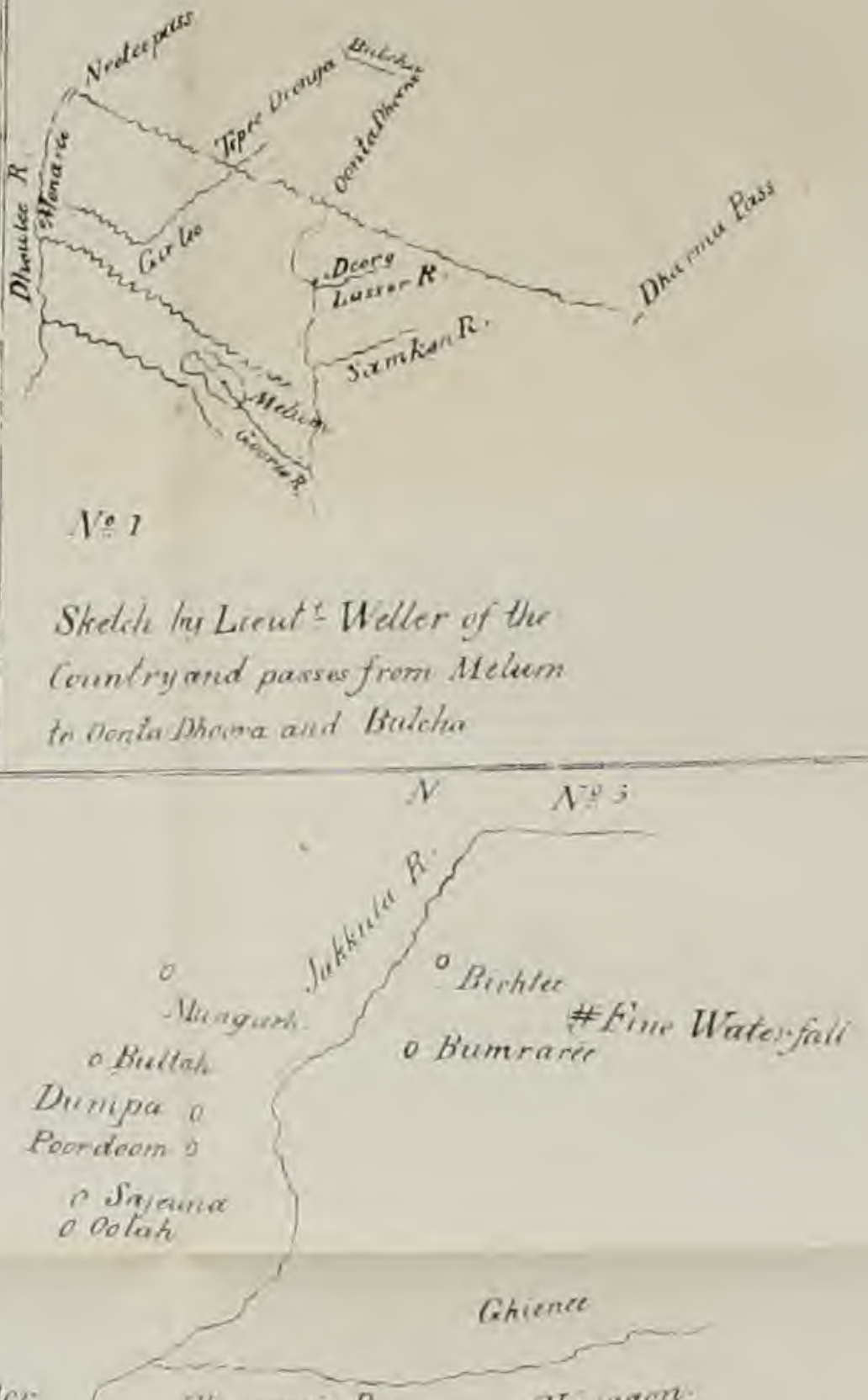
"The Bactrian Camel," as it is termed, is an inhabitant of the Kuzzack country among the Steppes of Tartary, beyond Bokhara, which, judging from the thick warm coat provided by nature for the animal's protection and comfort, must be subject to great severity of climate during the winter season. At Candahar, the animal sometimes arrives with kafilahs of merchants, and is termed "Bagdad-i," *i. e.* "of" or "from Bagdad," but on enquiry I find, that it does not occur

* Specimens of this wool are in the Museum of the Asiatic Society of Bengal.—ED.

N. 3.

N°3 Eye Sketch of Melum by Capt Manson and Mr Butler

N°2 Capt Mansons and Mr Bullens Sketch of The Route



N° 1

Sketch by Lieut Weller of the Country and passes from Melum to Oonta Dhoora and Bulcha

N°4 Stones on Peaks in the Goomka Glen
Capt Mansons Sketch.

at that place, the name having been applied to the species in former times, when Kuzzack was a *dependency* of Bagdad.

They are said to be numerous in their own proper country, and not uncommon even in Bokhara, where they are crossed with the Dromedary, (Camelus Dromedarius,) and produce the (Hybrid) Bokhara camel, an animal possessing enormous muscular power.

This cross varies in appearance according to the species of the dam; if she be a true camel, (Camelus Bactrianus, female,) then the produce partakes in its physiognomy, in a great degree of the camel, possessing a peculiar mildness in its expression, and a fineness in its general proportions. The head is of a light, blood make, with long hair upon the crown, nape, and along the fore part of the neck and throat, from the chin to the chest; also rather long and curly upon the fore arm; the tail too preserves more of the characters which are observable in the Camel, having the longitudinal line of hairs down the centre, which in the Dromedary are always wanting.

On the other hand, if the dam be a Dromedary, (Camelus Dromedarius, female,) the produce partakes more of the characters of that species than of those which distinguish the two-humped Camel. The hair is scarcely more elongated than the Dromedary, and is nearly of the same quality; but the animal is enormously powerful of limb and carcase, and well calculated to perform long and fatiguing journies through the hilly tracts between Bokhara, Herat, and Cabul.

The hump, in the cross-breed, is subject to great variation; sometimes appearing in the form of one long prominent ridge, covering the back from the withers to the loins, with a wide notch or depression in the centre, serving to mark the partial transition from the *two*, to the *one* humped species, or shewing that the space which intervenes between the humps of the true camel, is nearly filled up and obliterated by the intervention of the hump of the Dromedary.

At other times, there is to all appearance but one hump, situated far back upon the loins, like the posterior hump of the Bactrian Camel; but a closer inspection, and the application of the hand shews, that the portion of the back lying between this hump and the withers, although apparently entire, and not all prominently raised, is nevertheless divided, sometimes in *one*, sometimes in *two* places, sufficiently separated to admit of the thickness of the open hand being placed

between them. These openings (or *cracks* they might almost be termed) are ordinarily concealed, except to touch, beneath the hair.

Such a formation is awkward, as the weight is necessarily thrown so much to the rear, that theanimal's loins and sides are generally dreadfully galled by the constant swinging or rubbing motion of the load.

The cross-breed is termed " Boghdi."

This Hybrid Camel is in much repute among the northern tribes, and furnishes them at all seasons with an invaluable beast of burthen in a climate where neither one nor the other of the true species could be made available throughout the year. Art may be said therefore to have furnished what nature has denied them. The two-humped camel is said to be so impatient of heat, that it cannot endure the summer warmth even of so northerly a country as Bokhara, and this I can readily give credence to, since I had lately an opportunity of watching the habits of one of these animals which I purchased at Candahar. No sooner did the sun (even in *December* and *January*) fall upon the side of the yard where this animal usually stood to feed, than he walked over to the shade of the opposite buildings, as if conscious that his woolly coat was not adapted for summer weather.

During the warm months, therefore, the Bactrian Camel would not properly be available in more favoured climates than its own, and during that season, the Bokhara people would be deprived of their " Desert ships."

Again, the Dromedary, or one-humped male, can on the other hand endure but a moderate degree of cold, and the northern tribes would thus for many months be deprived of its services.

To obviate these evils, they have crossed the breeds, and obtained an animal capable of enduring alike the heats of summer, and the cold of winter. His limbs are large and powerful, his chest broad and ample, his shoulder strong and heavy, to bear the jolts and shaking he experiences in ascending and descending the rugged mountain passes and defiles, through which, heavily laden, he is doomed to travel for long and fatiguing marches.

No beast could be better adapted for the work he has to perform, or the climates he has to endure, for in him are united the perfections and capabilities of both species. His constitution derived from both,

enables him alike to undergo the rigors of a northern clime, and the heats of the southern districts, to which he travels.

It is reported of the two-humped Camel, that his hardihood is such, that the winter is the season when the trade between Turkistan and Russia is carried on, and that season is selected, because then the rivers which intervene between the two countries are frozen up by the severity of the frosts, and the camels are thus enabled to pass over on the ice.

The wool of this animal is as yet but little used, a small quantity only being exported from Bokhara to Cabul, and I believe to Umritsur in the Punjab. The great bulk of it is said to be sent at present to Russia, and manufactured into a kind of broad cloth, called "Salatiska," which is worn by soldiers.

It being my intention to publish some notes on the Natural History and Geology of this part of Korassan, I shall again have occasion to notice this animal more at length, and I will therefore pass on to what I dare say will be deemed the most interesting part of his history, namely, the wool he produces.

No. 1.—Is a sample of the wool taken from the sides and back of a full grown male Bactrian Camel, in the winter clothing. It is so thickly disposed, that the skin of the animal can with difficulty be discerned beneath it, even when the wool is turned back for that purpose.

In the spring, as the temperature grows milder, the whole of this wool detaches itself from the skin, being pushed off in masses and flakes by the hair which springs up beneath it, and which forms the summer clothing of the animal.

It is at this season pulled or cut off, and after being cleaned, is either manufactured into woollens of different texture for home consumption, or exported in a raw state to Russia; a small quantity also finds its way to Cabul and the Punjab.

It is produced abundantly both in Bokhara and Balk, and the Steppes of Tartary.

This wool is called "*koork*," or down.

It appears to be little inferior in fineness to that procured from some breeds of Shawl Goats, while it possesses a decided advantage over them all, in being both of a much longer fibre, and far more easily freed from the hair.

No.2.—Is a specimen of coarse thread spun from this wool by the hand, *i. e.* without the aid of the wheel; the wool is gathered into a mass, a small portion twisted into a thread by the fingers, and then attached to a cross stick with a weight, or to a stone which is kept twirling round, while small portions of the wool are continually added.

The threads thus made are coarse, and liable to break from being too loosely twisted.

This method is, however, very generally practised, more especially in these districts; the same also prevails in most parts of the Himalaya, and is in use even in the provinces of India in the spinning of cotton threads for common purposes.

Woollens made from threads thus twisted, are far more difficult to weave than those manufactured from threads spun by the hand wheel, as the looseness of the twist often causes them to catch and break as the shuttle passes to and fro.

No. 3.—Is a sample of the wool and hair, taken from the fore-arm.

No. 4.—Is taken from the under part of the neck and throat.

The hairs in these samples are so long, that the trouble of cleaning the wool would, I should imagine, be much lessened, and probably the hair itself might prove an useful article for making pencils and other brushes.

These wools are all taken from an animal which wintered at Candahar, so that the probability is, that the staple was not so long as it would have been, had the camel remained in the more Northern districts.

There is also another thing to be observed, which is, that the beast was not worked during the winter season, and consequently the wool was uninjured by the friction of a load.

It is both shorter and coarser when the animal has been laden. No doubt too, there may be as much difference between the wool of different camels, as between sheep; but the samples sent may be deemed upon the whole a fair selection, considering the limited range of my observation on the subject.

No. 5.—Is a sample of wool taken from the humps of a male Bactrian Camel, that had been much worked during winter.

No. 6.—Is from the sides of the same animal.

No. 7.—From the neck and fore-arm.

These are natural ringlets or bunches. The colour of these wools is generally that of the specimens herewith sent, but the long hair of the neck and fore-arm sometimes has a reddish or ferruginous tinge.

That which I have termed "hair," appears to be not very much, if at all, inferior to some of the coarser wools of Europe, while it possesses a decided advantage in being more than double the length of any sheep wool.

With regard to the utility of this wool, and the chances of its proving desirable in the home markets, I do not consider myself competent to judge. I send the samples to speak for themselves, to ascertain the probability of its ever becoming an article of import either in the crude or manufactured state.

Dromedary.

In addition to the above, I enclose a sample of a woollen cloth made from the soft wool procurable from the young Dromedary.

This is called "*Buruk Shootur-i.*" It is made by the Huzarrehs of the Cabul neighbourhood.

It is manufactured in pieces of from fifteen to eighteen inches wide, by six to eight yards long, and the price varies with the size from eight to thirty rupees per piece.

There are two other woollens which I have not yet been able to procure, but I will send them shortly in a supplement to this. They are called "*kart*" and "*oormuk.*"

N. B.—Since writing the above, I have procured specimens of *oormuk*, which I now enclose. It forms part of the dress of the Turcoman people. It comes also from Bokhara. This is chiefly purchased by the wealthy, and sells from fifty to one hundred rupees per piece.

"*Kart*" is somewhat similar to this. It comes from Bokhara and Turkistan, and is made from the wool of the yearling Dromedary.

Public Papers relating to the Nurma or Chanderi Cotton, in reference to queries by MR. PIDDINGTON, *Journal Asiatic Society Vol.* x. *p.* 716 *being a report by* CAPT. J. ABBOTT, *Assistant Resident Nimaur.*

(No. 4013 of 1842.)

From R. N. C. HAMILTON, ESQ., *Secretary to the Government, N. W. P. to* F. J. HALLIDAY, ESQ. *Officiating Secretary to the Government of India, Fort William, dated, Camp Ferozepore, the* 31*st December*, 1842.

Revenue Department.

SIR,—I am directed by the Honorable the Lieut. Governor, to transmit to you, for the purpose of being laid before the President in Council, the annexed copy of a letter, No. 1241, from the Resident at Indore, dated the 24th November last, with its enclosure, relating to the cotton of Nimar and Chanderi.

2. A counterpart of this letter is forwarded to the Secretary to the Government of India with the Governor General.

I have the honor to be, &c.

(Signed) R. N. C. HAMILTON,

Secretary to the Government, N. W. P.

Camp Ferozepore, the 31*st December*, 1842.

(Copy.)

No. 1 in No. 4013 of 1842.

No. 1241 of 1842.

From the Resident at Indore, to R. N. C. HAMILTON, ESQ., *Secretary to Government, N. W. P., dated Indore Residency, Camp Islamnugger, the* 24*th November*, 1842.

Political Department.

SIR,—Sometime ago I received through the Resident at Gwalior a reference from you on the subject of the Nurma cotton, together with a copy of Dr. Purvis' report on that of Chanderi, which was supposed to be the same. In replying to Lieut. Col. Speirs, I forwarded a copy of my letter to Mr. Bushby, in reply to a requisition from his office on

the same subject, which I requested the Lieut. Col. to transmit to you; I mentioned at the same time, that I could refer to Captain Abbott, Assistant in Nimar, for additional information, as the cotton used in the Chanderi fabrics was stated to come from Nimar, and the question was more interesting to that part of the country, as it affected a staple article of its commerce, than to Malwa generally, in which cotton does not appear to succeed, and is but partially grown.

2d. I have now the honor to submit copy of a valuable report, which I received from Captain Abbott, and of its accompanying letter, from which it will be seen, that the cotton formerly exported to Chanderi is called Mahalie, and not Nurma, which indeed, as before pointed out by me, is not an annual, but a large plant, which lasts about ten years.

3d. During the last rainy season, I planted a patch of ground in my garden with the Nurma cotton, from which when ripe, I intend sending the specimen together with those of the soil in which it grows, promised in my letter of the 1st November 1841, to Mr. Bushby.

4th. I may add, that I have lately procured from the Agricultural Society in Calcutta, a supply of the Georgian cotton seed, which I am distributing among the different states in Malwa and Nimar.

5th. In closing my letter on the subject of these cottons, I need scarcely remind Government, after Sir John Malcolm's copious report on Central India, of the richness of Malwa, and its adjoining provinces in productions important to commerce. The interest which that distinguished officer attached to them, induced him, from his first arrival in the country, to bestow an attention to their investigation worthy of the Government which he represented, and the results of which were found to be such, as to obtain for him the acknowledgments of learned Societies. Since his time, the subject would appear to have been entirely neglected, which cannot but be regarded as a misfortune to a country in which we hold so prominent a position, as to impose in my humble opinion an obligation on us to develope its resources, and from which we derive a revenue averaging at least twenty lacs of rupees per annum, collected on the spot at an insignificant expense. A renewal of these researches would, however, be of little practical benefit to the country, unless the means of communication with other marts were simultaneously improved. Government has done something to promote the object by entertaining the project of improving the road between

Agra and Bombay; but our duty cannot cease even with the thorough completion of that work, and I trust that as the finances of the state improve, a sense of its importance will arrest the favorable consideration of an enlightened Government.

6th. The Government of Bombay, from its proximity to these provinces being interested in these discussions, I have deemed it my duty to forward a transcript of the present Despatch and the correspondence to which it relates, for the information of the Honorable the Governor General in Council of that Presidency. I have, &c.

(Signed,) C. M. Wade,
Resident.

(True copy,)
(Signed.) R. N. C. Hamilton,
Secretary to the Government, N. W. P.

Indore Residency, Camp Islamnugger, the 24*th November*, 1842.

(Copy.)

No. 2 in No. 4013 of 1842.

No. 331 of 1842.

From Captain J. Abbott, *Assistant in Nimar, to Lieut. Colonel. Sir* C. M. Wade, *K. C. B., Resident at Indore, dated Mundlaisur,* 30*th September*, 1842.

Sir,—In reply to your letter and its enclosure of the 13th April last, relating to the Nurma (Mahalie) cotton, I have the honor to forward for the information of the Asiatic Society, all the particulars I have been able to collect regarding it. There seems great probability, that it may be utterly lost from the world in the course of a few years, unless Government or some Society interfere to rescue it.

2. The mamoodies of Chundairee, so far as I can learn, were considered unequalled by any other manufactures, in itself a strong argument for the surpassing fineness of the Mhahlie cotton of which they were woven. I believe there is little of the cotton soil of Nimar that would not produce it in more or less abundance, could a market be found for it.

3. Accompanying my report are seven small tin boxes, of which three contain specimens of Mhahlie cotton, two specimens of the Nurma and its seed, and the remaining two specimens of the common cottons of Nimar and Berar. Circumstances prevent my sending just now specimens of the soil in which the Mhahlie thrives. I purpose selecting them at a season more favorable to the design, the ground being now strongly impregnated with manure.

I have the honor to be, &c.

(Signed) J. Abbott, *Captain,*

Mundlaisur, the 30th September, 1842. *Assistant in Nimar.*

P. S. I have the honor to return the copies of correspondence upon this subject, with which you favored me.

(True copy,)

(Signed) R. N. C. Hamilton,

Secretary to the Government, N. W. P.

No. 3 in No. 4013 of 1842.

(Copy.)

Particulars relative to the Mhahlie Cotton of Nimar.

Q. 1st. What is the Nurmah cotton of Malwa? Is it the common cotton of the country, or a choice sort?

A. Nurma cotton is not indigenous to India. It is not, so far I as can learn, cultivated for manufactures in Nimar or Malwa. It is not annual, but grows into a bush, lasting ten or twelve years. As this cotton is evidently not the kind to which the queries of the Asiatic Society refer, I shall consider the name Mhahlie substituted for Nurma, and answer accordingly.

The Mhahlie I should say, cannot be indigenous to Nimar. The natives suppose the seed to have been sent, time out of mind, from Chundairee. They are utterly ignorant of its manifest superiority in texture to the cotton of the country, and it has never been in demand in Nimar, where in a few years its existence will altogether cease.

Q. 2d. Does it grow in any common cotton soil? or are peculiar sorts and spots sought out for it?

A. It will grow in any cotton soil, but formerly its high price commanded for it the choice soils.

Q. 3*d.* What manure, if any, is used to it?

A. The soil is prepared for Mhahlie cotton, precisely as for other cotton. The manure is dung and black earth from the villages.

Q. 4*th.* When sown? How sown? When harvested? How cleaned?

A. It is sown like other cotton at the end of June, but harvested about forty days later than the common kind, *i. e.* about the end of March. It has never been cleaned in Nimar, but was exported to Chundairee in the pod. The meaning of which I presume was to enable the workmen there to sort it, previous to cleaning, for the several qualities of manufacture in contemplation.

Q. 5*th.* What price does the best sort command? Whither is it exported, if at all?

A. The Mhahlie cotton so long as it had any peculiar value in Nimar or rather at Chundairee, where alone there has ever been a demand for it, sold in Nimar at fifty per cent. higher than the common cotton, and at Chundairee it sold at one and a half seer for the rupee, when the ordinary kind was selling at five seers; at present it sells for the same price as the common cotton, which, however, being white and having a coarser, perhaps stronger, filament, is preferred in the Nimar market; so that it appears to be cultivated at present merely from the accident of its seed being in possession of the ryuts, who formerly cultivated it with profit.

Q. 6*th.* Is it an annual cotton, or does it last more than one year?

A. It is annual. The Nurmah is not.

Q. 10*th.* Enquiry should be made, if it at the time of ripening any peculiar manure is added, as with some of the choice sorts of tobacco. If the plants are topped, the shoots pinched, or beaten with sticks, or allowed to be eaten down by animals. All these processes are used in various parts of the world (America, the French and Spanish Colonies, Persia, &c.) and no doubt influence both the productiveness and the quality of the cotton to a great extent. Nothing relative to the native methods of culture, irrigation, &c. should be overlooked.

A. No peculiar manure is added at the time of ripening. The plants are never topped; a process I have never known applied to cotton crops in India. It is sown in both rubbee and khureef soils; in the latter, it is alternate with jowaree. The difference in produce afforded by these two soils, viz. the irrigated and unirrigated, is very great.

Q. 12*th.* Enquire if it is subject to any diseases, or insects, which seriously affect the returns from it.

A. I can learn of no disease or insect to which the Mhahlie cotton is peculiarly liable. It is less affected by frost.

Q. 13*th.* The amount of return in clean merchantable cotton per beegah of a known number of square yards is of importance, and the average price of the best sort.

A. The produce of the Mhahlie is greater than that of the Goondailah, or common cotton of Nimar.

The ordinary crop of the latter is four maunds (of eighty rupees) per beegah of 22,500 square feet uncleaned, whereas the same area will return from five to six maunds of Mhahlie.

Moreover, the seed of the Mhahlie being smaller and the pod larger, (of the latter fact I am not so certain,) five chittacks of clean cotton are yielded by a seer of pod, whereas only four chittacks are obtainable from the common cotton. When the Mhahlie is irrigated, it will yield from seven to eight maunds of pod per beegah. Hence the produce per beegah of 22,500 square yards in merchantable cotton, is sixty eight seers and twelve chittacks for unwatered, and ninety-three seers and twelve chittacks for irrigated land; the seer being of eighty rupees, Company's. This advantage is reduced by the difficulty of disposing of the Mhahlie cotton.

The growth of the Mhahlie was confined to two pergunnahs of Nimar, Dhurgaon and Kussode, and to a few villages of those pergunnahs I should add to a single village of Muhaiswah. Those pergunnahs seem to have been selected from their proximity to Chundairee, for the market of which alone it was ever reared. Although at Muhaiswah and Kurgaon of Nimar, there are several celebrated manufactories of mamoodies, dhooties, khun, phatub, sahries and chadurs, some having silken and others golden borders, the Mhahlie has never been employed at either of those places. The extensive importation of fine cotton cloths from England seems to have annihilated the Chundairee manufacture, so that there is no longer any demand for the Mhahlie, which is selling at present cleaned at five seers the rupee in Nimar, the price of the common kind. The facts above detailed may illustrate the difficulty of introducing amongst the ryuts of India, any improvements that may seem to us for their advantage. Having no

capital, they cannot select their markets, and any novelty in the texture or hue of a commodity gives it disadvantage in the market of the district. Although the softness of the Mhahlie cotton is too remarkable not to be perceived at once, yet it has remained in this district an unknown number of years, utterly disregarded.* There can be little doubt that if sent to Bombay, it would command the market for export there, and the experiment seems quite worthy of trial; there is no difficulty in separating the seed. But the colour is not white, and the method employed in bleaching the Mhahlie at Chundairee, should be ascertained from gentlemen resident at Sâgor. It were also a curious enquiry to be made at Chundairee, when the manufacture of mamoodies was first established there. What led to the selection of the Mhahlie cotton, and (if it be of foreign origin) what induced the choice of Nimar as the garden of its produce, other, and I believe richer, cotton lands being near to Chundairee. In addition to its defective hue, the manufacturers of Nimar conceive that the filament of the Mhahlie is not so strong as that of the common cotton, and in consequence prefer this for the coarse cloths woven in the villages. Indeed the manufactures at Muhaiswah and Kurgaon, although rich and extensive, are not celebrated for the fineness of their texture, as were those of Chundairee; and therefore so long as the Mhahlie maintained its high price, there is little wonder that the enterprising Hindoo manufacturer neglected it.

Of the Nurmah I cannot learn many particulars in this district, where, as an article of produce it is quite unknown. The natives allow that it is very superior to the common cotton; but they object to the expense and trouble of preserving it from injury throughout the year. Nothing can more strongly exemplify the apathetic spirit of the ryut; for the jungles in Nimar bring up to every cultivator's door an abundance of thorny plants fitted for enclosures, and I imagine the produce of the Nurmah must be about four times that of the common cotton plant, for it rises to the height of seven or eight feet, branching out on all sides. It is said to abound in Kurrah Manickpore. Its hue is whiter than that of the Mhahlie, and the natives of

* We trust that this really beautiful varieties of Cotton will now be better studied and known, and this scientifically for they are not only in all probability valuable in themselves but they may become invaluable to India as stocks from which to *breed* new sorts, a process apparently not yet dreamt of amongst our Cotton experimentalists.—Ed.

Nimar think its filament finer: but this I doubt. The specimens I have the honor to send are scarcely worthy to be called such, and should not be relied on, being the produce of isolated trees, the comparative value of which I have no means of ascertaining. The Mhahlie and Goondailah specimens are worthy of reliance. There can be no doubt that the soil and climate of Nimar are capable of producing varieties of cotton vastly superior to the staple of the district, and I believe the same fact has been proved in regard to other tracts of Hindoostan. But it seems equally certain, that in order to the introduction of such improvements, a market must in the first place be created for the produce. This it might be well worth the while of Government to effect. Wherever water carriage admits of ready transfer to extensive marts, the demand would speedily render this interference needless.

Choolie Muhaiswah is a misnomer, only one village in that district having produced the Mhahlie cotton. Dhergaon is the chief garden and mart of the Mhahlie, but being an obscure pergunnah, the principal neighbouring town has naturally been used to designate the locality.

I received the despatch relating to this cotton at the most busy season of the year, when it was impossible for me to quit the station even for a few hours. The rains have since commenced, and the earth being recently manured I think it advisable to await a better season for selecting specimens of the soil. I have detained this report several months, in the hope of sending specimens of the Berar cotton, for which I had written to Nagpore. But owing to a very simple mistake of the merchant at that place, I am disappointed for the present, as the Mhahlie cotton is said to be sometimes designated Berari, and the soil and climate of Berar and Nimar cannot, I imagine, be very dissimilar, I thought it of consequence to compare together the growth of these two districts, in order to trace the origin of the Mhahlie.

The climate of Nimar is very equable. The temperature nearly that of Calcutta. It is in the same latitude, and elevated only about 500 feet above the sea. The air, however, is much drier, as might be supposed from its inland position, and the springs are seldom nearer than thirty to forty feet to the earth's surface. The formation is trap, occasionally basaltic. I have never heard of this thick crust being completely perforated, whether by human act, convulsions of nature,

or the action of the elements: although the Vindhya mountains abound in chasms from 300 to 800 feet in depth, and present on the south a precipitous scarp of 1,500 feet; and the Nerbudda has farther sapped into the rock some 800 feet, reckoning from the foot of those mountains. The immediate deposit upon this rock in Nimar is generally a deep bed of clay, mixed with lime, sand, and kankur. Occasionally rotten sandstone prevails: and upon this stratum lies the black soil generally found upon trap formations, though not peculiar to such. This averages perhaps fifteen feet in depth near the river, but is deepest when found on higher flats, having been less worn by the elements. This black soil is generally supposed to be the debris of the trap formation, and from thence to take its hue; I confess I doubt the correctness of this theory. Trap is colored wholly by the black, or purer oxide of iron. It is decomposed by the absorption of an additional volume of oxygen by the iron, which increasing its mass, rends the rock into powder. In this condition, the color of the trap is a rusty red, and incapable I think of giving that intensely black dye to a soil composed of its particles. I speak under correction, having no means of analyzing the soil. But as a similar hue occurs in soils resting upon granite and other formations, I have been more disposed to ascribe it to the presence of carbon, than of iron. It is singular that under this soil, the richest diamond mines in the world are found. The fact, that a stratum of clay and kankur is interposed between the trap rock and the black soils, seems to countenance my theory, and the yearly destruction of the jungles in Malwa by fire, would in the course of ages have supplied an abundance of carbon. But if, as is said, this black soil form under the blowpipe, a black glass, the theory can scarcely be maintained with any confidence.*

The natives prefer the blackest soil for all kinds of cotton, and in fact, for every purpose. The other soils are all more or less impo-

* The black cotton soil certainly owes its colour also to the protoxide of iron, and not to carbonaceous matter. See Transactions of the Agricultural Society Vol. vi. p. 208, in which are quoted three analyses of this soil from Bundelcund. It is possible that the black soil may be owing to the decomposition of a kind of trap no longer existing, which contained a greater proportion of alkali, (soda, or potash) than the present and more enduring kinds of the rock, or it may have been an original volcanic product? or a volcanic mud of a peculiar kind? The question is one far too obscure and complicated to be discussed in a note, and indeed to be discussed at all in the present state of our knowledge.—H. P.

verished by a mixture of lime and sand, the black soil requires moderate but frequent irrigation. It is full of the germs of vegetables, becomes a mucilage when wet, and a rock when dry.

The monsoon in Nimar is usually mild, the table land of Malwa carrying off the greater body of vapour. The ryuts dread very heavy falls, or the long prevalence of cloudy weather.

I regret that my recent acquaintance with this district, so greatly limits my means of collecting immediate information, and renders the report so meagre and imperfect.

(Signed) J. Abbott, *Captain,*
Assistant in charge of Nimar.

Mundlaisur, Nimar, the 30*th September*, 1842.

P. S.—Since writing the above, I have ascertained that at Chundairee they do not clean cotton by the ordinary method of passing it between parallel rollers, but by the more gentle process of rolling over it with the hand an iron ruler, or thin cylinder, a polished stone being beneath. This saves the fibre from fraying, and is practised by the Bullaees, (outcasts,) whose females make the finest of the thread employed in Indian fabrics. During this process, they extract all the particles of leaf, pod, earth, &c., as well as coarse fibres of the cotton itself. In the exquisite fabrics woven at Chundairee, the length and perfectness of the fibre must have been of the utmost consequence, and it appears to me, that length of fibre was the principal recommendation of the Mhahlie cotton. A specimen of Berar cotton having just arrived, is forwarded.

(Signed) J. Abbott.

(True copy.)

(Signed) W. S. Eden,
1*st Assistant to Resident.*

(True copy.)

(Signed) R. N. C. Hamilton,
Secretary to the Government, N. W. P.

(True copy.)

F. J. Halliday,
Officiating Secretary to the Government of India.

Proceedings of the Asiatic Society.

(Friday Evening, 11th November, 1842.)

The Honorable the President in the Chair.

The following Books were presented by the Authors, and purchased by the Society.

Books received for the Meeting on the 11th November, 1842.

The Calcutta Christian Observer, November 1842. Presented.

The Annals and Magazine of Natural History, June and July, 1842. Vol. IX, Nos. 58 and 59. Purchased.

London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 3d Series. Vol. XX, Nos. 132, 133, and 134. Vol. XXI, No. 135. London, 1842. Purchased.

Edinburgh New Philosophical Journal, by Professor Jameson. London, 1842. No. 64. Presented by the Author.

Journal des Savans. Paris, Janvier, Fevrier, Mars, Avril, Mai, 1842. Purchased.

Tracts, Historical and Statistical, on India, by B. Heyne. London, 1814, 4to. one Vol. Purchased.

Bulletin de la Société de Géographie, 2nd Serie, Tome XVI. Presented.

Histoire Naturelle des Poissons, Tome XVI. Purchased.

Jahrbücher der Literature. Wien, 1841, Nos. 93, 94, 95, 96. Purchased.

Geschichte der Ilchane, das ist der Mongolen in Persien. Von Hammer Purgstall. Darmstadt, 1842, Erst Band. Presented by the Author.

Bopp, über die Verwandtschaft der Malayisch-Polynesischen Sprachen mit den Indisch-Europaischen. Berlin, 1841, 4to. Presented by the Author.

Newbold on Ipoh, or Upas Poison used by the Jacoons and other Aboriginal Tribes of the Malay Peninsula. London, 1837, Pamph. Presented by the Author.

L'Espagne Artistique et Monumental, Planches lithographies by D. Genaro Perez de Villa-Amil. The text by D. Patricio de la Escosura and the Plates lithographed by Victor Adam Arnout Bachelier, &c. &c. No. 1, containing four Plates.

Much attention was excited by the splendid work on Spanish Architecture last mentioned. It is sent to this country in the hope of finding some part of that support which it so richly merits, as an almost unequalled production of the lithographer's and designer's arts.

Read a letter from Count Graberg, soliciting the honour of being elected a Corresponding Member of the Society. The application was referred to the Committee of Papers for report.

Read the following letters from the Government of India:—

No. 178.

To the Secretary to the Asiatic Society.

Military Department.

Sir,—I have the honor, by direction of the Hon'ble the President in Council, to transmit to you for communication to the President and Members of the Asiatic Society, and for publication in their Researches, as a sequel to the articles in which

previous results of the same work have appeared, the accompanying Despatch, in original, No. 36, dated the 13th August last, from the Surveyor General of India, containing the final report upon the operations for measuring an Arc of the Meridian, carried through the centre of the Peninsula to the Northern confines of Hindoostan.

2. The Society will no doubt publish the report in communication with, and under the correction of, Lieutenant Colonel Everest, or such of his Assistants as he may think proper to entrust with its supervision through the Press, so as to ensure that it will be printed with the requisite accuracy; and as they may probably be desirous of annexing to the report the lists of latitudes and longitudes ascertained by the Triangulations, which have been communicated to Government, a copy will at an early opportunity be furnished for the purpose.

3. I am to request, that the original Despatch of Colonel Everest may be returned when no longer required, and that the Society will be so good as to favour this department with a few spare copies on Europe paper of the report when printed, for record, and for the purpose of transmission to the Hon'ble the Court of Directors.

I am, Sir,

Your most obedient servant,

Council Chamber, 14*th Oct.* 1842. W. M. N. Sturt, *Major*,

Offg. Secy. to the Govt. of India, Mil. Dept.

It was resolved—That arrangements should be made for complying, at the earliest possible moment, with the wishes of Government. A note from Major Bedford was recevied, stating that the Tables of Latitudes and Longitudes would be forwarded as soon as ready.

No. 296.

H. Torrens, Esq.

Secretary, Asiatic Society.

Sir,—In compliance with instructions received from the Council of Education, I have the honor to inform you, that a Deer now in possession of the College Council, has been ordered to be transferred to the Asiatic Society, and I have been directed to place myself in communication with the authorities of that body, with a view to effecting the transfer of the said specimen, and of receiving in return any Morbid Specimens, and duplicates of Anatomical objects, whether human or comparative, which can be spared from the Museum of the Society, and are likely to be of use in that of the Medical College.

2. In order that the above may be effected in the most satisfactory manner to ensure the safe transit of the object in question, I have the honor to request, that you give the necessary instructions, to the gentleman in charge of your Museum, to whom it will be made over at any time, or in any manner which he may wish.

I have likewise to request, that you will direct the same officer to furnish me with a list of objects, which the Asiatic Society may think equivalent to the Deer in question.

I have the honor to be, Sir,

Your most obedient servant,

Medical College, Nov. 9, 1842. Fred. J. Mouat, M. D.

Secretary, Medical College.

Resolved—That Mr. BLYTH be requested to effect this change, and by making over to the Medical College the Society's collection of specimens of Morbid Anatomy.

No. 999.

To H. TORRENS, Esq.

Secretary to the Asiatic Society.

General Department.

SIR,—With reference to the correspondence noted in the margin,* I am directed to state, that the Hon'ble the Court of Directors have reported the receipt of the following contributions presented by the Asiatic Society for the Museum of the East India House; viz.

Lr. from Offg. Secy. Asiatic Society, dated 1st February 1841.
,, to Do. ,, do. 3d ditto.
,, from Actg. Curator Asiatic Society's Museum (without date.)

One case of Duplicate Specimens of Birds.

One case containing two Jars of Reptiles.

One case of Geological Specimens, collected by Lieut. Hutton, at Spiti in the Himalayas.

I am, Sir,

Your obedient servant,

Fort William, the 28th Sept. 1842.

H. V. BAYLEY,
Depy. Secy. to the Govt. of Bengal.

It will be recollected, that this dispatch was made in February 1841, from the Museum. See Journal, Vol. IX, page 1056.

No. 982.

To H. TORRENS, Esq.

Secretary to the Asiatic Society.

General Department.

SIR,—I am directed to transmit the accompanying copy of a letter from the Military Board, No. 3,373, dated the 1st instant, and of its enclosures, being a letter from Capt. Tremenheere, with that Officer's second report on the Tin of Mergui.

As the specimens of tin forwarded to you with my communication No. 1,773, dated the 20th December last, can be probably duplicated, I am directed to request, that a set may be furnished to this department for transmission to England, as recommended by the Military Board.

The three boxes of specimens referred to in the Military Board's letter, will be transmitted to the Society when received, for the purpose of being in like manner duplicated, one set for the Hon'ble Court, and the other for the Museum of the Society.

I am, Sir,

Your obedient servant,

Fort William, the 12th October, 1842.

H. V. BAYLEY,
Depy. Secy. to the Govt. of Bengal.

The Curator of the Museum Economic Geology was requested to give due effect to the wishes of the Military Board, and the Secretary to publish Capt. Tremenheere's Report in the Journal.

A letter from Lieut. Baird Smith, B. E., N. W. Provinces, was read, stating that he was engaged in researches about Indian Earthquakes, and requesting particularly the assistance of the Society in procuring a copy of a Persian or Hindoostanee work relative to this subject, entitled the Zil-Zillee Namah. The note was referred to the Librarian to enquire for the work in question.*

THE EARTHQUAKE.

Shortly after the above letter had been read, a smart earthquake was felt! The following note relative to it was drawn up, and signed by the Hon'ble the President, as expressing generally the opinions or feelings of the meeting:—

Memorandum.

At ¼ to 10 p. m. the proceedings of the Society were interrupted by two or three slight vertical shakes or heaves, with a noise like the rumbling of a passing carriage, and one strong horizontal shake from East to West, or from N. E. to S. W. The whole took place within about half a minute of time. H. T. Prinsep.

We may add, that the Barometer stood about half an hour afterwards at 30·5, and the Thermometer at 80°. The weather was squally with light showers at times from the East, but clear and cool in the intervals. The exact time at which the shock took place was, as will appear from the following note from Mr. E. Gray, Watchmaker, 9h. 38m. p. m.

To ascertain the exact time as nearly as possible, Mr. Piddington addressed a Note to Mr. Gray. His reply is as follows:—

Dear Sir,—I did note the time when the Earthquake took place. It ceased at 9h. 38m. p. m. My clocks, as you may suppose, required my immediate attention, and I found their weights swinging in a direction somewhat from the North of the East point to the South of West, but from which of these quarters it came, I cannot pretend to say.

Yours most obediently,

15*th November*, 1842. E. Gray.

A paper, being a first article of "Contributions towards a History of the Development of the Mineral Resources of India," by S. G. Tollemache Heatly, Esq. was presented, and referred to the Editor of the Journal for publication.

* No trace of this work could be found, and the Calcutta Persian literati doubt of its existence. Two extracts, one from the Ewatee-oos-Seir and the other from the Herat-ul-Hecmut, were sent to Lieut. Baird Smith by the Secretary.

Two papers of "Notes, principally Geological, from Bellary to Bijapore in Southern India," by Capt. Newbold, of the Madras Army, were also presented, and referred to the Editor of the Journal for publication.

A letter from Capt. Bogle, Commissioner at Arracan, accompanying a copy of a "Report from Lieut. Trail, of the Quarter-master General's Department, under date 12th April 1826, on the Route from Pakung Yeh in Ava to Aeng in Arracan, as pursued by a Detachment of British Troops under the Command of Capt. Ross, M. A." was read. The Report was referred to the Editor of the Journal for publication.

For all the foregoing Communications, the thanks of the Society were ordered to be returned.

Read the following report from the Curator:—

Sir,—The interval since our last Meeting has not been signalized by much in the way of discovery of new species of animals, nor have many species been added to the Museum which it did not previously contain; but much has been done towards completing the required series of specimens of various species already possessed, and acquisitions of the first and second kinds above noticed have not been wanting.

In the class of Mammalia especially, here so difficult to obtain recent specimens of, have been added a Neelghai, an Axis Deer, a fine specimen of the adult male *Felis Chaus*, one of *Viverricula Indica*, a young Monkey *(Macacus Rhesus)*, of which, though common in Bengal, we did not previously possess an example, a young Mungoose *(Herpestes griseus)*, and a considerable number of Bats, shot by myself, and comprising at least some, if not several, undescribed species.

From the Barrackpore menagerie, has been received a recent male Neelghai *(Portax pictus)*, and a male Silver Pheasant *(Phasianus Nycthemerus)*.

From P. Homphray, Esq., an emasculated Axis Deer *(Cervus Axis)*, accompanied by a note from which I extract the following particulars, and refer the reader to my remarks on the growth of antlers in castrated Deer, published in p. 598, *ante*.

"Mr. H. had this Deer castrated in June, 1839, on account of his being extremely vicious: two or three weeks after the operation, he dropped his horns, and new ones grew in their place, since which he has not shed his horns. Mr. H. need scarcely mention that Deer when castrated do not afterwards [*apud* Buffon] renew their horns, except as Mr. H. supposes in the present case [the preparatory processes for] the formation of the new horns had commenced before castration; after which operation, the skin of the horns does not peel off as it does in all other cases when the horns arrive at maturity, but continues to grow on thick and fleshy. Mr. H. has another castrated Deer of the same species alive, whose horns are in the same state as those now sent, and he also shed his horns once after castration."

The specimen of *C. Axis* presented by that gentleman to the Society has the horns of normal shape, and of tolerable size, but imperfectly developed towards their extremities, particularly rugous, and the thickened skin which invests them is almost totally denuded of hair.

From J. Stalkart, Esq.

A fine recent specimen of the male *Felis Chaus:*

Ditto of *Viverricula Indica:* and

A beautiful Lory (*Lorius grandis*, vel *puniceus* of Gmelin).

From R. W. G. Frith, Esq.

A frontlet of *Cervus Duvaucellii:*

Ditto, with abnormal antlers, of *C. Hippelaphus:* and

A living female of *Gallinula lugubris*.

From Dr. Mouatt,

A Bat: and

A small collection of Insects from Darjeeling.

From J. Heatly, Esq.

Three bottles of Snakes, believed to be from the collection of Dr. Russell, and probably the individuals figured in his celebrated work on Indian Serpents. Two of the species, however, are very common in this neighbourhood; *viz.* the *Coluber dhamna* and *Tropidonotus dora*, and the third is *Bungarus annularis*, Daudin, or the *Bungarum Pamah* of Russell, pl. III.

Of the species collected by myself, the most interesting are two *Falconidæ*, which I have been fortunate enough to shoot in the neighbourhood: viz.

The European Hobby Falcon (*Falco Subbuteo*): and

A splendid adult male of *Spizœtus niveus* (v. *Nisäetus Nipalensis*, Hodgson), having the white under-parts beautifully lineated with black.*

With much respect,

Sir,

I remain, yours obediently,

E. Blyth.

Report of the Curator of the Museum of Economic Geology, for September and October, 1842.

I regret to say that illness has prevented my doing much in September and part of October, but in recompense we have many additions to record.

Museum Economic Geology.—We have received from Lieut. Yule, Executive Engineer, Cherra Poonjee, a capital set of drawings of the process of procuring and manufacturing the Iron Ores of that locality, with a very complete suite of specimens to accompany them, and an able paper, giving full accounts of the work, cost, &c.

From Capt. Tremenheere, B. E., we have to acknowledge two boxes of Tin Ore from Tenasserim, with one of the decomposing granites which form its matrix. Also, a very complete assortment of specimens of timber, with a bottle of the *Theetsee* Varnish and a sample of Gum Kino. The note relative to all these has not been yet received, so that I am unable to label and place them on the table. They will appear at the next meeting. Captain Tremenheere also suggests that our acknowledgments for contributions should be in some form like that of the accompanying engraved letter of the Royal Geological Society.

* I have since obtained other examples of this species, the most remarkable of which is a fine old female entirely of a *dusky-black* colour, with a dash of grey on its upper-parts. This was paired with a male of an ordinary colour.

Lieut. RIGHY, B. E., has sent us from Cuttack, a valuable assortment of the Building Materials, (stone, timber and iron,) used in that province, with a very complete memorandum accompanying them.

Mr. INCE, Salt Agent at Burrisal, has forwarded us another block of wood perforated by the destructive Worm of the rivers of that quarter, with two bottles of the River Water. This last I am collecting for every month in the year at the two extremities of the Deltas, those of the Megna and Ganges, so as to obtain some approximate notion of the quantity of silt carried to the ocean by our rivers; a problem of the highest interest to geology.

Mineralogical and Geological.—Captain NEWBOLD, of the Madras Army, a zealous friend to these researches, has presented us with a collection of 150 specimens, Mineralogical and Geological, from Egypt, Aden, and Southern India, and has added greatly to their value, by a detailed descriptive catalogue, of great interest.

I have, as before stated, been wholly occupied with our minerals, which are now so far on the road to arrangement, that they are in groups and families, so as to allow me to place from all our old collections such specimens as are of value, or serve to fill up blanks: a work of much time and labour, from the scattered and confused state of the old collection, which is such, that the most valuable specimens are often the most difficult to find.

H. PIDDINGTON,
Museum, 1st Nov. 1842. *Cur. Mus. Econ. Geol.*

With reference to the ornamental letter recommended by Capt. TREMENHEERE, it was determined that the Society's engraved Plate might be used for the letters of the Museum with a lithographed addition.

Proceedings of the Asiatic Society.

(Friday Evening, 9th December, 1842.*)*

The Honorable the President in the Chair.

The following list of Books, presented and purchased was read, and the thanks of the Society voted to the donors.

Books presented to the Library of the Asiatic Society, at the Meeting on the 9th December, 1842.

The Calcutta Christian Observer, new series, December, 1842, vol. III, No. 26, 1 pamph.

The Oriental Christian Spectator, 2nd series. Bombay, September and October, 1842, vol. III, Nos. 9 and 10, 2 pamph.

The Calcutta Literary Gleaner, December 1842, vol. I, No. X, 1 pamph.

Journal des Savans, Juin, 1842. Paris, 1 pamph.

Edinburgh New Philosophical Journal, by Professor Jameson, 1842, No. 65, 1 vol.

Journal of the Royal Geographical Society of London, 1841, vol. XI, parts 1 and 2, 2 vols.

Journal Asiatique, 3rd series. Paris, Aout á Decembre, 1841, tome XII, Nos. 66 á 69, et Janvier, Febre. Mars, 1842, tome XIII, Nos. 70, 71, and 72, 7 pamph.

Proceedings of the Geological Society of London, 1841-42, vol. III, pt. 2nd, Nos. 78 to 83, 1 pamph.

Hamilton's Address to the Royal Geographical Society of London, 1842, 1 pamph.

Voyage au tour du Monde par les Mers de L'Inde et de Chine de M. Laplace. Paris, 1839, tome V. 1 vol.

Darwin's Structure and Distribution of Coral Reefs. London, 1842, 1 vol. *Purchased.*

A very curious Coat of chain mail, with rows of plate of thick tortoise-shell, worn by the Dayaks of Borneo, was presented by B. Rodyk, Esq. Registrar of Malacca, through Dr. Griffith.

A letter from S. Mornay, Esq. was read, tendering for sale a collection of Minerals for Co's. Rs. 200. Upon the report of the Curator of the Museum Economic Geology, that a part were of much rarity, or desirable as filling up blanks in the Mineralogical Series, it was referred to the Committee of Papers to arrange, if possible, for the purchase of this part.

Upon the recommendation of Mr. Blyth, the sum of ten Rs. each, was allowed to the principal and assistant Taxidermists, on account of the very heavy extra work of the month of November, in their department.

Two letters from Mr. Batten, C. S. Assistant Commissioner, Kemaon, were read, announcing the dispatch of the interesting Journal of Lieut. Weller, B. E. bringing Capt. Herbert and Manson's Account of the Jowahir Pass into a complete form, and promising, if possible, to send an account of the Dhurma and Bhyanse Passes into Thibet, so that with Mr. Batten's own account of the Neetee Pass, (erroneously printed in the Journal as Mr. Benson's,) a nearly thorough topographical and scientific Description of the Passes of this interesting country will be completed.

Mr. Batten's second letter announces the dispatch of some more of Captain Herbert's Journal. The MSS. had been received, and were exhibited. The thanks of the Society were tendered to Mr. Batten and to Lieut. Weller, for their very zealous co-operation.

A highly interesting paper by Captain Thomas Hutton, B. N. I. on the habits of a large species of Galeodes, called by him *Galeodes vorax*, from its killing and devouring small lizards, and even killing young musk rats and small birds, though not devouring these (warm-blooded) animals, was presented and read. Referred

to the Secretary to be printed in an early number of the Journal, with the thanks of the Society to Captain Hutton.

A paper on a new genus of Falconidæ, by B. H. Hodgson, Esq. Resident at Kathmandoo, with a note by the Zoological Curator, Mr. Blyth, was also presented, and referred to the Journal for publication.

A summary description of two new species of flying Squirrel, by B. H. Hodgson, Esq. Resident at Kathmandoo, was also referred to the Journal.

Monograph of Indian species of Bats, of the restricted genus Vespertilio, by E. Blyth, Esq. Curator, was also presented, and referred to the Journal for publication.

For all these papers and presentations, the thanks of the Society were voted.

Report of the Curator Museum of Economic Geology for the month of November.

Museum Economic Geology—Our contributions for this month are, Capt. Tremenheere's second series from Mergui, comprising the decomposing Granites which form the matrix of the Tin ores of Kahun at that settlement These were alluded to in my last report, and I have only to add, that Capt. Tremenheere's paper is in the hands of the Printer, the plan which accompanies it in those of the lithographer, and the specimens will be, as suggested by the Military Department, divided for sending to the Court of Directors.

We have also, from the same zealous contributor, a set of fifteen specimens of various kinds of Timber and Woods from Mergui, with a bottle of the Theet-see Varnish, and a specimen of the Gum Kino of that locality, of which, as I learn from Mr. Thomson, of the house of Scott Thomson and Co. considerable quantities are now sending, or have been sent, to Europe.

We have from Capt. Baker, Superintendent of the Doab Canal, five specimens of Cement, Kunkurs, and Limestones from the Dehli Canal, and other localities in the N. W. Provinces.

The Museum has been referred to by Lieut. Guthrie, from Cachar, relative to some specimens of Stalagmitic Limestone found near that place, and to some water which drips from the rocks where it is formed. The Limestone is a common stalagmitic concretion, and the water contains a little Sulphuretted Hydrogen.

Geological and Mineralogical.—We are proceeding here with our work of arranging the Minerals, but the want of the new cases which are sanctioned by the Committee, impedes us in some degree.

We have no Geological or Mineralogical contributions for this month.

H. Piddington,

Museum, 1st December, 1842. *Cur. Mus. Econ. Geol.*

H. Torrens Esq.

Secretary, Asiatic Society.

Sir,—I beg to represent to you the absolute necessity for two more cases in the Mineralogical and Geological department of the Museum.

2. I am already so far advanced with the classification of our rich stores of Minerals, that I have them arranged in genera and families, but even without room for what we have, (for the cases are now too full,) without room for the deficient Minerals to complete our series, and without any chance of room for our valuable fossil shells and other delicate organic remains; we have none for the various contributions which are arriving or promised us from all parts: I have far more, even in geological series, than would fill every vacant corner!

The expence of the two cases will be 106 Rs. complete.

I am, Sir,

Your obedient Servant,

31*st October*, 1842. H. Piddington,

Curator, Museum Economic Geology.

Major W. M. N. Sturt,

Offg. Secy. to Govt. of India, Military Dept.

Sir,—I have the honour by direction of the Asiatic Society of Bengal, to acknowledge the receipt of your letter No. 178, dated the 14th ultimo, with its enclosure.

2. In requesting you to convey the thanks of the Society to the H. the P. in C. for this mark of his attention, I am desired at the same time to state for the information of H. H. in C. that the Society will have pleasure in complying with the wishes of Government, by publishing as early as possible the dispatch from the Surveyor General of India, containing the final report upon the operations for measuring an Arc of the Meridian carried through the centre of the Peninsula to the Northern confines of Hindoostan.

3. To ensure the necessary accuracy, the Society would prefer printing the report under the supervision of either Lieut.-Col. Everest, or an Officer of his nomination, and I am accordingly desired to suggest, that Lieut.-Col. Everest may be invited to mention to whom he would wish the proofs to be sent for correction before they are finally printed.

4. Lieut.-Col. Everest's Dispatch will be returned when it is no longer required, accompanied with a few printed copies of the Report, as requested, for the purposes specified. I have, &c.

The 24*th November*, 1842. H. Torrens.

NOTICE.

The Editor begs to refer his readers to the Introductory notice which precedes the only article of which this number is composed. Possessed, almost against all hope, of the power of publishing this valuable document, his wish has of course been to give it as speedily as possible; but he feels that as all his subscribers are not equally interested in the subject of which it treats, the occupation with it of one whole number of the Journal which *they* support, would be an unfair return for the substantial aid in matters of general science which he has received from so many among them.

He has therefore resolved, (printing this year 13 instead of 12 numbers of the Journal,) to offer the extra number containing Capt. Herbert's Report to them without any charge.

N. B.—The labour of emendation of the Report has devolved entirely upon Mr. Piddington, Curator in the Mineralogical and Geological Department to our Society, to whose scientific knowledge, and critical ingenuity, we are indebted for the elucidation of many passages, which would otherwise have been hardly intelligible, owing to the defective text.

EXTRA NUMBER.

[*Issued gratis to Members of the Society, and to Subscribers to the Journal.*]

JOURNAL

OF THE

ASIATIC SOCIETY.

Report of the Mineralogical Survey of the Himmalaya Mountains lying between the Rivers Sutlej and Kalee. Illustrated by a Geological Map, By Captain* J. D. HERBERT, *Superintendent.*

To some of our Indian, and to many of our European readers, it may be necessary to explain the circumstances which gave rise to the following report, and those under which it has so long remained unpublished.

Captain Herbert of the Bengal Infantry, Deputy Surveyor General of Bengal, and Superintendent of Kemaon Surveys, was appointed by the Government of India, then under the Marquis of Hastings, to undertake a Mineralogical Survey of that part of the Himalya Mountains, which form the British Frontier to the North-West; but it would appear that this was not fully executed, though much was done; and the elements of much more which might have been accomplished at a small expence were already collected.

Captain Herbert, after editing for three years the valuable Gleanings in Science, the parent of our Journal, was appointed Astronomer to the King of Oude, whither he proceeded, but enjoyed for a very short time his post, dying of an apoplectic attack in 1833.

When our present Curator of the Museum of Economic Geology, Mr. Piddington, assumed temporary charge of the Museum, he found 12 cases filled with what were well known by the Assistants to be "Captain Herbert's specimens," but beyond this fact, not a line of Catalogue, Journal, or Note relating to the specimens could be discovered; It became then an object of great importance to the Society, and to Science, to trace out, if possible, any records which could throw light upon this valuable collection, and after a persevering search of eighteen months by the Secretary and himself, their labour was rewarded, first by the discovery of five volumes of Captain Herbert's Notes, which had been carried into KEMAON! but fortunately left there in the care of a zealous friend to Science, and a valuable associate of the So-

* See Introductory Remarks.

ciety, Mr. J. H. Batten of the Civil Service; next, by that of the report now published (to which Captain Herbert's paper on the Mineral Resources of the Himalaya in the Physical Transactions, Vol. XVIII. is a sequel,) and through the report, by the knowledge that his geological map, and plans of the river basins of that part of the Himalaya, exist in the records of the India House. It is needless to add, that no time has been lost in requesting copies of these valuable documents from home.

It remains but to add a word on the lacunæ which it will be perceived occur so frequently in the first pages of the MSS. These are owing to some corrosive liquid having so far destroyed the manuscript that it has been sometimes necessary to fill it up altogether conjecturally, but at other places there are enough of words or letters left to assure us, that we were not far from the very words used by Captain Herbert. It will be noted, that all our emendations are distinguished both by italics and by brackets.

INTRODUCTION.

1. It has been my intention to give, in the accompanying paper, such a general sketch of the geological features of the mountain tract between the Kalee and the Sutlej Rivers, as the series of partial and scattered observations which I have yet been able to make will allow. In the absence of every thing like information, such a sketch, though necessarily imperfect, and even premature, will not be perhaps without interest. It will at least serve to exhibit to the Government, who have so favorably distinguished me, the nature and extent of my labours since entering on this duty, and also to mark out the train of investigation which they have suggested to me.

As such I offer it, but with diffidence. Geology, as a science, has not yet attracted in India that attention which its importance merits, and it would be futile in me to deny that, till selected for this duty, I had but a slender acquaintance with the subject. While exploring the local phenomena of this tract I have been in reality studying the principles of the science; an advantage in so far as I may hope to have escaped the trammels of system. But on this account I have also laboured under some disadvantages, inasmuch as a premature account like the present, of an unfinished survey, may be expected to lie under some imperfections, which a little more technical knowledge on my part might perhaps have removed. "But a survey that shall accomplish every thing, must be a work of time, nor will any thing be contributed towards it by

him, who fearful of being wrong where as yet it is impossible to be always right, and unsatisfied with the best he is able to attain, delays the record of his observations to the period of perfection." Should it be considered as redeeming in any degree the pledge of industry and zeal, which my acceptance of such an appointment must have held out, I shall consider its chief end answered.

3. Hereafter, when a more enlarged field of observation shall be attained, I trust I shall be able to make it more worthy the attention of the scientific geologist. Having once put on record what has been done, and digested it into something like a regular form, it will be easy to add to it as my researches extend and become more particular. One part will throw light on another. A particular fact carefully observed, may sometimes lead to a happy generalisation, and in this way many deficiencies will I hope be supplied which must necessarily attend so early an effort. In the meantime, imperfect as it is, this paper will have its uses. By exhibiting what has been done, it will shew what remains to do, and it will serve as a guide to direct any future labours, by pointing out in what quarter interesting facts may, or may not be expected to occur.

4. Considered as a geological description of these mountains, many blanks will be observed. For besides that, it was impossible in so short a time to go over every part of them, there is a difficulty peculiar to this quarter which very much interferes with geological investigation. This is the total absence of every kind of excavation calculated to afford information, whether mines, roads, or quarries. The former, few as they are, are inaccessible to any but those accustomed to them from their infancy. The total length of roads as yet laid open, does not much exceed 150 miles, and such is the light thrown on the subject along the different lines as to render it still more a matter of regret that we have not greater access in this way to the actual rocks, the nature of which is often only to be guessed at. Of quarries there are absolutely none, for the province, though possessing excellent limestone, slate, and other productions, capable of being turned to account, had been, up to the period of our conquest, so wretchedly misgoverned, as to have occasioned resources of this kind to lie utterly neglected. From the consequent difficulty of determining in many cases the nature or relations of the rocks, some particulars have necessarily been taken

for granted without actual examination, which in this case would have been impossible.

5. In the Geological Map I have laid down much that has not been actually examined, as might be concluded from what I have stated in my letter to Government, paragraph 7. To refuse to employ those generalisations which the experience of all geologists has shewn to be well-founded, is to forfeit the advantages derivable from the labours of our predecessors, and to impose on ourselves the task of reconstructing the whole science from our own materials. When the same rock has been found on the line of direction in every point in which it has been examined I have deemed myself justified in laying down that rock as continuous through those points. Even at the termination of the survey, many conclusions of this nature must be taken for granted; for it has been well observed, that "no human patience would suffice for the examination of every piece of rock that projects through the surface." And, even were that effected, still much must be taken for granted, especially in these mountains, the rocks being concealed, as they so often are, by deep collections of debris, and covered by luxuriant coats of vegetation. I was, however, in a very early stage of the survey, taught to except from this conclusion granite, as being a rock the occurrence or non-occurrence of which in any particular spot I found I could never predict with any certainty. Limestone also I found seldom could be depended on for any distance, forming always beds in other rocks, and never appearing under those relations which I conceive necessary to constitute a principal [*formation.*]

6. The elevations expressed in the sections,* have been determined by barometrical measurement, a method which unless under favorable circumstances, and with great facilities [*is liable to error, but*] the degree of accuracy attained is sufficient for the purpose, as it is a matter of no importance whatever whether the place of a rock be assigned fifty feet below, or above, its real level. They are as correct I believe as geological sections ever are, and certainly sufficiently correct to answer all the purposes for which they are required. The fixed points determined by the Trigonometrical Survey have been always

* I regret that the circumstances under which this report has been prepared, have prevented the preparation of these. They are, however, more than half finished, and shall be forwarded with as little delay as possible.

used when they fell in the line, and they have not unfrequently been found of value as terms of comparison by which to judge of the accuracy of the barometrical results.

[*The nomenclature adopted, is that of MacCulloch's*] Hebrides. It were no doubt very much to be desired, that a system of nomenclature founded altogether on mineralogical distinctions, (like Brogniart's for instance,) should be generally received by geologists. It would save much useless and cumbrous description. Till such a reform, however, be introduced, the safest plan is to follow the example given in the above work, of noticing and describing correctly every compound included under any general head or term, as constituting a distinct geological formation. By this means the danger of confusion is entirely obviated.

Silt, sand, gravel, or boulder stones which are evidently derived from the breaking up of pre-existing rocks, and are of the latest formation, are all comprehended by Dr. MacCulloch, under the term "alluvium of transport." Professor Buckland was, I believe, the first to establish in a satisfactory manner, that there are deposits which may be discriminated as originating in two distinct causes, either in the action of the present rivers of the globe, or of a mighty rush of waters or deluge, far surpassing the greatest effect of rivers as they exist at present even in their highest floods. To the former, the term alluvium is restricted. The [*latter he distinguishes by the term* diluvium, *and though this cause may not have operated on every occasion, yet it is always useful to*] bear it in mind. Its reality in some particular cases is too obvious, at least in this quarter, to escape the notice of the most indifferent, or even prejudiced observer. I have therefore adopted these terms, considering them conducive to precision, and as having the sanction of such high authority. The angular fragments and rubbish, which are generally found either in their original position or only so far removed as may be traced to the action of gravity, are termed by Dr. MacCulloch, "alluvium in situ," and "alluvium of descent." I have ventured to use the term debris.

9. In the mineralogical details, I have adopted the nomenclature lately proposed in the system of Professor Mohs of Freyberg. The synonyms in this science have, it must be confessed, become too numerous, and the knowledge of them forms a very considerable part of the little that is to be learned from what are called systems of Mineralogy. To

adopt, then, a new set of terms may seem like increasing the difficulty of making ourselves intelligible, and wilfully adding to the confusion. But amongst the old names, there are none generally received, all being originally imposed in an arbitrary [*manner*.] But in the new terminology there are legitimate grounds for selection, the names being connected with a system of arrangement, which, if it be not all that could be wished, is yet extremely convenient. They express in a greater or less degree, the relations which these minerals have to each other; in other words, their places in the system.

There appears also little doubt but that, eventually, this system will be universally adopted, and those names supersede the present barbarous collection, not more puzzling by their numbers, than objectionable for the total want of euphony, and [*I have*] given some account of the mineral productions considered in an economical point of view, and with reference to the question of the due development of the resources of these provinces. Their value is not to be correctly estimated in the present condition of the country. When an improved system of government shall have had time to produce its full fruits in the increase of the population, and the improvement of its habits, in exciting a taste for the arts and conveniences of civilized life, and in effecting ready modes of communication, and effectual means of transport, it will be seen how many and [*how vast are the resources which here present*] themselves, which [*under good*] management, might be made sufficiently productive to become worthy of attention to a Government disposed to improve its resources and to leave no source of revenue neglected.

11. Gold and silver have in every age been sought after with avidity as the most prolific sources of national wealth. Nothing, however, can be more certain, than that, in reality, they are the least productive of all the several different mineral resources. The comparatively small quantity in which these metals are found, and the greater expence in raising them, satisfactorily account for this apparent paradox. In South [*America this is well known to the*] speculators in mines. It is there a common saying, that a copper mine is a fortune, a silver one scarcely pays itself, but a gold mine is ruin."

12. It is not then as considering the existence of the precious metals as the most promising, or the most productive, that I would lay stress on the great probability which there is of the discovery of a mine of gold

within these provinces. The reasons on which this probability rests, will be found in the Supplementary Paper.* Whether the discovery may in any reasonable period reward the zeal of an enquirer, or may wait finally that advanced stage of improvement in [*which all the resources of a country are carefully and accurately explored is a problem, the*] solution of which it were vain to seek. But of the actual existence of the metal within these mountains, no one can doubt who will read the few details I have given.

13. In the copper, lead, and iron, however, in which the province abounds, may be found a more tangible, as well as more productive source of wealth. It is certain that the former metal exists in very considerable quantity, and for the iron, nothing is wanting but a proper system of management to render it superior to that of England. To her repositories of these metals, of tin, and of the mineral coal, is England mainly indebted, [*for her vast wealth and power; and it is strange that they should be neglected in India, as if*] the truly valuable minerals were the gold of Potosi, or the diamonds of Brazil and Golconda. Why they should not here equally prove mines of wealth, if properly managed, appears difficult to understand. With the ore in abundance, fuel, and other means of reduction at hand, labour cheap, a very short line of mountain carriage, and half of that a line of made road, what is there, but capital and skill required to produce any quantity of the metal, and considerably under the present market price?

14. But these though probably the most productive, are not the only mineral sources of wealth * * * *
nearly its weight of silver, as even though it should not all prove to be of such first rate quality, yet the inferior kinds are also of such extensive use and application, as to render it a truly valuable deposit. Quarries also of marble, of slate, of potstone, of gypsum, supplies of sulphur, of sulphate of iron, and of alum are found. The trade in borax is well worthy of attention, and no doubt the whole supply of Europe might be drawn through these mountains. If to these be added other articles of trade and consumption, such as timber, hemp, bees' wax, wool, and live stock, as sheep, &c. it will readily be acknowledged in

* Captain Herbert alludes here to his paper on "the Mineral Productions of the Himmalaya Mountains," p. 236 Part I. Vol. XVIII. *Trans. As. Socy.*—Ed.

contemplating these [*provinces, that they are by no means so barren or so worthless as may at first sight appear.*] The indigenous population is not likely speedily to improve, or to enter into *these* views, at least without the support of European capital and the example of European enterprise. And certainly, if the experiment of European colonization is ever to be tried in India, we cannot select a better spot than these mountains, whether we consider the favorable nature of the climate, the great room for European improvements, the quantity of available land, or lastly, the nursery which such a colony might form of a hardy and warlike race to which we might in the hour of need owe the safety of the empire. [*But these views may be by many thought*] visionary, and [*I now*] turn to notice, before concluding these preliminary remarks, one other probable source of wealth, which though not, strictly speaking, belonging to these districts, is yet at no great distance from them; and to the discovery of which, should it be discovered, the geological investigations now going on must furnish the key. I allude to the strong reasons I have brought forward for believing in the existence of coal in some part of the Dooab; such a discovery would indeed be more valuable than that of a mine of the precious metals. In the great scarcity of fire wood, [*this mineral*] would be invaluable. When we consider too how completely the Dooab is adapted by nature to the ready formation of a complete system of internal communication, we shall be convinced that it would be sufficient to give an astonishing impetus to the march of improvement, and effect probably in a few years such a change as is difficult to form even an idea of at the present moment.

The following paper may be conveniently divided into five sections, the subject of each being as follows:—

1. Physical aspect and arrangement of the surface.
2. Geological details.
3. Recapitulation of the preceding, or general view of the geological structure.
4. Conclusion; with notices of the most remarkable features of the preceding general view as compared with systems, and with observation in other countries.
5. Mineral productions, comprising an account of the mines, method of working, and suggestions for their improvement.*

* See Note at p. vi.

Of these the second being the most voluminous, and consisting entirely of practical details, can only be interesting to a professed geologist. [*It is my intention hereafter to label and refer each rock specimen of the large collection*] I have made to the account of its occurrence as here given, by number, so that, when the paper is studied with the cabinet to refer to, I consider that it will give as correct an idea of the geology of the province as could be had by actually travelling over it. And there will be the further benefit that the experienced geologist will be able to correct any mistakes into which I may have fallen, either through inadvertence or want of knowledge.

The first section constitutes a detailed and systematic account of the Physical Geography of this district, being the first ever given. Such a view independent of [*its connection with the geological details, to the full comprehension of which it is absolutely necessary, is also much*] called for as a contribution to general Geography, the latest works published being singularly deficient in details on this subject, as well as erroneous in the few that are given. As an example, I would refer to Mr. Meyer's Geography, a very costly and bulky work, lately published, and to Brewster's and Rees' Cyclopœdias, (Art. Himalaya and Physical Geography.) In none of these works is a clear idea obtainable of the physical features of this interesting quarter of the globe. I could have wished to have had a little more [*time for the systematic arrangement of the facts and opinions in this*] division, and I intend to improve and extend it considerably hereafter.

The geological reflections with which the paper concludes are, I am sensible, those in which I stand most in need of candid criticism. The early period at which I have been obliged to draw them up, the want of books of reference, till within the last two months that I have been in Calcutta, and the necessity of attending to the arrangement, digestion, and revision of the other parts of the report during this time, thus distracting my attention; added to the anxiety I have felt to [*do justice to*] the subject will, I trust, plead some excuse for the deficiencies observable in it. Altogether, indeed, I would state as a sufficient apology for the errors which may be found doubtless in every part of the paper, the great hurry entailed upon me in the preparation of the fair copy owing to the difficulties and perplexities originating in circumstances which I have explained in my letter accompanying.

But these hindrances are now I trust at an end, and with the assistance so liberally granted me, I am not without hopes of improving and adding to this paper so [*as to render it not altogether discreditable to myself, and I trust such as may*] embolden me to look forward to the patronage of Government in the eventually contemplated act of publication.

SKETCH OF THE GEOLOGY OF THE HIMMALAYAS.

Section I.

1. Previously to entering on the detailed description which is to be the subject of this paper, it will be necessary to take a general but cursory view of the Geography of Central Asia. This great country, so interesting in every point of view, constitutes it is probable, whether we consider its physical aspect, or its geological structure, a system, or whole, without [*some general view of which to assist us, none of its*] parts can be fully [*comprehended.*] It is in their connection with this singular country that we shall see some of the most interesting relations of the tract in question. Nor does it appear possible to obtain a clear and connected idea of those relations, without extending our view to the great whole, of which our mountain provinces form but a part.

2. Unfortunately, however, so deep is the obscurity which covers the Physical Geography of Central Asia, that little is to be done beyond offering probable guesses on many of the most important points. The [*accounts of geographers and travellers, even those lately given to the*] public, are so meagre as to leave us little to glean. And even in that little they are frequently so contradictory, that it is not easy to obtain any thing like certainty, except as to a few leading features.[1] Even

1. It is quite astonishing how little we know even of countries comparatively easy of access, and often visited, I mean of their physical features. Of Persia we do not to this day know the elevations of its great plains and mountain ranges. Of Cabul we are equally ignorant. It would appear as if observations, amongst the easiest to be made, and requiring little skill or ability, have yet a mysterious terror for the otherwise most intelligent and able travellers. Our ignorance is the more provoking, as very near approximations to truth may be made in all the several results required by Physical Geography, with very slender means, and scarcely any science: how much may be done by a traveller possessed of only a pocket sextant, a good watch, a thermometer, and a pocket compass.

these will throw perhaps some light on the subject, and will at all events enable us to take a view of this tract, altogether different from what has hitherto been adopted.

3. If we [*consider the map of Asia, we shall be struck with the appearance of a*] large central space, which is strongly marked by the circumstance of being but little intersected by rivers, while yet on every side innumerable streams flow from it, and unite to form some of the largest rivers of the Old World. The Amur, the Hoangho, the Yangtse-Kiang, the Maykaung, the Maygive, the Irrawaddy, the Kiendun, the Burampooter, the Ganges, the Indus, the Oxus, the Jaxartes, the Obi, the Jenisei, and the Lena surround with their sources this tract, and with courses varying from 1,200 to 3,000 miles in length, radiate from it to the surrounding seas in every direction.

4. Inasmuch as the source of every river must be higher than any other part of its course, it is just to infer, that the zone in which these rivers originate is higher than the plains through which [*they flow*] to seek the Ocean. [*Their*] lengths of course may be considered to be, within certain limits, proportional to the elevation of the source; we may further infer, that the line which connects the water-heads of these great rivers, must be of very considerable elevation, compared with other parts of Asia external to that line.

5. We know from observation, that the tract in which are found the sources of the Ganges, the Indus, the Oxus, the Obi, the Jenisei, and the Lena, is diversified by lofty mountains, some of them the highest on the globe. The Himalaya, the Karakoorum, the Hindoo Koh, the Beloor Tag, the Bogdo, the Alak, and the Altai mountains are all found along this line. We are then entitled to infer, that this mountain zone is in like manner continued to the S. E. and to the E., consequently that it completely surrounds the central tract.

6. Of the particular features of the interior, little is known. It has been usual to call it a plateau, and to suppose it of very great elevation. The great sandy desert of Cobi, which is known to occupy part of it, affords some grounds for this appellation; but with regard to the conviction of its great elevation, this seems to have originated in incorrect ideas of natural boundaries, and a consequent misapprehension of what is, or is not the central plateau. [*It has been*] presumed that the [*whole line of*] elevation along the mountain barrier above indicated should be

considered as the bounding limit, and that every point within this line was entitled to the above appellation.

7. Captain Webb, amongst others, appears to have fallen into this mistake in assigning the bed of the Sutlej (14,000 feet) as the lowest level of the plateau,[2] whereas the bed of the Sutlej belongs to the Sinditic Basin, (so in MSS. qu: *Ind*itic?) and is consequently part of the barrier zone which surrounds the central tract. In like manner, the country visited by Captain Turner, and commonly known as Thibet, the description of which is generally adopted as that applicable to the interior, must be considered also as part of the mountain barrier, since it is watered by the streams or feeders of the Sanpo; which if it be not the Burampooter, must be either the Kiendun, or the Irrawaddy.

8. Considered [*as a question*] of Physical Geography, [*the true*] line of boundary is undoubtedly the chain of water-heads, and this is by no means synonimous with the line of greatest elevation.[4] It may be that the central tract is not of such great elevation as has too hastily been presumed. It may be that this presumption is correct; the mountain barrier which surrounds it serving, as in the [*case*] of the Ghats of Malwa,[5] to [*support*] a high table land of tolerably even surface. But however this be, it is not the less necessary to avoid confounding the boundary tract of mountain land with the central included area.

9. Of other particulars we are equally ignorant; what its rivers are, if any; and whither they flow; some we do know [*contribute to*] certain

2 The *Quarterly Review* in reporting this fact, has not noticed the error. But this work has never been celebrated for its disquisitions on physical or mathematical subjects. In this particular article, and the abusive one on the same subject which called for it, they are particularly open to censure. The two productions form an amusing contrast.

3 The latter is D'Anville's opinion, the former Rennel's. The great mistake into which this acute geographer fell regarding the course of the Sutlej and Ganges, naturally makes one distrustful of his authority on this point. The little light which the employment of our troops to the Eastward has thrown on the subject, tends to add strength to these doubts.

4 This remark is not unnecessary, for it is a mistake made by many, who conceive that because the source of a river must of necessity be higher than any part of its bed, *therefore* all the elevations in its immediate neighbourhood must be higher than those situated near a more advanced part of its course.

5. There is not however the analogy of geological structure to make this conclusion probable. Malwa is of the trap or overlying formation one which has derived its name from this peculiarity of structure, whereas all the evidence we have on the subject tends to support the opinion of this great circular barrier being composed by primary rocks.

lakes; and some [*we presume*] are lost in the sands of the Great Desert. But to obtain any thing like detail, on these and many other points, is in the present obscurity of the subject impossible. Of its geological structure, we have not an idea that is not purely hypothetical.[6] And yet, it may be averred, that the geology of Asia can never be rendered fully intelligible, or even the science itself be placed on a firm basis, till the whole of this tract be fully explored, and the rich mine of illustrations, which it doubtless contains, be fully laid open.

10. Considered in its various relations to Asia, I might even say to the Old World, it is undoubtedly the most interesting spot on the surface of the globe, and it is certain that the traveller who shall first succeed in developing these relations in all their bearings, will establish for himself no inconsiderable name. Unfortunately for science, this task is not likely to be soon effected. The jealousy of the Chinese government, to which the greater part of it belongs, opposing insurmountable obstacles to the progress of investigation and discovery.[7]

Section II.

11. It appears [*certain that*] this central area—whether we call it a plateau, a basin, or series of basins—is surrounded on all sides by a broad zone of mountain land in which originate the great rivers of Asia. The [*tract*] of which I am now to give a description, and which comprises all the British possessions within the mountains, forms but an inconsiderable portion either in length or breadth of this great Alpine belt. In interest of description, however, it does not yield to any part of it. For within its boundaries rise some of the most remarkable peaks of the Himmalaya summits, not more celebrated in the annals of superstition than in those of science, and from its area spring the sources which unite to form the Ganges. The sacred River! the fertiliser of pro-

6 That is of the interior.

7 The extraordinary perseverance and intrepidity which distinguished the late Mr. Moorcroft, bade fair to give us some knowledge of part of this country, certainly of a great portion of the surrounding mountain tract, had his life been spared. Few men have possessed in an equal degree the qualifications necessary to ensure a traveller's progress through those countries, and it is not likely that an enquiring spirit like his would have rested while any thing remained to be learned, or any quarter open to research presented itself. His premature death, while on the point of returning to his countrymen, is much to be deplored. It is hoped that the materials collected may yet be made available to the increase of our knowledge of those countries.

vinces! the waters of which bear health and plenty through a course of 1,200 miles!

12. The boundaries of this tract are to the S. E. and N. W.; the rivers Kalee and Sutlej; to the N. E. a line drawn from the Kalapanee fountain, (one of the sources of the Kalee,) to the confluence of the Tedong river with the Sutlej; and on the S. W. by a line drawn from the Kalee, in latitude 29°, longitude 80° 8′, to Ropur, on the Sutlej. These boundaries form a right-angled trapezium, the two parallel and longest sides being directed about N. 60 W., the rectangular side being to the Eastward, and the oblique side to the N. W., forming angles of 50° and 130° with the parallels. The only exceptions to the regularity of these boundaries are: 1. A narrow strip comprehending part of the vallies of the Sutlej and Speetee rivers, which runs up as high as latitude 32°, and which is within the British limits. 2. The valley of the Jahnuvi river, or right bank of the Bhageerettee, which though included by the above boundary, is considered to be part of Thibet.[8]

13. The length of the several bounding lines are as follows:—

1. That facing the S. W. ..... 272 miles.
2. ..... N. E. ..... 192 ditto.
3. ..... S. E. ..... 96 ditto.
4. ..... N. W. ..... 120 ditto.

and the superficial extent in round numbers may be taken at 23,000 square miles. If we include the slip of plain country along the S. W. boundary, and which is geologically connected with it, the extent will be about equal to that of England Proper.

14. The tract limited by the boundaries just particularised, may be described as altogether mountainous. A few inconsiderable and level spots, hardly to be called vallies, are found, but neither is their number or extent such as to render any qualification of this description necessary.

8 The only village, called Choongsa or Neelung, owes also a nominal subjection to the Rajahs of Gurhwal and Bissahir, whose countries are conterminous with this district. The villagers are of the Thibetan race. Their village consists of about sixty houses, which are but little raised above the ground and flat roofed, on account of the extreme violence of the winds which prevail in that quarter. It is situated on the right bank of the Jahnuvi, in latitude 31° 8′, longitude 79° 5′, and has an elevation of about 10,000 feet. The river is about 100 feet broad, and from four to six feet deep.

In ruggedness of feature, it does not yield probably to any country in the world, and such is the irregular and confused appearance, which the endless ramification of its mountain ranges presents, that it is with difficulty the unpractised observer can persuade himself that any thing like order or regularity can be deduced out of such a seeming chaos.[9]

15. No continuous chain of elevations can be distinguished on a first and cursory view; no great vallies, no table lands, nothing in fact to lend a clue to the development of the mountain masses. The aspect, from whatever height the country be viewed, is that of an assemblage of elevated peaks, irregularly and confusedly heaped together. Even the snowy chain, though defined to a certain degree by a phenomenon so singular on a first view to the inhabitant of the plain country, loses on a nearer approach all character of continuity and regularity, and appears under the same confused and irregular aspect which the lower elevations are observed to bear.

16. It is only by tracing the courses of the rivers and their tributary streams, that a clue can be found to lead the observer out of this labyrinth. By connecting their sources, and by following out the devious windings of the several feeders, an idea is obtained of the extent, the direction, and the connection of the several ranges. Such an analysis, (vide sketch of the great river basins,) will be found to modify considerably the notions which the first view of this mountain tract from the plains is calculated to give.

17. Instead of a succession of parallel and continuous ranges running S. E. to N. W., and rising one behind another in regular array and increasing elevation, till the series is closed in the farthest distance by the line of snow-clad peaks,[10] we see only one continuous range of any extent forming an irregularly curved line, which bends round the tract commencing on the N. E. angle, with a North-westerly direction,

9 This is also the arrangement, or rather apparent want of arrangement observed by Saussure in the Albs, who says, "When we contemplate the range of which Mount Blanc forms a part, from less considerable elevations, it appears as if these colossal mountains were situated in a line, and formed a chain, but this appearance vanishes entirely from the bird's-eye view here presented. They are distributed in great masses or groups of various strange forms," &c. &c.

10 The deception is so strong in viewing these mountains from the plains, that most people continue, even after having visited the interior, to speak of the 1st, 2d, 3d, and snowy ranges.

which it gradually alters to a South-easterly one on the S. W. angle, and latterly due South, just before it is lost in the plain country.

18. This range forms one of the boundaries of the basin of the Sutlej which bends round the convex side, while within its concavity, are contained the numerous sources of the Ganges, the several feeders of which are separated by a most intricate ramification. On this account, (as it will be necessary often to refer to it,) and as there is no native name for it, it may be termed the Indo-Gangetic chain.

19. We see then, that with the exception of a narrow strip belonging to the Sutlej, all this tract is occupied by the sources of the three principal branches of the Ganges; viz. the Jumna, the Ganges Proper, and the Kalee.[11] A line drawn through the points where they severally enter the plains, represents pretty exactly the common boundary of plain and mountain land. It is the S. W. boundary mentioned in Art. 12, and its length from Ropur, the *debouché* of the Sutlej, to Brihon Deo, that of the Kalee is 272 miles.

20. The great disproportion of drainage effected by the Sutlej, which is one of the boundaries, and by the other or Gangetic system, is very striking. Not less so is the difference of their courses as to direction, the one running nearly due West, the other South; and as to length, the former having a course from its origin in Lake Monsuror to its *debouché* at Ropur of 550 miles, whereas the longest branch of the latter has only a course of 292 miles. It is this want of analogy in the character of these two great river systems that forbid our speculating on the arrangement of surface which may obtain beyond them.

21. In the case of two rivers of such magnitude as the Indus and Ganges, which direct their waters to the opposite seas of India, we naturally expect to trace some indications, however obscure, of a separating elevated tract, something farther than the point where the Indo-Gangetic chain ceases. No such indications are however found, for the intermidiate tract is much at the same level as the interior of the river districts which it separates.[12] Physical Geography is full of these disappointments,

11 In terming the Kalee one of the sources of the Ganges, I mean of course the Ganges of Bengal; the Kalee is the principal branch of the Dewah or Gogra river, which falls into the former near Chuprah.

12 This fact is very important, and points out the facility of establishing a system of irrigation all over the Dooab and Rohilkund. I ascertained that the bed of the Jumna at Raj Ghat, on the road between Chilkana and Boorea, is but five feet

a proof, if it were wanting, that we are still but imperfectly acquainted with the structure of the globe.

22. The length of the Indo-Gangetic chain is about 340 miles, as defined on one side by the Kalapanee fountain, one of the sources of the Kalee, where our first precise knowledge of it commences, and on the other by its termination in the plain country, which is sufficiently sudden to be definite. From its gradually decreasing elevation along this line, it is natural to infer, that it is but a ramification of that more extensive line of water-heads, (Art. 5,) which would exclude from the central plateau all the mountain tract watered by the Sanpo and the Indus, as well as by the Ganges. We are not then to suppose that in crossing the Indo-Gangetic chain, we have made a near, or even the nearest appulse to the great table land of Tartary;[13] we are equally near it in the basin of the Ganges. But if this central plateau really means any thing, it must be something distinct from its surrounding barrier of mountain land, or if not, all the river basins are equally entitled to the appellation.

23. Next in extent to the Indo-Gangetic chain are the two principal ramifications; viz. that which separates the subordinate basin of the Jumna from that of the Ganges Proper, and that of the latter river from that of the Kalee. From their origin in the parent ridge to where they are lost in the plain country, their length is about 160 miles. Like the principal chain, they cease suddenly, nor is there any trace either in the Dooab or in Rohilkund of a continuation of them, however obscure.[14]

below the level of the Saharunpore cantonment, (month of March.) At Badshahee Mahul, it is 200 feet. Here then is a water-head capable of supplying any number of canals, and for a continuance the Ganges offers similar facilities for Rohilkund. The elevation of its bed at Hurdwar is 1,000 feet above the sea, while that of Mooradabad is only 609 feet.

13 The bed of the Sutlej can by no figure be termed a table land, for it is a deep valley shut in by lofty mountains. But even if it were, it is not the table land of Tartary, which is the country watered by the Oxus and Jaxartes. It is a strange mistake which is made, and by many who have the reputation of being well informed, that of confounding the Calmuck or Mongolian race with the Tartars, and their country with Tartary, whereas no two races can be more distinctly marked than these are. It was the country of Thibet, and not Tartary, which Captain Webb saw, and which is inhabited by a tribe of Calmucks or Eleuths.

14 A levelling operation which I executed some years ago, connecting Scharunpore with the Jumna, and which furnished the result mentioned in the note, page xvii. established also a more unexpected conclusion; viz. that the ground in the immediate vicinity of the river for a short distance rises to the height of forty-five feet above its level in the cold season.

The great disproportion in the length of these branches compared with those thrown off to the Sutlej, is very striking, (Art. 20.)

24. From these, as well as from the main chain, proceed a multitude of other ridges, and from these again a third set, and so on till the area becomes covered with this intricate ramification, which but for the assistance derived from observing the courses of the rivers, would almost bid defiance to any analysis. The longest of these, is that which separates the principal branches of the Ganges Proper; the Bhageerettee and the Alecknunda, of the Jumna; the Jumna Proper, and Fouse, and of the Kalee; the Gunjeea, and the Ramgunga. These vary from fifty to 100 miles in length. It would be useless to enumerate the others, especially as they have no distinctive appellations. Nor would the enumeration add any clearness to our idea of the aspect of the country. Suffice it to say, that as they descend in the scale of subordination, they become shorter, and diminish in elevation.[15]

25. All the passes leading into the country of Oondes, are situated in the main chain, it being indeed the only one, as will be evident from the foregoing description, necessary to be traversed between the Dooab and valley of the Sutlej, unless for the convenience of a better road, or more regular supplies. These passes have all, with the exception of three, been visited, and their height above the sea determined, excepting the main pass, of which though supposed to be the highest, it is to be regretted Mr. Tate, the Surveyor, who visited it has left us no measurement. The higher points of the chain are not so well ascertained in all their details, owing partly to their not being visible, and partly to an idea which has prevailed of their great inferiority to the southern peaks, or those included within the Gangetic basin, and consequently ramifications from this chain.

26. It appears however to be sufficiently established, that from latitude 31° 23′, longitude 77° 50′, the elevation of this chain is considerable, being with the exception of a few passes, clothed in the livery of snow all the year round. Its tendency to fall off in that direction is evinced by the gradually decreasing height of the passes, and from the latter point to its termination, little snow is seen, excepting during the winter months. In latitude 30° 35′, longitude 17′, the 77° elevations of what

15 This is to be understood, however, only in a general sense, as in many instances the subordinate ridge rises to a greater elevation than that from which it ramifies.

may be called one of its passes is only 2,500 feet. A little beyond this it is lost in the plain country.

27. The following Table of heights contains every point measured in this chain, and the accompanying section embodies the particulars. I have included the names of a few passes, which though not measured, appeared worthy of notice, either as forming frequented points of communication with Oondes, or as presenting unusual difficulties to the few venturous mountaineers who have attempted them:—

Table of the Elevations of the Principal Peaks and Passes of the Indo-Gangetic Chain.

Peak or Pass.	Elevation.	Remarks.
	Feet above Sea.	
Pass to Tuklakot, ...	17,598	This Pass is on the N. E. corner of the Mountain Tract, and leads to Tuklakot, a Chinese or Thibetan factory.
Koontas Peak, No. 2, ...	20,992	
Koontas Peak, No. 1, ...	22,141	
Labong Pass, ...	18,870	
Danna Pass (at least,)	18,000	Not measured
Jowahir Pass (at least,)	17,000	Ditto, ... These are two of the most frequented, the first is easy, the other difficult.
Neetee Pass, ...	16,814	....
Mane Pass (said to be,)	18,000	Visited, but not measured.
Neelung Pass (probably,).....	16,000	Is said to be very easy of access.
The Cone (Snowy Peak,).....	21,178	These Peaks are visible from the Plains, they give rise on the Southern side to the Tonse.
No. 39, vide As. Res., 14 vol.	19,481	
L. Ditto, ...	19,512	
The Needle, ...	19,064	
Goonass Pass, ...	15,459	A good deal of snow in Sept.
Borando Pass, ...	15,000	Much snow in June.
j (Snowy Peak, vide as above,)	17,425	
i Ditto, ...	17,331	
h Ditto, ...	17,337	
g Ditto, ...	17,035	
Shatool Pass (at least,)	15,600	A very difficult Pass.
d	17,174	
C	16,982	
a	17,044	
Pass below Bagee Fort, ...	9,039	The range has here a S. W. direction.
Pass below Bagee Fort, ...	9,039	
Whartoo Peak, ...	10,673	
Nagkunda Pass, ...	9,000	
Theog Fort, ...	7,926	

Peak or Pass.	Elevation.	Remarks.
	Feet above Sea.	
Mahasoo Temple, ...	9,265	The Camp was 8,965 feet, temple 300 more.
Juke Peak, ...	8,120	
Tarba, ...	5,000	
Kimdera Pass, ...	4,989	
Kol Peak, ...	7,612	
Ujmergurh, ...	4,000	
Bhoora Peak, ...	6,439	
Suran Village, ...	5,500	
Bonytee Debee,...	5,120	
Jytuk Fort, ...	4,854	
Gutasun Debee,...	2,500	Not measured.
Sandstone Hills, ...	3,000	Ditto.
Foot of Hills, ...	1,500	Ditto.

28. A geologist of some eminence, and remarkable for the soundness of his views says, that "writers have erroneously confounded the line of greatest elevation with a chain of water-heads." If we take a survey of the present tract, we shall every where see this opinion confirmed. The range above described, is that which separates the two river systems of the Ganges and the Indus, the principal drains on the side of India from the central plateau. But it is by no means the highest ground, for it is within these basins, and not on their common boundary, that are found disposed those elevated peaks, the real height of which has so long formed a subject of discussion,[16] and from which, as considered the highest summits of the globe, this tract derives one of its principal sources of interest.

29. The term Himmala, generally applied to these peaks, means snowy, so that it is rather descriptive of a broad zone or belt, than of a series of peaks as distinguished from the lower ridges in their immediate vicinity. They have been called a chain, yet no term is less descriptive of the manner in which they are arranged; neither are they a

16 It is a curious fact in the history of science the extreme slowness and even unwillingness with which this result has been admitted. Theoretical considerations founded on an experiment in an air pump were held to be sufficient grounds for doubting of our Indian observers. "Jurare in verbo magistri" was the order of the day, and the authority of a name was considered sufficient to justify doubts of results which should have been judged of on their own merits alone. The infallibility of their own dogmas was never even questioned.

series of groups,[17] but rather of transverse ridges (at least within the basin of the Ganges,) which ramify from the Indo-Gangetic chain, over which they yet tower several thousand feet.

30. A line or plane connecting their summits will represent that of greatest elevation. It is evident from Art. 17, that it must cross the Indo-Gangetic chain. It is nearly certain, that in like manner the highest summits of the next portion of the great circular barrier are to be found within the basin of the Indus, and the line continued still farther would doubtless cross the separating chain of the Oxus.[18] Whether this arrangement holds all round, or how far; what is the elevation of this line in every part of its course; of these points, and of many others equally interesting, we are entirely ignorant.[19]

31. But we do know, that from the Hindoo Koh, or Snowy Mountains of Cabul, to the peaks visible from Patna, this line or plane never sinks for any distance below 21,000 feet. Lieutenant Macartney measured one of the former, and found the height 20,493 feet;[20] and in 1815, when with my corps on the Goruckpore and Betwah frontiers, I determined

17 On design communement toutes les elevations de terrain, pour peu qu'ils se prolongent, sous le nom general de chaines. Mais il est certain que les montagnes forment plus souvent des groupes que des chaines. Mais les chaines les plus apparentes ne sont souvent que de Lignes de groupes "Malte Brunn Precis de la Geographie," tom. 2, p. 160.

18 It has been thought otherwise: the Himmalaya have been supposed to find their continuation through Persia, and the chains of Taurus and Caucasus as far as the Caspian Sea. The point may, however, easily be settled, for it appears from Captain Christie's Journal, that there is no snow on the mountains in the neighbourhood of Herat, and it is known from the Ayeen Akberry, that the journey from Bokhara is unattended with difficulty. It is therefore evident, that the Himmalaya, as such, have no continuation in this quarter. But it may be said, and with truth, that the phenomenon of snow is no test of the identity of a chain or ridge of mountains. The Himmalaya, however, is no chain, as I have already shewn, and when we speak of these peaks as constituting a series, it is either as snow-clad summits, or as the highest in their immediate neighbourhood. Considered in either of these lights, their continuation must be sought in the Beloor Tag, and that these are situated within the basin of the Oxus, admits of little doubt. Lieutenant Macartney appears to have been puzzled with regard to this point, but this was owing to the mistake he fell into regarding the course of the Indus. He at once decides against the common opinion. Vide also Rees' Cyclopædia. Art. Altai Belur.

19 The papers of Mr. Moorcroft and Mr. Trebeck, should they ever be recovered, will doubtless supply many interesting particulars on this subject, and it would be extremely curious to compare their results with what is here hypothetically stated.

20 So in the account of Cabul, but from the data given, allowing one-tenth for refraction, I find 19,470; doubtless the place of observation is elevated 1,000 feet or more above the sea.

one of the latter to have an elevation of 27,000 feet.[21] Those who have travelled through Oude, within a sufficient distance of the mountain tract, know that the series continues in all that line without any such inferiority, at least as the eye can detect. This is a presumption, if it be no more.[22]

32. The fact, that in a line of 500 miles two summits are found exceeding five miles in perpendicular height, not isolated, but connected to appearance by a regular series of peaks of very little inferior elevation, is alone calculated to give us a lively idea of the enormous magnitude of this mountain zone. It is almost certain, that if we confine ourselves to 21,000 feet, we may find a connected line of such peaks extending through a distance of 1,000 miles. When I say connected, I mean without any apparent breaks, because as already noticed of those within the basin of the Ganges, it is probable that they are not connected in reality, except through the line of water-heads from which they ramify.

33. But, it may be asked, how shall we be certain that this is really the line of greatest elevation, and that is on this side the highest peaks are within the river districts, and not on their boundary; may they not be so likewise on the other side, and consequently there be found in the basin of the Indus, as suggested by M. Humboldt, still loftier summits than those which distinguish that of the Ganges ?

34. To this it may be answered, first, that as we have already seen this line of greatest elevation is undoubtedly prolonged into the basin of

21 This is the peak mentioned by Mr. Colebrooke, (As. Res.) under the name of Dhawala-giri, or the White Mountain. Captain Webb, whose measurement he reports, found nearly the same result. Captain Blake also, when employed as Surveyor on the Goruckpore frontier, found the same height nearly. I consider my measurement as less exceptionable than either of these, for the following reasons :—

(1.) The position of the peak depends on a traingulation established from a base of 1,142 feet measured with a chain, and not from the protraction of the route, the angles being taken by an excellent sextant of Berges. (2.) The angle of elevation was taken repeatedly, and at different seasons, by reflection from mercury with the same sextant. (3.) A much nearer approach to the peak was made one of the stations, being distant only seventy miles, whereas the nearest of theirs was 120 miles.

22. It would be very desirable to have the positions and elevations of the principal summits along our frontier fixed with tolerable correctness. Such a task would not be either difficult or tedious, provided the attention were confined to those points alone. It would form the very best foundation for a correct map of India, for these peaks once fixed, every place from whence they are visible, may be settled with equal precision, and thus afford means of correcting the Easting or Westing of our protractions, which is the great desideratum. This subject has been noticed by Major Hodgson in the paper in 14th vol. A. S. Res.

the Indus, and most probably into that of the Oxus also, that in some part of this line there may be peaks higher than those in the Gangetic basin is possible, nor can we assign any reason, why it should be improbable. But that there is a higher chain, or series of peaks, beyond the Sutlej, parallel to that which we are considering, is an opinion which is supported by no probabilities whatever.

35. Undoubtedly the subject is even yet involved in some obscurity, which cannot be fully cleared up till all the particulars in that quarter become known. The only direct evidence which we possess on the subject is unfavorable to this conclusion. Mr. Moorcroft, who crossed, and Captain Webb, who visited the Neetee Pass, are both silent as to the existence of such loftier peaks to the N. or N. E. In my journey to lay down the course of the Sutlej I found that after passing this line, all the loftier peaks appeared to the Southward, while those to the North were of a totally different character, rounded summits, almost free from snow, and evidently of less height. In like manner in ascending the height above Shipkee, (16,000 feet), the peaks to the N. E., East, and S. E., were of this character, while to the S. and S. W. appeared those of the true Himmalaya aspect.[24] Nor does Captain Webb, in his visit to the head of the Kalapanee river, notice any high peaks as being visible to the N. or N. E., though he was then not twenty miles from the lake Mansuror.

36. We are justified then, by all that we know of this elevated tract, in considering it as unconnected altogether with the disposition of the water-heads. Nor can any principle of arrangement be traced which will allow of our proceeding one step beyond that point, at which our positive knowledge of the subject terminates. We may, if we choose, guess, that beyond this, another line still higher may be found, and we may even add a third, still more lofty, but we must be contented to have these conclusions considered as mere guesses too, unsupported by analogy, and having no claim whatever to be received even as probable.

23 Further reasons will appear for doubting the existence of a series of loftier summits to the North, when we come to the geological details. Strange that Europe should have been so slow to acknowledge the actual height of the Himmalaya; still stranger, that being unable any longer to deny the accuracy of the measurement, a higher range must be supposed to the North of it, so that it may still be averred, they are not the highest.

24 Vide *Asiatic Society's Researches*, Vol. 15.

37. It should be noticed, however, that the term line is incorrectly used, or at least with great latitude, and even substituting that of plane, it is still necessary to bear in mind, that its direction, whether as referred to a great circle, or the loxodromic curve, is by no means uniform, or even regular in its deviations; unless indeed we regard it as of considerable breadth, and in that case its surface would be very irregularly studded with peaks. In this way we may certainly affirm, that it is parallel to the common boundary of mountain and plain land. In fact, it is impossible to contemplate such masses disposed along such a distance without feeling convinced, that there is some connection between the greatness of their elevation, and the original formation of the mountain systems in which they are found. The parallelism becomes more obvious when we consider a more extended tract.

38. The following is a Table of all the results hitherto measured, distinguishing also the river basins within which they are situated :—

		Captain Webb.		Major Hodgson.		
No.	Designation or Names.	No.	Elevation.	Letter.	Elevation.	River Basin.
						...
		27	20,923			...
		26	21,045			...
		25	22,277			...
		24	22,238			...
5		23	22,727			...
		22	19,497			...
		21	19,099			...
		20	20,407			...
		19	22,635			...
10		18	21,439			...
		17	19,153			...
		16	17,994			...
		15	22,419			...
		14	25,669	A No. 2,	25,749	...
15		13	22,313			...
		12	23,263	A No. 1,	23,531	...
		11	20,686			...
		9	21,311			...
		,,	...	A No. 3,	23,317	...
		8	23,164	B.	23,441	...
		7	22,578			...
		6	22,498			...
		5	19,106			...
		4	21,611	U.	21,612	...
		3	22,810	D.	23,062	...
		"	...	Q.	19,928	...

No.	Designation or Names.	Captain Webb. No.	Captain Webb. Elevation.	Major Hodgson. Letter.	Major Hodgson. Elevation.	River Basin.
						...
		3	19,938	Q. C.	19,530	...
		„	...	C.	21,940	...
		2	22,058			...
		1	22,345	M.	22,792	...
	St. Patrick,.....	„	...		22,798	...
	St. George,.....	„	...		22,634	...
		„	...	F. C.	21,772	...
	The Pyramid,.....	„	...		21,379	...
35		„	...	F.	21,964	...
	Sree Kanta, ...	„	...	G.	20,296	...
	Rudra Humdah, ...	„	...		22,390	...
	Serga Raur, ...	„	...		22,906	...
	Bunder Pooch, ...	„	...	E.	20,916	...
40	Another summit, ...	„	...	E.	20,122	...
	Shippure, ...	„	...		18,681	...
		„	...	C.	21,155	...
		„	...	H.	20,668	...
		„	...		20,501	...
45	Peak visible from Jhala, ...	„	...		18,795	... ...
	Ditto Twara, ...	„	...		19,352	...
	The Cone, ...	„	...		21,178	...
	Raldung,.....	„	...		21,411	...
	Rishee Gungtermy,	„	...		21,389	...
50	Poorkyol, ...	„	...		22,700	...

39. In judging of the comparative direction of these summits and those of the Andes, it is not sufficient to be told that the highest of the former overtops Chimborazo, the principal summit of the latter, by nearly one mile of perpendicular altitude; for this single fact, great as is the difference which it implies, falls short of giving a competent idea of the subject. Let us take the highest summits of the Cordilleras measured by Humboldt, and those of the Andes of Peru by Condamine, and others. Although not the same chain, they are situated on the line of greatest elevation, and in both these particulars, they correspond with the Himmalaya. According to Myers, they are as follows :—

Chimborazo, ... 21,441
Desea Cassada, ... 19,570
Cayambe Area, ... 19,336
Cotopaxi, ... 18,891 or 19,155 according to others.
Antisana, ... 19,149

Popocatepetl, ...	17,716 or 17,734
Chillatepetl, ...	17,371
Illinissa, ...	17,238

From this list it would appear, that there is but one summit elevated more than 20,000 feet, and only five which exceed 18,000.

40. Of the fifty-one measured peaks of which we have given a table, there are twenty-eight as high, or higher than Chimborazo, and there are forty-four as high, or higher than Desea Cassada, the second summit of America. Popocatepetl, the sixth in order, is overtopped by not less than 100 summits within the limited tract we are considering; many of the passes even (which are the lowest points) in the Indo-Gangetic range, (which as I have before stated is not the highest ground,) exceed in elevation the sixth summit of America. These facts may perhaps give a more correct idea of the great difference which exists between these two tracts, the loftiest on the globe, and the most remarkable in every point of view. If the rivers of America (and even this is doubtful) exceed in volume and length those of the Old World, at least the mountains must yield.*

41. The great elevation of these peaks is scarcely more striking than is the depth of the vallies or hollows which separate them, and which are always the beds of the rivers. Thus the Poorkyool Peak towers to a height of 22,700 feet, while its base is washed at a horizontal distance of five miles by the waters of the Sutlej; the bed of which river has here only an elevation of 9,500 feet. The difference is 13,200 feet in five miles. In like manner the difference of elevation from the summit of the Kuldung Peak to the Sutlej, in a distance of five and half miles, is 14,711 feet. Of the Soommeeroo Peak to the Mundaknee, distant four miles, 11,000; of a peak (No. 17, Captain Webb's list) to the Gurjeia, distant two miles, 12,370; of the Jowahir Peak to the Goree, distant eleven miles, 15,749. These vallies are far beyond any thing that is to be seen in the Andes.[25]

25 Although the Andes have no river vallies comparable in depth with these, yet there are some chasms, as they should rather be called, which taking together their

* Our author was, it will be remembered, writing before Mr. Pentland's measurements of Sorato 25,400, Illimani 24,350, and Descabezado 21,100 feet.—H. P.

42. The above list, if it were thought necessary, might be much increased. It is very true that they are nearly consequences of the manner in which these peaks are disposed, but it is this very disposition which is so singular, and worthy of remark. It is the extraordinary elevation above the ground on which they immediately stand that is so striking to a traveller within these mountains, because it is at once taken in by the eye, and requires no consideration to aid the effect. It is different with summits placed on an elevated table land, where we are continually obliged to remember the height of the latter, and even with this assistance, they fail to astonish and confound the imagination in the degree that a nearer view of the Himmalaya is found to do.[26]

43. I must remark here, that the instances given above, belong to a fact which is general throughout these mountains, and which as it is very striking, and seems capable of throwing some light on the mode of their origin, ought not to be passed over. It is this: wherever the separating ridge of two river vallies approaches the banks of one of them, there is its highest point; and where it holds a middle course for any distance, it is there found to be lowest; equally throughout the higher and the lower mountains will this remark be found to hold good, nor am I aware of a single exception to it.

44. But it is chiefly as snow-clad summits on the border of the Torrid Zone that these mountains have attracted attention. It is probable that but for this phenomenon, their elevation would have remained to this day a desideratum. To the inhabitant of the plains, who being under a summer temperature of nearly 100°, is exhausted with heat, it is certainly a phenomenon full of wonder. To those too who consider the heat to be in the sun's rays, (the bulk of common observers,) the wonder must be greatly increased, as the summit of the mountain is nearer by five miles to the sun than the plains at its foot; even the scientific observer cannot entirely divest himself of that feeling of admiration, which the sight of any thing so unusual to his common ex-

depth and extreme narrowness, are very striking. M. Humboldt mentions several of these, one of which though it be not 3,000 feet across, is yet upwards of 4,000 feet deep. Captain Hall too, notices the depth and steepness of the ravines or *quebrados of Chili.*

26 But as these mountains are elevated on the high plain of Quito, which is elevated farther above the sea than the top of the Pyrenees, and constitutes more than one-third of the computed height, they are inferior in actual elevation to Mont Blanc. See Rees' Cyclopædia, Art. Andes.

perience, however agreeable to the deductions of science, must necessarily excite.

45. It is this phenomenon which has always occasioned them to be objects of attention, and it is singular enough that it is also on erroneous considerations connected with this phenomenon that the doubts of their superior elevation have been founded. I shall include under the remarks on climate, what I have to offer on the theory of the subject and the arrangement of the Isothermal bands. I shall here confine myself to a statement of a few of the most interesting particulars connected with the occurrence of this phenomenon.

46. It will be readily understood, that according to the season of the year, the zone which is marked by snow will be of more or less extent. If we take our estimate in that month in which the quantity is a minimum, and after which there falls more than melts, we may satisfy ourselves that a belt of ten to fourteen miles in breadth is distinguished by this phenomenon. It is not meant that snow lies in every point of this tract, but merely that within it will be found summits bearing snow all the year round. The minimum elevation of this snow-bearing tract is nearly in round numbers 15,000 feet, which may therefore be taken as the elevation in this latitude of the curve of perpetual congelation. There are, however, many spots of greater elevation perfectly bare of snow, this fact is, however, connected with a different arrangement of the seasons, and will be noticed in the section on climate. At all elevations exceeding the above, where snow lies, it is generally quite firm, except immediately after a fresh fall.

47. Many parts of this zone have such a disposition of the surface that it is quite impossible that any part of the snow which falls should ever be lost, except by melting, or by evaporation. The loss from the former cause must be very little at elevations much exceeding 15,000 feet. At 18,000 it must nearly cease altogether. The loss from evaporation will doubtless be considerable under so rare an atmosphere, still however we may safely conclude, that a surplus is left every year to accumulate. In favorable situations, we may imagine then the depth of these snows to be very great. In fact, we may suppose a case, without hazarding any improbability, where they have been yearly increasing since the origin of these mountains. Such supposition is calculated to give us a stupendous idea of the magnitude of these deposits.

48. We have seen that the line of greatest elevation intersects instead of bounding the river districts (Art 30). On each side of this line to the north as well as to the south the peaks diminish in elevation, yet not equally. To the southward the decrease is more rapid, and is accompanied by an anomaly which is sufficiently striking. The diminution of elevation, which is pretty regular till near the boundary of the plains and mountain land, is there suddenly interrupted. The peaks shoot up considerably above the mean elevation of those immediately north of them, and as suddenly sink into the plains; so, that if we divide the country, south of the line of greatest elevation, into five parallel zones, the fifth will be as high as the third, while the fourth will be found considerably lower than either.

49. Some of the most remarkable instances of this fact are the following: The Ghagur, which rises above Bhumowree, has one of the lowest of its passes, in a road distance of fifteen miles, elevated 7,121 feet above the sea. Another instance may be seen in the high range south of Sreenugger. A third in the Soorkunda range, as connecting that peak with Bhudraj. The latter overlooks the Doon, the former is but fifteen miles from Dhera, situated in the centre nearly of the valley, yet their altitudes are respectively 7,510 and 9,271 above the sea. The Jamoo Peak is another example. The Bhoora Peak a still more remarkable one. The latter elevated 6,439 feet above the sea, appears actually to overhang the lower hills which form the transition from its foot to the plain country. Many more instances might be adduced, were it necessary to multiply the examples. If a surface be supposed, such as to represent everywhere the mean elevation, that surface will not be inclined regularly plane, but will have a considerable curvature.

50. Another curious feature in the physical structure of this mountain tract is the situation of the high peak called the Choor. Its summit is elevated 12,149 feet above the sea, and if it be made the centre of a circle of sixty miles diameter, the circumference will on one side just fall on the common boundary of plain and mountain land, while within this circle, no point will be found within 15,00 feet of this height, and even those mountains which approach this limit, are, strictly speaking, part of the chain of which the Choor is the highest peak. From whatever quarter it be approached, it will be seen from very great distances standing up above the surrounding ridges like a huge beacon,

at once remarkable for its superior elevation, as for its peculiarity of form. The investigation of its geological structure must, for these reasons, be found very interesting.

51. Of the several rivers and streams by which the drainage of the Gangetic basin is effected, some have their origin from the Indo-Gangetic chain, that is, from the farthest side of the snowy zone, others spring from various points within that zone, or from its southern face, and a third class from the lower mountains where snow only rests a few months in the year. To the first class belong the principal sources of the Kalee and Ganges Proper, the Kalee, the Dhoalee, and the Sooree, branches of the former. The Dhoalee, the Bishun Gunga, and the Jahnuvi of the latter. To the second class belong the subordinate branches of these two rivers, and the principal ones of the Jumna, that is to say, the Ram-Gunga and Surjoo (Kalee); the Pindar, Mundaknee, Kalee, Bhillung and Bhageerethee, (Ganges); and the Beraee Gunga, Jumna, Soopin, Roopur, Pubbur, and Andryttee (Jumna). To the third class, which is the most numerous, belong all the other branches of these rivers, but six of them only require mention, as being at all remarkable. Of these, three pour their waters into the principal stream within the mountains. These are the Luddeea which joins the Kalee, the Nyar which belongs to the Ganges, and the Girree a branch of the Jumna. The other three have a considerable course within the plains. The Cossillah and Ramgunga join a little below Mooradabad, and with the united stream, eventually contribute to swell the waters of the Ganges. The Murkunda, the third of these, loses itself, it is said, in the sands of the Desert.

52. Amidst so many branches, it may seem difficult to fix on that which is entitled to the pre-eminence, and to be considered as the principal source of the river. If, however, we recollect that the most distant source must be the most elevated, and must have contributed the largest supplies, we shall have a principle of selection, easily applied, and which leads to some curious results. In particular, it will appear, that the Soopin is the parent stream of the Jumna, and its source must therefore be the principal one. Of the Ganges, neither the Bhageerettee or the Dhoallee, so long considered rival sources, is entitled to that distinction. In reality, the Jahnuvi is the most distantly derived of all its branches, and must therefore be admitted to be the real source of this great river. Singularly enough too, of all the mountain rivers, this is the only one

that has not been traced up to its origin, owing to its being within the limits of Chinese authority; the conclusion then is inevitable, that however we may pique ourselves on having visited and fixed the sources of the Ganges, the position of its most elevated and distant source is still a desideratum. Nor has the first beginning of this mighty river been yet beheld by European eye.

53. The following Table gives the particulars from which the foregoing conclusions have been drawn. It exhibits the distance, in miles measured along the river's course, of each source, taking as the point of departure, the place where the river enters the plains.

Name of Branch.	*Dist. of Source.*	*River Basin.*
Kalee, ...	180	
Dhoalee, ...	180	
Gungeea, ...	165	Kalee.
Ramgunga, ...	127	
Surjoo, ...	143	
Dhaolee, ...	225	Ganges.
Bishunnunga, ...	202	
Jahnuvi, ...	233	
Pindur, ...	203	
Mundaknee, ...	150	Ganges.
Kalee, ...	143	
Bhaeergettee, ...	203	
Bhillung, ...	150	
Jumna, ...	123	
Bheeraee Gunga, ...	124	
Tonse (Soopin), ...	154	Jumna.
Pubbur, ...	150	
Roopur, ...	143	
Andryttee, ...	145	
Sutlej, ...	555	Sutlej.
Cossillah, ...	100	Kalee.
Ramgunga, ...	105	
The Ludhee to its confluence, ..	.. 52	
Nyar, ...	82	
Girree, ...	112	

54. The sources of these rivers which spring in, or from, the Snowy Zone, are elevated from 10 to 17,000 feet, the first being that of the Jumna, the latter of the Sutluj, the two extremes. There is evidently some connection between the length of a river course and the elevation of its source. I find from a comparison of those which flow in the same direction, and which may be consequently supposed to have the same declivity, that the height of the source above any given point is as the square root of the distance from that point. Thus the Jumna, Kalee, and Bhagerettee are respectively elevated above the points where they enter the plains, 9,573 feet, 10,593 feet, and 12,776 feet, which results are as the numbers 10, 11, 6, 12, 9. Their distances from those points are 123, 143, and 203 miles, the square roots of which are as the numbers 10, 11, 1, 13, 3, differing by less than unity from the preceding.[27] The Sutlej will not bear a comparison with these, because its course *is* in a different direction, and has not consequently the same declivity. In the direction of its course, its great length, and the little aid it derives from accessory streams, it forms a strong contrast to all the other mountain rivers.

55. A feature common to all the water-heads that belong to the Snowy Zone, is their situation always in a comparatively open and level spot, with an accumulation of snow resting against the base of some lofty peak, from which the embryo stream derives its first supplies. According to the season of the year, the snow-bed will be of greater or less magnitude and depth. During many months, the place will be deep in snow, and unapproachable. After the snow begins to melt, a constant moisture is kept up for many months, while in the fine season again, vegetation goes on luxuriantly. The consequence is, the formation of a thick coating of peat, which is invariably found at all elevations, having a temperature such as to ensure during several months the slow and gradual melting of the accumulations of snow that occur during the winter. From 11,500 to 13,000 feet, according to locality, may be considered as the height at which peat will be found. It is always however

27. This law is not applicable to different parts of the same river's course, and yet it gives very near approximations in the case applied. Thus if from the distance in miles of any source from the *debouche* the square root be subtracted, and multiplied by 882, the product is the height in feet above the *debouche*. This would give 12,221 feet as the height of the source of the Tonse. The result by the temperature of boiling water was 12,784

in greatest quantity, and of a better quality in such spots as above described; that is, in hollows; because the supply of water is more constant, and equally gradual.

56. The discharge of the four great rivers at their entrance into the plains, has not been directly measured, except in the case of the Jumna. It appears however reasonable to infer, that the discharge will be proportionate to the extent of country drained; in other words, to the total length of course made up by adding the several branches of the river together. This rule I found to hold in the case of the Tonse and the Jumna, the discharges of which I measured in 1819. Thus, their total lengths of course were as the numbers 1, 2, 6. Their discharges as the numbers 1, 2, 8. In adopting then this expression for the valuation of the discharge, and taking the Jumna at 4,000 cubic feet in a second, (which is within a few feet of the result I obtained in March 1819,) we shall have the following results:—

	C. F. in one second.
Discharge of the Kalee at Bishin Deo, ...	4,800
Jumna at Badshahee Mahal, ...	4,000
Ganges at Hurdwar, ...	7,000
Sutlej at Ropur, ...	8,100

We see here that, notwithstanding the far greater length of course which distinguishes the Sutlej, (more than double,) it does not greatly exceed the Ganges in discharge. This is owing to the comparative narrowness of its basin, and its want of great branches.

57. Although there are no great vallies in the interior, (Art. 15,) yet along the common boundary of mountain and plain land, on a line parallel to that of greatest elevation, there are seen a series of small vallies, which are however unconnected with each other, and sometimes separated by a long interval. These vallies are always marked by the *debouche* of some great river, and there is doubtless some connection, in the origin, between them and the river systems. Although there is not a valley to every river, yet they are found along the whole tract at intervals, as far as Patna on one side, and beyond Cashmeer on the other. The occurrence of these vallies through such a distance, and so symmetrically situated, favors the idea which would attribute a community of origin, or at least connection in structure, to the whole of this tract of Alpine land.

58. Those belonging to the tract to which the present description is confined, are the Pinjore Doon or valley, the *debouche* of the Guggur; the Kyarda Doon, the *debouche* of the Jumna and Ganges; and the Pattee Doon, the *debouche* of the Ramgunga. They are all bounded, or separated from the plains by a low chain of hills, which is also a line of water-heads, and contains the sources of those streams which, engulphed in the tract immediately at their feet, afterwards spring up in the Teraee, occasioning the humidity of soil which is so characteristic of that tract.

59. The Dehra Doon, which is the principal of these vallies in extent, and probably the only one demanding a detailed description, is from the Jumna to the Ganges about forty-five miles in length. Its breadth is variable, being in some places scarcely ten, in others fifteen miles.[28] The surface is undulated, and has, in particular directions, a strong declivity.[29] Many banks or steps occur, varying in height from one to thirty feet. These generally follow the course of the streams, one on each side; appearing to have the same relation to them which the Kadur, or marshy lands of the plains, have to the rivers there. Their distance, or the breadth of the channel they mark, is very considerable even in the case of the smallest stream, and they exhibit the same variations in arrangement which the river banks in the plains do.[30] There is little question but that they have once been the beds of running water, however incapable the present streams may appear of filling them even in their highest floods.

60. The drainage of this valley is effected entirely by the two rivers, Asun and Sooswa, which rising within a few hundred yards of each other near the middle of the valley, run in opposite directions, the former to meet the Jumna, the latter to the Ganges. The fall of these rivers is considerable; the elevation of the source of the Asun being 2,148 feet above the sea, and its confluence with the Jumna 1,469 feet, being a fall of 652 feet in little more than twenty miles. The fall of the Sooswa in a course

28 The admirable new road made by the Honorable Mr. Shore, leading from the Keeree Pass through Dehia to Rajpoor, at the immediate foot of the northern hills, measures, I think, fifteen miles.

29 The base which I measured in the Doon in 1819, had a difference of level of 300 feet between its two extremities. Its length was about four miles.

30 That is to say, a steep bank is always opposed to a low shelving one. When both are alike, neither are observed to be remarkably steep or shelving.

of about the same distance is 948 feet, its confluence with the Ganges having but an elevation of 1,200 feet above the sea. The course of these rivers is parallel to the direction of the valley, and very near the South-western boundary, so that their supplies are almost entirely drawn from the Northern barrier of mountains. The numerous feeders which spring from these, all flow across the valley, shewing, that there is a considerable declivity also in that direction. In fact it is found, that from Rajpoor at the foot of the hills, the fall is regular to within three miles of the Kheree Pass, and amounts to 1,300 feet. Thence to the Kheree Pass is a rise of 618 feet. This line is that of the new road; it passes through Dhera cantonment, and very nearly, if not exactly, separates the two basins.

61. The range of hills which bounds the Doon to the Southward, is of peculiar aspect, and presents some very interesting appearances. The total depth of this belt in the widest part is about ten miles. The range is not intersected by vallies with sloping sides, as the great mountain tract is, but by the beds of torrents which are generally bounded on each side by perpendicular precipices, sometimes 500 feet in height. The ridges are extremely narrow, so as to bid defiance to any examination of them, except such as can be effected in the beds of these torrents. The line of water-heads which separates the streams which seek the Doon from those flowing plainward, does not hold a regular course, as compared with the general tendency of the mountain belt, being sometimes at the border of it, as at the Lal Durwaza Pass, sometimes nearly in the middle, as at the Timlee Pass. The former has been stated to have an elevation of 2,935 feet, the latter is only 2,339. The peaks do not rise more than 600 feet above these levels, so that 3,000 to 3,500 may be taken as their general height.

62. The appearance of this valley is highly picturesque, particularly in the neighbourhood of Dehra. The intermixture of cultivation, in which the fields are defined by hedges, with patches of green, over which are scattered fine groves of trees, the undulation of the surface, and its intersection by numerous streams, are features that might almost remind one of the scenery of England. The proximity of lofty mountains occasionally clothed with forests, in which the pine, oak, and walnut are conspicuous, gives a variety to the landscape, which viewed at a favorable season, is picturesque and beautiful in a high degree. The soil is gravelly,

yet to judge from the cultivation, far from poor; and though at present thinly peopled, and but partially cultivated, was once otherwise. The land revenue had dwindled down to 10,000 rupees, when it came into our possession. It is said to have yielded 80,000 in the time of the Rajahs of Gurhwal. Under the fostering care of the British Government, it will not be long in recovering its former prosperity. The principal difficulty appears to be the want of water for irrigation, yet this is an objection easily remedied, for with so varied a surface, and so many streams, water might at a trifling expense be conducted in almost any direction. Capitalists are wanting to undertake this and other improvements.

63. The Pinjore Valley is the next in point of extent. It has in parts a breadth of perhaps six miles, and its length may be estimated at about thirty. It is tolerably even in its surface, and the hills which bound it to the Southward, are of much less depth and of less elevation than those of the Dehra Valley, at its South-east angle, in the *debouche* of the Gaggur, a river which is lost in the sands of the Desert. From Tuxal the streams run in one direction towards the Guggur, in the other towards the Plassia river, a feeder of the Sutlej. Pinjore, the principal village or town, with a fort, of masonry, is elevated 1,819 feet above the Seebar, which is at the foot of the mountain, and near the separating ground of the two river basins is 2,402 feet above the sea. Munsie Debee, a temple in the plains, just without the Doon, is 1,263 feet. From these results an idea may be formed of its declivities. It is not so well cultivated as the Dehra Doon, though it appears to possess equal capabilities.

64. The Kyarda Doon is of less extent than the last, having in its widest part but a breadth of six miles, and in length being but twenty-five miles. This estimate of its length supposes it to terminate at the Pass of Ghatusun Debee, where it narrows so much as to be scarcely entitled to the name of a valley. From Ghatusun, the elevation of which is 2,500 feet, the streams flow eastward to the Jumna. To the westward flows the Markunda, which enters the plains under Nahun Siki, on the Ghuggur. It loses itself in the sands of the Desert, so that we cannot refer it either to the Sutlej or the Jumna basin. I have however considered it to belong to the former, and Ghatusun I suppose the lowest point of the Indo-Gangetic chain. Of the Pattle Doon, I cannot give any account, as I have never visited it.

65. About thirty miles north of Almorah, or a little west of north, there is a small tract of rather greater extent than those to be hereafter noticed, and more uniformly level in surface. It is watered by the Gaomuttee and its several feeders, a river which joins the Surjoo, one of the branches of the Kallee at Bagesur. These feeders are very numerous, and the glens in which they rise being broad, with a level terrain, form by their inosculations with the principal one, the appearance of a considerable tract of open and almost level country. From Koolan to Retora is a distance of ten miles, in all which line the surface appears to have little undulation. The forest is not too thick, and yet from some unexplained cause, the tract is unhealthy in a high degree, so much so, as to be in a great measure neglected, and allowed to run waste. The elevation of Byznoth, a temple of some sanctity on the Gaomuttee, and which may be taken as the lowest point of the valley, is 3,800 feet; the villages are situated chiefly on the lateral ridges which divide the several subordinate glens.

66. In the beds of the different rivers there are, as might be expected, various spots of a limited extent, and of sufficient evenness of surface to be always objects of interest to the cultivator, though from their smallness, scarcely entitled to the denomination of vallies. These spots generally occur in an advanced part of the river's course, and being therefore the lowest places in the mountains, are necessarily the hottest. In general they are fertile, yet are all considered more or less unhealthy, particularly at the breaking up of the rains; and when narrower than usual, so notoriously subject to the *awal*, or jungle fever, as to be entirely neglected; instances occur in the bed of the Surjoo and Kalee. But where the width is rather greater, or the surrounding mountains not too lofty, they form the most populous, the most productive, and the most beautiful spots within the mountains. The width is seldom more than half a mile, but the length is sometimes considerable.

67. The most remarkable instances of this kind may be seen in the bed of the Sutlej at Soonee and at Dutnuggur; of the Bhagerettee at Teeree; of the Aluknunda at Sreenuggur; at Pannae of the Western Ramgunga along nearly the whole of its course; of the Cossillah for a distance of ten miles; of the Benee Gunga for about the same distance; of the Buspa at Sungla; the Sirjoo at Kubrol, of the Geree Gunga in a great part of its course; and in the Comoulda, one of the principal

feeders of the Jumna: several smaller streams are equally, if not more, remarkable; and in general, similar level, and comparatively open, spots are found at the heads of all the rivers.

68. To this class also belongs the series of petty vallies to be seen in the neighbourhood of Petorah, though not constituting the bed of a river. The largest of them does not exceed perhaps two square miles, but they are in such number, as to render that district one of the most productive, for its extent, in the mountains. They are generally connected by some narrow gorge, so that, in one quarter, a distance of five miles may be travelled in which the surface is almost perfectly even. The appearance of the country, owing to such a number of these local spots, and the consequent insulated situation of many of the peaks, is peculiar to that quarter, and very striking. In the neighbourhood of Dhooara Hath, about twenty miles from Haurel Bagh, a pretty extensive piece of tolerably level ground is to be seen, and similar pieces in the neighbourhood of the small lakes, which are to be seen about ten miles above Bhumowree, on the road to Almorah. With the exceptions here stated, (and their collective sum bears but trifling proportion to the total surface,) all is rugged and difficult, a succession of steep and lofty ridges and deep glens.

69. The lakes mentioned in the preceding article, constitute a feature in the physical description of this tract which should not be forgotten. They are, however, on a very small scale, compared with the grand system of mountains to which they belong. One of them, Bheem Tal, situated about ten miles above Bhumowree, on the Almorah road, is only 3,000 feet in length, by 2,400 in breadth; the depth, however, is said to be very great. It is situated at the lowest point of the valley, about three miles in length, and at some distance from it appears a considerable pool, which is at present connected with it by a running stream, the intermediate ground being marshy, and covered with flags. These circumstances leave no doubt in the mind of the spectator, that the whole of this valley once formed a lake, and it might easily be restored to the dominion of the water, by damming up the outlet, which the present lake has found for itself. The elevation of this spot above the sea is 4,200 feet.

70. About five miles east of Bheem Tal, is another called Nynee Tal, having nearly the same extent. A little beyond this is a third, called Nakoon-ka Tal, and besides this, some others of much less extent.

Within ten miles of Jytuk, near Nahun, is another called Ren Kee Tal. It is in breath about 400 feet, and in length, as measured by the perambulator, one mile and a half. In common with all the others it is said to be of great depth, and to abound with excellent fish. A pool at the head of the Tonse, called Resul Kee Tal, and thought by the mountaineers to be unfathomable, may also be mentioned. As likewise a similar pool at the head of the Dinee river, one of the feeders of the Bhageerettee. The waters of all these are perfectly sweet and tasteless.

71. Along the foot of the mountains extends a tract called Bhabur, which has been always I believe reckoned an integral part of the mountains, politically speaking; it is of considerable elevation, and is farther distinguished by an almost total deficiency of springs or running streams, excepting such as, issuing from the mountains with a large body of water and considerable force, make their way through it without having their waters engulphed.

72. It is bounded to the southward by a line of springs or water-heads, which is also the northern boundary of the tract called the Terrai, one equally distinguished with the former from the southern plain country, but occasionally annexed to it and occasionally to the hills. This tract is remarkable for its moisture, as the other is for its dryness. Water in the driest season, (March 1826,) is never more than thirteen feet from the surface, generally much less. It is intersected by numerous streams, which with the inclination of the surface, affords such facilities for irrigation, as to render the tract, when fully cultivated, highly productive.

73. The Terrai is defined in its southern boundary by a rise or step, which runs parallel to the common boundary of mountain and plain land. This rise is a very singular feature in the aspect of the country, and forcibly impresses the spectator with the idea of some great catastrophe in which water has been the chief agent. The height is variable, and occasionally is as much as thirty feet, sometimes it is sudden or steep; and it is then intersected by ravines, the effect of floods in the rains; sometimes it is gradual, and it is then liable to be mistaken for an undulation of the surface; sometimes it consists of two banks or steps, and occasionally even of three; a similar step or break in the surface is found to accompany the course of each of the rivers after quitting the mountains. In this case, it forms the boundary of what is called the *khadir*, which as may

be understood from what precedes, is a low tract of variable width within which the river has its bed. These appearances correspond exactly to the banks described as accompanying the rivers in the Doon.

74. The Terrai may then be considered as a very shallow valley parallel to the direction of mountain land, and the *khadirs* or low lands of the rivers, as so many transverse vallies communicating with it. This itself is a presumption that the rivers have not formed their *khadirs*, but this is further established by the fact that the *khadir* is widest in the vicinity of the mountains, and diminishes as the river flows southward, till at no great distance it disappears altogether. At Bhogpoor on the Ganges, the *khadir* is of great width, yet in the highest floods in the rains, the river never rises to its level. At Durra Nuggur, the *khadir* is from five to seven miles in width; such a valley could never have been scooped out by the stream which now flows there.

75. The Terrai being thus distinguished by a fall or step, is usually considered very low in comparison with the low country south of it. Such however is not the case, although so strong is the deception in looking at the face of the country, that few people can be persuaded of the truth of the matter. Yet a little reflection would be sufficient, without any thing like measurement, to shew that it is a deception. The streams which take their rise at the foot of the Bhabur all flow southward, with banks of nearly equal height, and currents of considerable force. And from the Bhabur, which is so high as to be visible to the eye, there is no sudden descent to the Terrai, the line of demarcation being traceable only from the presence or absence of the springs, or from geological considerations connected with the nature of the deposits.

76. The preceding will, I hope, give some idea of the physical features of the country I have undertaken to examine, without which the geological description must be in a great measure unintelligible. The two classes of facts are so connected, that it is impossible to separate them; each throws light on the other; and if we wish to trace those general relations which furnish the highest and most interesting discussions in this new science, we must begin by taking a clear, as well as comprehensive, view of the physical aspect and arrangement of the surface.

77. It is my intention to give in the first place the simple geological details as observed, in order that a clear idea may be had of what is ac-

tually known, as distinguished from what may be considered matter of opinion or inference, subjoining an attempt to combine these details into something like a systematic view of the general structure of the tract, adding such inferences and illustrations as have occurred to me in reconsidering the subject. In the geological details, I shall follow out the extent of each rock as yet observed separately, and in the order in which they actually occur, beginning with the highest zone, and descending gradually to the plains.

Section II.

GEOLOGICAL DETAILS.

78. In the zone of the Himmalaya, the only rock which I have yet observed, I mean as covering any extent, that is, as constituting a formation, is gneiss; other rocks are found it is true, but only in the form of veins or beds. Gneiss has been traced from Deao, opposite Muzzoolea near Seran in the western corner of the Survey, by Brooang in the valley of the Buspa, and thence ascending to the Snowy Pass of the same name, leading into the valley of the Pabur. In this line the varying level, (5,500 to 15,000 feet,) leaves no doubt of the great thickness, as well as lateral extent of this formation. It is not, however, every where equally obvious, the coating of debris being often of great thickness and covered with luxuriant vegetation. Frequently the only trace of its occurrence consists in large angular blocks lying on the surface or imbedded in the coat of debris. This may perhaps be considered inconclusive evidence of the existence of this rock as a formation, but the case admits of no other, and the same difficulty meets us at every step in these mountains, and as no fragments or any other traces occur, or any other rock in this tract, with the exceptions I shall presently mention, we shall find a difficulty in saying what rock is found below the surface, if we find it necessary to deny the existence of gneiss.

79. This rock is of the most ordinary character in the greatest number of instances, consisting of quartz, felspar, and mica, and nearly in the usual proportions. It seldom contains any foreign imbedded mineral. The felspar is almost always white, seldom grey, and only

in one instance of limited occurrence have I observed it of reddish hue. The quartz is most commonly white and semi-transparent, occasionally grey; the mica is of all shades, varying from silver white to a deep brownish black; some specimens contain both extremes of colour.

80. There are three distinct types of structure in this gneiss, two of which are well separated, both in appearance and position. The laminar which is often contorted, the granular,[31] in which the laminar structure is often obscure; and what may be termed the glandular. The first two appear to pass into each other, and to be irregularly mixed together, but the third preserves a great uniformity of appearance over a considerable tract. It has really the laminar structure as strongly marked as the first, but it is well distinguished from it by the imbedded lenticular, or round nodules of felspar which it contains, and which give it a most peculiar appearance. The laminæ are bent round these nodules, which have a foliated structure, and are sometimes disposed in two layers; the line of junction, which coincides with the axis of the nodule being so faint as only to be perceptible by the varying reflection of light from the two parts. There is very little doubt but this line of junction coincides with one of the faces of composition of the mineral, but I have not yet established this point to my satisfaction.

81. The dip of this rock appears involved in some obscurity; along this line, at least it presents some anomalies, the explanation of which I have yet to learn. This may be, nay doubtless is, partly owing to the frequent concealment of the rock beneath the coating of debris, leaving us in these cases to form our judgment from the configuration of the mountains, with reference to the sides of slope and precipice. Even this test sometimes fails, either from the great accumulation of debris completely modifying the superficial forms of the rock, or perhaps from the absence of definitely marked stratification. For even occasionally when the rock itself is visible, there occurs doubt as to this point, the fissures being so numerous and variable in direction, as to render it impossible to pronounce which are, and which are not the lines of stratification.

82. From Deao to Kungos, the dip appears to vary between N. and E.,

31 By this term it is not meant to designate the granitic structure, but an aggregation of small grains, in which the difference of the felspar and quartz is often difficult to be ascertained.

being often N. E., and this on both sides of the Sutlej, the angle of inclination being about 30°. One measurement gave N. 70° E. But near Nichar, again it appears to be to the West of North, the inclination still much the same, or even less than 30°. A very remarkable rocky precipice occurs opposite this village, traversed by numerous rents and fissures, but nothing can be traced like marks of regular stratification; nor can even a line from the neighbouring strata be fancied to connect with any of them; yet from the appearance of the rock, I have not a doubt but that it is gneiss. Near Keelba, there is a considerable access to the rock, which is a perfect laminar gneiss, yet nothing like the regularity of stratification is observable in it either, the lines running confusedly in every direction.

83. At Woongtoo bridge, the stratification is also very obscure, and the natural divisions of the rock very various in direction, but as the laminar structure, which is, or ought to be, discriminative of gneiss is here often obscure, if not altogether wanting; the rock by many will perhaps be considered a granite. A few miles beyond this bridge, with an interval of distinctly stratified rock, a similar amorphous mass is seen on the right bank of the Sutlej, surmounted by regular strata of gneiss dipping S. W., but presenting that arrangement which has obtained the name of wedge-shaped strata; the upper layers approaching more and more to the perpendicular position. On this side (the left bank) is a similar mass of gneiss, but with an opposite dip, (that is to N. E.), and with the same arrangement, the inclination of the lower strata being inconsiderable, while the superficial are nearly vertical. This appearance struck me very much, coming on me, as it did, after a long and patient examination of the Woongtoo rock.

84. Beyond the irregularly seamed rock noticed as occurring near Keelba, we find a perfectly stratified arrangement continuing from a considerable distance, the dip pretty regularly N. E. and the inclination between 20° and 30°. This is the glandular type noticed article 8. On turning up the Buspa, below the village of Brooang, extensive types of stratification are seen, but with a S. E. dip, and an inclination of about 25°. This dip continues in the ascent to the Pass as long as any thing like stratification can be perceived. But in the last 4,000 feet of ascent, the rocks again put on the shattered and fissured appearance before described, and on the Pass itself, nothing like stratification can be traced, owing to the

intricacy of these seams, and the various directions in which they lie. But of the identity of the rock there can be no doubt, as I examined it along the whole of this line, and collected numerous specimens. It is a gneiss of the most perfect type. The Pass is strewed, as might be expected from the appearance of this rock, with huge angular blocks. I may add, that on the South side, a N. E. dip is again met with, but accompanied by a considerable change in grain, and a thinner laminar structure. This observation was made at an elevation of about 12,000 feet above this; all around, the ridges appeared with the same fissured and shattered aspect, while the river (Pabur) bed is strewed with fragments of every size, leaving no doubt that the rock is gneiss.

85. The only imbedded minerals I have observed in this tract are, 1. mica in tabular crystals, but not well defined, nor otherwise of any particular value, (near Seran); 2. schorl occasionally sparingly disseminated in small prismatic crystals (near Seran); 3. garnets of a lighter colour than usual, small and sparingly interspersed, their figure obscure if not imperfect; 4. quartz of bluish green color in six-sided prisms, occasionally attaining to the size of an inch in diameter, and two or three in length. They are found imbedded in a granite vein near the village of Keelba, but are with difficulty separable from the matrix. The quartz which forms the regular ingredient of this granite is of a light grey colour; 5. it is said that copper and gold were formerly obtained at a spot between Yanee and Keelba on the right bank of the river, but that the workings have been long abandoned.

86. Hornblende rock occurs in beds in the neighbourhoods to Sera, Tanada, and Kemgos. It rarely consists of the pure mineral, most commonly of a mixture of that and felspar. It is sometimes of a schistose structure, sometimes of that which I call the cleaveable. The two types appear to pass into each other by imperceptible gradations; in one case only, near Seran, could I perceive any thing like a transition or passage of the gneiss into this rock, the change in the other instances being sudden, and the contrast marked. These beds are generally of very limited extent, seldom more than a few yards, particularly between Deas and Suran, in which line they are also numerous. Near Tanda, the bed is larger and occupies the whole of the mountain side, forming the ascent to the village. A bed of micaceous schist occurs near Seran, and one of compact quartz rock, forming a precipice of great mag-

nitude. At the confluence of the Buspa, the road lies along the foot of this mass, and is strewed with fragments from it.

87. Granite veins are evidently numerous in the neighbourhood of Wongtoo bridge, for among the fragments that are met with for several miles on each side, we observe a proportion of them to be granite. These fragments often present undeniable evidence of their veinous origin in retaining part of the gneiss which formed the wall of the vein, and it was this circumstance, combined with the low proportion they bear to the fragments of the gneiss, that first suggested the idea of their being derived from that source. But there can be no doubt on this subject, as in the immediate neighbourhood of the bridge, just before descending to the river bed, these veins may be seen in great number intersecting the gneiss, most commonly in a direction from N. E. to S. W., and again in the anomalous rock at the bridge.

88. The granite of these veins is always of a large grain, and is remarkable for the very large proportion of felspar it contains, the mica being comparatively deficient. The felspar is white and foliated, the quartz of a light grey, the mica generally brown. No difference of composition is observable between the middle and the sides of the veins, nor any change in the gneiss in its neighbourhood. The breadth is very various, and equally so the extent. The former is from a few inches to several hundred feet. They occasionally divide, but they cannot be said to ramify, at least not in a remarkable manner.

89. The rock which occurs at the bridge, and which contains the largest of these veins, is something of an anomalous nature, and might be adduced as an instance of that transition between gneiss and granite, which has been so often observed. Some specimens would certainly be considered to belong to the former title, while others might be chosen, which would as certainly be referred to the latter. It has, however, in mineralogical aspect, a strong resemblance to the more well-defined gneiss in its neighbourhood, while it has none whatever to the granite veins. I may add, that its occasional want of a distinctly laminar structure, and the indistinctness of its stratification, are the only obstacle to its being considered identical with the surrounding accurately defined gneiss.[32]

32 It has been usual to call anomalous rocks of this description granitic gneiss, but the mere giving it a name affords no new information, nor in any way settles the doubt as to which type of rocks it should be geologically referred.

However this may be, I ought to notice that it is of limited extent in this direction, certainly not exceeding a square of 500 yards.

90. The band of gneiss thus traced out from a recent visit, may have its limits increased by a reference to notes made in a former journey. The particulars will not be so minute, and specially the dip and inclination are wanting, as an examination of the rocks was then a secondary object, and the subject not so familiar. But they will be sufficient to establish the great extent of the gneiss formation, and I ought to add, that of the few particulars I am to mention, there can be no doubt; as I made an ample collection of specimens which I afterwards examined at my leisure, with the opportunity of consulting those who were well acquainted with the subject.

91. On the Gonass Pass, five and half miles east of the Brooang Pass, (Art. 84,) and elevated 15,516 feet above the sea, the rock is a small grained, dark coloured gneiss, with the lamina rather indistinct, and often breaking with a conchoidal fracture. The dark colour is owing to the mica, which is black. The ingredients are most intimately mixed, and scarcely to be discriminated by the unassisted eye. In the descent thence to the bed of the Buspa, (about 9,000 feet,) the rock is seldom visible, but at Singlo (9,178), and thence in the ascent to the Harung Pass (14,500), the rock is gneiss. At Mibar (9,698), the same rock prevails, and indeed as far as Pooaree on the Sutlej, between Pooaree and Poorboonnee, a crumbly white granite is met with, the type of which, as far as my memory can guide me, is to be found in other parts of these mountains, and will be described further on (Art. 264). From a recent examination between Poorboonnee and Reeba, masses or beds occur, but of limited extent, of a rock, consisting almost wholly of felspar, generally in a state of decomposition. It is probably a granite. From Reba to Rispa is again well-defined gneiss, which on the ascent above Moorung, is exchanged for clay slate. The clay slate continues by Nissung to very near Dabbling. Just above Dabbling, a mass of granite occurs, the true relation of which I cannot attempt to give at this distance of time. From Dabbling to Shipkee gneiss prevails, the laminæ and even strata frequently very much contorted, particularly at a precipice in the river bed between Doobling and Namja. Between Namja and Shipkee, it is imperfectly laminar, has a small grain, and is of a bluish grey colour. Beyond Shipkee, that is east of it, as far as it

could be judged of by contour, the mountains would appear to be clay slate.

92. To the north of Shipkee, between the Sutlej and the Speetee rivers, is gneiss, with some patches of granite, but whether veins or beds, must be left for determination on a future visit. This gneiss continues again by Nako to Shalkur, beyond which it is succeeded in the neighbourhood of Soomra and Laree by clay slate. We have thus traced gneiss very nearly to the confines of our possessions. In returning down the right bank of the river, we find it equally prevalent, the whole way from Shalkur to Woongtoo, with the following inconsiderable exceptions; limestone occurs in the bed of the Yoollung, which joins the Sutlej near Leoo, and again on the Hungrung Pass, (14,000 feet.) Whether these masses are connected, or form two distinct beds, must be left for future decision. Granite is found in the neighboured of Rarung, Meero, and Rogee: with these exceptions, and perhaps an occasional bed of mica slate and quartz rock, the whole of this line is gneiss.

93. The preceding account of the rocks of this tract, derived from recollection, agrees in the main with one published in the first volume of the Geological Transactions, new series, drawn up by Mr. Colebroke, from specimens forwarded by Captain Gerard, who also traversed that route. The chief difference is in my assignment of gneiss as the rock formation, giving to all the others, with the exception perhaps of the clay slate near Moorung, the subordinate character of beds or veins.[33] I may here add two other observations from that paper, which are not to be found in my notes, but are of importance. The dip is noticed at Pooaree as being E., and the angle of inclination 25° to 30°. The other is a notice of the rock found on the Shatool Pass, about five miles west of the Borunda Pass, and elevated 15,000 feet, which is stated to be gneiss.

94. We may now move eastward, and we shall find at the source of the Tonse (12,800 feet) gneiss again, of a dark grey colour, fine grain, and conchoidal fracture. This gneiss contains so large a proportion of

33 It will be readily understood, that a series of specimens collected by a person not conversant with geological enquiry, whose attention too was strongly occupied by another subject, may well fail to exhibit the relative extent of each rock; such a collection can give us no assistance in discriminating insulated beds from alternating formations, or either of these from veins.

quartz, and is so hard, as to afford sparks; at Jumnootree, also the prevailing masses are gneiss; quartz rock also occurs, but in subordinate quantity. From Jumnootree,[34] a route passes in the bed of the Bhagheerettee at Sookee, reaching in two intances an elevation of about 15,000 feet (Bamsoora and Chaigu Pass.) The whole of this line is gneiss. From Sookee again, in the upper part of the course of the Bhageerettee, we met with scarcely any other rock; granite I have only seen in fragments. The snowy peaks at the head of this river are distinctly stratified, and have all the appearance of the neighbouring accessible gneiss. In the Jahnuvi, gneiss continues to Neeling, where it is succeeded eastward by clay slate. The valley of the Chor (thief) river, which is a feeder of the Jahnuvi, and springs from that point in which the Buspa also originates, but with an opposite course, appears to be also formed of this rock.

95. We have now reached the Kalee, (branch of the Aluknunda), and here the recent examination of this tract equally established the prevalence of gneiss, from Ookee Muth Joola (rope bridge) to Kedurnauth, the source of the river. In this gneiss the mica is often black, and the quartz glassy, and in one solitary instance if I am not mistaken, it admits of hornblende as an ingredient in addition to the other three more usual ones. The most marked varieties in structure or mineralogical aspect are the following: Near Nalaputtun, the laminæ are undulated, the quantity of felspar diminishes, and I think it passes into a micaceous schist at length by the almost total loss of this mineral; beyond Mykunda, numerous fragments occur of the glandular type before described, and which is afterwards seen in Litee, in an immense precipice forming a beautiful natural section at the foot of the descent to Jilmilputtan. Some of the nodules have even a rounded appearance, similar to that of rolled pebbles; hornblende occurs in addition to the usual ingredients in specimens obtained between Mykunda and Ukrot Kothee. This rock is also remarkable for containing a peculiar mineral, which I shall presently have occasion to describe more particularly. Near Ukrot Kothie, it has all the aspect of quartz rock, exhibiting, what may be called, a transition into that congenerous formation. It gradually loses its mica, and appears at last to be a mere mixture of quartz and felspar, the fracture conchoidal and laminar, structure very obscure. Beyond Gowree

34 Mr. Fraser, who traversed this route, gives the same account of the rocks, and particularly dwells on the stratified aspect of the lofty peaks.

Koond, occurs a type in which the nodules of felspar assume a lenticular shape. The ground being a dark grey, and this mineral of a snowy whiteness, makes it occasionally a very beautiful rock. Beyond Bhyro Ghate, the rock is scarcely accessible in situ, but the angular fragments, which are very numerous, are sufficiently indicative of its nature, and prove that the surrounding peaks and ridges are chiefly, if not wholly, gneiss. And the correspondence of appearance between the nearer ridges, which have evidently furnished these fragments, and the great Soommero or Kedurnauth peak attest the fact that here also, as at the head of the Ganges, this rock attains an elevation of nearly 23,000 feet.

96. The dip of this rock is more regular within this tract than in the neighbourhood of the Sutlej. In the bed of the river below Ookeernauth, near the Joola, it was observed to be from 8° to 20° N. E., while the inclination was 30°. Between Mykunda and Bhet, the dip was found to be twenty-five to forty-five N. W., and a little beyond this, due North. Beyond Mykunda again, it was observed 50° N. E. Beyond Borosa, it is also E. of N.; but the strata have a secondary set of divisions which are at right angles to the former, and consequently dip in the opposite direction. The first set have but little inclination. The latter are nearly perpendicular. This is an appearance often met with, and it is sometimes difficult to say, which are and which are not the stratiform divisions. Those have been generally adopted which correspond to the general run of the neighbouring strata. At the fine section near Jilmilputtun, the strata which are from four to ten feet in thickness, dip 10° N. E., at an inclination of 30°. After crossing the river, the dip is 30° N. E., the inclination the same.

97. The only beds observed are one of micaceous schist near Nalaputtun,—if this be not indeed a gneiss with less felspar than usual, and an instance of that oscillation which is observed between rocks so nearly allied in origin and structure as these two ? It is remarkable for containing the largest garnets (common) I have seen in these mountains. Their figure is however irregular. The specific gravity I determined to be about 3.8. This is rather higher than the determination hitherto made, but I think it must be evident to any one, who will examine the uninterrupted series of gravities between common and precious garnets, and will also consider the variations in the analysis, that the former is

merely a more or less impure specimen of the latter. The degree of impurity may be estimated from the specific gravity.

98. Between Bhet and Mykunda, also, occurs a bed of micaceous schist under much the same circumstances as at Nalaputtun, that is to say, containing felspar in small quantity; the contact with the well-defined gneiss not being visible, so as to allow it to be ascertained whether it be a bed or a mere modification of the more general rock. Beds of hornblende rock are very common, but always of limited extent; as before observed, they seldom consist of the pure mineral, almost always of a mixture of that and felspar. Occasionally this rock, by the decomposition of the hornblende and oxidation of the iron it contains, acquires a rusty colour, and an earthy composition. In this case it is soft, and partially disintegrated. And a mass of a similarly disintegrated rock, but of a yellowish grey colour, is found in its vicinity. It is probably a decomposing gneiss. A rock something similar occurs again in the ascent to Gunness Ghata from Jilmilputtun. The composition is arenaceous, consisting of quartzose particles in a white earthy basis. This is also probably a gneiss, though from the absence of every thing like the stratified structure, I am more inclined to consider it a granite. But the name is of little moment; whether gneiss or granite, it is of limited extent, and being such as I have described, is surrounded on every side by gneiss. It does not contain mica.

99. No granite veins, unless the preceding can be considered one, were any where to be observed. But fragments of great variety, size and beauty may be seen in the small valley at the head of the river near which the temple of Kedurnauth stands; all these consist in great proportion of felspar, containing very little quartz, and much less mica; some want the mica altogether, some the quartz. The felspar is always white or grey, in the former case perfectly opaque, in the latter translucent. The quartz is generally grey, the mica sometimes a deep black. Those compounds which consist of the translucent variety of felspar and black mica without any quartz, are extremely beautiful, and could this rock be obtained in any quantity, it would pay for its transport. But the small quantity in which each type occurs, is equally remarkable with the great variety of them, and their total dissimilarity to the granites found in more southern localities. They are all angular, appear to be of recent fracture, and with those

met with near Wongtoo, (Art. 87,) doubtless portions of veins, as in many the same circumstance may be observed which was observed there, the adherence of part of the containing rock to one of the sides of the vein. This is always gneiss.

100. In the bed of the Mundaknee, or Kalee as it is more usually called, below Ookeernauth, many very large rounded blocks are scattered about, of a granite very much resembling the anomalous rock at Wongtoo bridge; it contains angular nodules of a crystalline felspar imbedded in a granite paste. This felspar is here of the glassy variety, and it is the only example of the mineral I have ever found. These blocks have a smooth surface, unlike the rough and granular appearance left by the phenomenon of desquamation to which granite is subject, and to which so many granite boulders owe their origin. If these boulders have been also formed by this cause, it is equally certain that they have undergone also the attrition, which alone could have smoothed their surfaces to the degree observed.

101. The only imbedded mineral of any interest in this quarter, is one occurring in small amorphous grains. It is of a bluish grey colour, translucent, a vitreous lustre, and uneven fracture. It is very easily frangible, hardness 5.5 : 6.0. The composition is impalpable. The quantity I was able to procure was so small, that I do not lay much stress on the determination of its specific gravity which appeared to be 2.3. It is certainly not under 2.2, nor more than 2.4. Before the blowpipe it is infusible, but decrepitates. It is not affected by acids. This character does not agree with any mineral yet described, yet I should wish to obtain it in greater quantity, and subject it to a more leisurely examination before I pronounce it new, in all but geological situation and infusibility. Before the blowpipe, it comes very near the species, empyrodox quartz.*

102. Some of the fragments of gneiss found at Kedurnauth, contain kyanite in flat prisms, from half an inch to an inch in length, and about one-twentieth to one-third of an inch in breadth. Cinnamon stone in grains is also to be found in them. The granite fragments abound in schorl, under its common figure of three-sided prisms,* the lateral angles replaced, terminated by obtuse trihedral summits. The largest I observed, was about an inch in length and half an inch in diameter, but the small crystals are always best defined. Hyacinth is more rare, and the

* MSS.

crystals, which are quadrangular prisms, terminated by quadrilateral pyramids set on the angles are very small, not more than one-twentieth of an inch in their largest dimensions. Carbonate of lime, (calcareous spar,) was observed only in one specimen.

103. In tracing this formation of gneiss eastward, we find it accompany us from the bridge under Ookeernauth, by Krokee and Oosaree, in the ascent to the Toongnath Pass, (10,000 feet.) Near Krokee, it contains the bluish grey grains described, Art. 101. At Oosaree it is chloritic, the mica having given way to this mineral. The quartz is rather in greater abundance than usual, which renders it rather a hard stone, and as the laminæ are very much undulated in the south wall, and the rock splits readily into masses of the required thickness, it is found valuable as a mill-stone, and is much sought after on the Pass. Well-characterised gneiss, of a small grain, and marked schistose structure, occurs. The dip was observed to be N. 20° E. It was particularly obvious in the arrangement of the mountain slopes and precipices. Fig.* will give some idea of this appearance.

104. Beds of hornblende schist, as usual, are met with, sometimes in a state of decomposition, (between Krokee and Oosaree), sometimes persistent (on the Pass), but in a very small quantity. It is here succeeded laterally by clorite schist, which also occupies a very small space, some very large masses of quartz rock are observed, which have evidently been derived from the lofty crest that crowns this Pass to the north. A small strip of granite of a middling grain and ordinary aspect, occupies the eastern edge of the Pass, and is I think, part of a vein. In the descent in the Pass no rock is seen in situ, but the fragments are all gneiss, and one type in particular is singularly beautiful, having thin prisms of kyanite dispersed through it in great abundance, thus giving it something of a porphyritic aspect.

105. The next locality within the elevated zone where gneiss has been traced, is at Dampa on the Gooree river. It was there observed under two types, interstratified with one another. The one a light grey, having much the appearance of quartz rock, the other darker coloured and larger grained, resembling the rock near Zanee on the Sutlej and

* The figures referred to here and other parts of this report are wanting, for the same reason that has interfered with the preparation of the sections. They will be forwarded hereafter.—MSS.

Jilmilputtun on the Mundaknee. The two types are interstratified. The dip is very regularly N., a little E., and the strata are occasionally curved amongst the fragments, besides gneiss which constitutes the major part. Quartz rock was observed, and a few spots of hornblende rock, but none of granite.

106. From this point in the ascent to the village of Sacen, gneiss is the only rock observable. Thence descending to the Nullah, and ascending to the Pass called Chabinna-ka-Doora, elevated 9,000 feet, the same rock continues, and in the whole line of so ordinary a type, and presenting so little new or anomalous, as to afford no room for description or remark. It yet accompanies us onward round the head of the Soorung glen to the Pass of Rooroo Dhooroo, elevated 10,000 feet; the line of route then descends to a Nullah, (elevation 6,000 feet). Gneiss the whole way. It ascends and descends, passing round the head of a valley, and finally crossing Sere Soongur Khan, a Pass elevated 10,000 feet, descends by Naneik into the bed of the Ramgunga, having yielded no rock but gneiss in all that line, not even a solitary bed. I ought however to notice that in a very great proportion of this distance the coat of debris is of an enormous thickness, and covered by a most luxuriant vegetation. In the bed of the Ramgunga, the dip was observed N. 5° W., the inclination being 15°. There were however two other sets of divisions, but not equally strongly marked.

107. The preceding comprehend the most northern observations of the extent of this rock. I shall now follow out its southern boundary, which as it presents some anomalies and irregularities, I have chosen to separate from the previous detail in order to avoid confusion, and to present in a clearer light the fact of the great lateral extent of this formation. I have not the least doubt, that a greater field of observation will establish the general prevalence of gneiss over the whole of what I have called the zone of the Himmalaya. It is true that this is mere opinion, but it is the opinion of one who has considered the outlines of the mountains with reference to their geological structure, and who may be said to have viewed the whole of it at greater or less distances.

108. I shall, as before, begin with the western parts, taking up my account at Deas on the Sutlej where, as I mentioned, gneiss occurs of a well characterised type. In the bed of the Nullah, between Deaoo and

Muzzooleea, may be seen a bed of chloritic schist. Dipping conformably with the gneiss it oscillates on one side towards talcose schist, on the other towards chloritic gneiss. The latter change is seen where it comes into contrast with the gneiss. This intermediate rock, as it may be called, is much intersected by veins of scaly chlorite in which quartz is also interspersed. The veins are very tortuous, and the quartz always follows the course of the chlorite. In the ascent to the Kutedorna Pass, just below the village of Darna, gneiss was observed, but of limited extent, and no other rock was visible.

109. Between this Pass and Putenoo I find no notice of the rock, owing I suppose to thick debris below Putenoo. In the route leading down that glen, one of the feeders of the Nowgree (to Roon on the latter river) chloritic and talcose schists are the only rocks observed, these rocks frequently contain quartz. The dip is generally north. The contact of the gneiss with the new rocks could not be discovered. In the bed of the Nowgree occurs an anomalous variety of talcose schist, or perhaps rather quartz rock. It is a mixture of silvery talc and quartz, but is not schistose, having more the amorphous aspect of granite. It contains, disseminated in grains, a mineral with the lustre of quartz, semi-transparent, varying in colour from a bluish white to an indigo blue. It does not appear to have any cleavage. The quantity was too small to determine the specific gravity. It is infusible *per se*. With soda it forms a clear glass. This rock has been meet within very distant localities, and will be often referred to. At this place it is intersected by patches or veins of chlorite.

110. In the ascent from the Nowgree, fragments of a subschistose rock, of a greenish colour, may be seen, containing probably hornblende, besides chlorite; still higher on the pass above Birsoot, straight laminar chlorite schist prevails. In descending to the stream below Ketoo, the same rock continues, but having a fibrous structure; it contains nodules of quartz, and the chlorite is always observed to be bent round them. The dip was found here to be S. E. In the bed of the stream blocks of gneiss are seen, but no occurrence of it in situ. Chlorite schist continues to the foot of the ascent leading to the village of Koolior, when it is exchanged for a grey fibrous argillaceous schist, irregularly cleavable with a scaly granular fracture. The dip here was also found to be S. E. Probably this latter is in reality but a variety of chloritic schist. As long how-

ever as the green colour is made the discriminative character of chlorite, descriptive geology must notice it as a change.

111. This latter rock continues in the ascent beyond Teda, assuming latterly a magnesian character, and containing veins of quartz. The transition between magnesian clay slate, and talc slate with which chlorite slate is associated, is so common, as to render the above conjecture probable; masses of a rock which might be called quartz rock are then met with. It is of a fine granular composition and slaty structure; a little higher an enormous precipice occurs formed of the projecting ends of the strata, and facing the north. This rock is a gneiss of a grey colour, fine granular composition, and perfect schistose structure, and the dip, it would appear from the above, must be South on the Sulan Pass; again the rock is gneiss, but no observation of the dip could be made.

112. In the descent from this Pass to the village of Koornoo, so thick is the coat of debris, that not a single example of the rock is to be detected excepting fragments. These are gneiss; but from Koornoo the rock is finely exposed, particularly in the bed of the stream which leads from the bridge below Koornoo to the foot of the Pass above Surmal, and which here separates the Sutlej basin from that of the Jumna. This stream runs in a narrow gorge with high perpendicular walls on each side, formed of the projecting ends of the strata. These are observed on each side to correspond perfectly, not only as to the seams and directions of the strata, but also in the mineralogical character of the rock. This rock is an ordinary gneiss of a grey colour, and marked schistose character, the strata are sometimes five feet thick, and between them is a distinct separation or fissure; sometimes they are not more than six inches thick, and these changes occur within a very short distance, the dip is regularly S. 40° to 50° E. The inclination 15° to 25°.

113. In the neighbourhood of the Surmal village, gneiss is still found, occasionally, however, almost losing its felspar and consequently oscillating towards micaceous schist or quartz rock. The route from this village to Kuatar, at the head of the Nocor glen, leads along the high ridge which separates the basins of the Sutlej and of the Jumna. This ridge has an elevation in this quarter of from 7000 to 11,000 feet; some parts are above the limit of forest. It rises rapidly as it continues upwards, and is seen to be crowned with snow-bearing peaks at but a

short distance from the Pass above Surmal. It is generally covered with an enormous coat of debris and of peat, but the rock is visible in more than one place. It is gneiss, occasionally small granular, occasionally with bent laminæ, and resembling the passage into micaceous schist. The dip is as often S. E. as N. E., nor did there appear to me any clue by which I could trace the connection of their opposite dips, which are many times repeated even in a very short distance. Beds of hornblende rock are frequent; this rock is very often quite amorphous, and has but little of any appearance of a schistose structure. It occasionally contains mica and even quartz, as well as felspar, and may thus be said to be identical in composition with the syenites, but it never loses the characteristic appearance of hornblende rock, and the above minerals are always in small quantity.

114. In the descent from the Kedrolo Pass to Kutar, the gneiss is latterly found to lose its felspar, and in the neighbourhood of that village it is an ordinary well-defined micaceous schist. From hence this latter rock continues in the bed of the Nocor river, lying at so low an angle that it is difficult to observe the dip or direction. I should have observed that the outline of the great ridge and its ramifying branches, from which the Kedrola Pass forms the descent, is peculiar. It is sharp and serrated, while that of the mountains east of Kutar, and even the branches of the former, as they fall in the scale of elevation, are observed to assume smooth rounded outlines, with scarcely any sharp peaks or breaches. But if the smooth ridge is seen to rise to any thing like the elevation of the serrated ridges, it also becomes serrated like them, while again on sinking, it takes the rounded form. This fact, combined with the low degree of inclination which the strata bear, would seem to justify in inferring the superposition of gneiss on micaceous schist, nor is there any thing so unusual in the fact, however contrary to a once generally received system, to occasion any hesitation in admitting the truth of it.

115. In the bed of the Nowr river, besides fragments of the mica slate, the rock in situ many large blocks are seen of gneiss of a type which I did not observe any where in this quarter in situ. Judging however from the connections of this rock in other places, I would infer that it must also be in abundance here, forming most probably those serrated crests which crown the mica slate ridges. This rock may be called a porphyritic gneiss. It is composed of rather a middling grained

paste, in which I believe the three ingredients are found, and in this paste are included angular nodules of crystalline felspar; this arrangement gives a very beautiful appearance to the rock when polished. It is the same rock which has been noticed in the river Kalee below Ookeemuth, and also at Wangtoo bridge. It appears very often to form the transition between granite and gneiss.

116. The micaceous schist continues to the village of Kohaen, situated below the foot of the Tekkar, but every where covered by a thick coat of debris. In the nullah the tendency of the dip was, if any thing, East; but here it was observed to be South-west. Below the village, a small stream joins the Nowr river. In the bed of this river, micaceous schist is still observable, but on crossing the river on the ascent to the village of Surmal, gneiss is seen resting on it. The dip of both rocks North-east, and the inclination very little. The mica slate has here a greenish colour, but it is not chloritic. The relations between micaceous and chloritic schist do not warrant, I think, our extending the latter title to those rocks of the former class, which have merely a greenish tinge. The lines of chloritic schists are rather connected with the talcose schists, a connection perfectly agreeable to our views of system, since it has been well established that the two minerals, talc and chlorite, are but varieties of the same species, (the prismatic talc mica of Professor Mohs.)

117. From Saraut to Seel, the route passes along the eastern declivity of the ridge which separates the Nowr glen from the valley of the Girree and its feeders. This ridge is every where of the rounded and swelling form which was mentioned as indicating micaceous schist, accordingly it is the only rock observed. It is frequently of an arenaceous composition, and strongly resembling some varieties of micaceous sandstone. This type occurs near the village of Kulgaon, occasionally it is of an earthy aspect, loses its schistose structure, and becomes fissured in every direction. This type projects through the surface in amorphous masses; it very probably contains felspar, though the grain is too small to detect it by any ocular examination. I incline to consider it as in reality a small grained decomposing granite, but further examination of its relations to the surrounding rocks are necessary to enable me to pronounce decisively.

118. From Seel to Deolara, the residence of the Ranee of Torbut, the route turns up the valley watered by the stream which joins the Pubbar

river, opposite to Raeengurh. In all this line, mica slate is the only rock occurring in situ. The dip was observed to be N. W., inclination 15°. Several very large fragments of gneiss may be seen near the village of Torbut; one which I noted, had the dimensions of 50 feet by 20 by 10. Whence these have come is not so obvious, for the crests of the range do not bear the serrated outline which is here discriminative of gneiss. Near the Deolora, the type consists almost wholly of mica, very tender, and of a yellowish brown colour. It contains numerous veins of quartz, as this type always does. The new road which has been cut by order of Major Kennedy passes through it, and is covered deep by the highly comminuted debris of this rock, the lightest and most transportable sand that is formed. The annoyance to the traveller's eyes in a light breeze is not to be described, while the sun strongly reflected from the lamina of the rock, occasions a glare which is almost as irritating to the eyes, as the subtile powder which is every instant blown into them.

119. At Seel, the rock is of the arenaceous type, and it contains, disseminated in great abundance, octahedral iron ore in small grains and imperfectly formed crystals. This mineral has a specific gravity of 4.81; but as there are some impurities in the specimen I tried, it is probable this determination is too low. The limits of octahedral iron ore are 4.8, 5.2, while those of axotomous iron ore, which it in some respects resembles, are 4.4, 4.8. But it is very probable that the true limits of the octahedral species, (magnetic iron ore,) do not descend below 5.0, for all the massive or larger crystallised specimens exceed this determination, and that the magnetic iron sand will form a distinct species between the axotomous, (titanic iron,) and the octahedral.

120. The abundance in which these grains are found, may be judged of by the specific gravity of some of the specimens of the micaceous schist in which they are disseminated. This was found to be 3.45. Taking 2.76 as the specific gravity of pure micaceous schist, and 4.8 that of the iron, it may be easily demonstrated that the latter constituted by bulk one-third of the rock, or by weight very nearly one-half.

121. In ascending from Deohea to the Pass of Chount Kagulla, leading into Poondur, micaceous schist alone is observable, but in general in the coating of debris thick fragments of gneiss occur, and it is probable

that the summits of this range are composed of this rock. On the Pass, micaceous schist is the rock; but it approaches in character to gneiss, containing I think felspar, though in small quantity. On the other side of the Pass, however, just at the edge of the steep descent, gneiss occurs in strata very nearly horizontal, the dip being if any thing North-west. This place, which is at the head of the glen in which is situated the village of Meemooa, presents some very romantic scenery. Immense precipices are formed of the columnar masses of gneiss, which here and there stand out from the general rock, and raise their gigantic heights far above the green knolls and patches of debris, enamelled with a thousand flowers that fill up the bottom of the glen. The crests of the surrounding ridges in which the gneiss is gradually lost being concealed by the luxuriant vegetation, are again crowned with noble forests, in which the yew, the horse chesnut, the oak, pine, and sycamore are all conspicuous. At every step the traveller disturbs the Moonal, (Phasianus Impejanus,) which with its shrill disagreeable cry forms the only interruption to the silence and solitude of the scene. It was a beautiful morning in May when I ascended it. The thermometer was only 50°, while in many of the secluded nooks, the springs were frozen. It is in scenes like these, and in such temperatures, that the explorer finds some recompense for the heat, and toil, and dust of less favored situations.

122. Descending into this glen, the gneiss is perceived to have considerable extent, and the valley for a still further distance, is strewed with huge blocks of this rock. At the precipices above described, a brownish tender micaceous schist may be seen resting on it; lower down in the bed of the nullah below the village of Mummora, the gneiss is finally exchanged for that rock, which here again appears to underlie it. It may be seen to form by the broken ends of the strata, corresponding layers on each side of the narrow water-course which it bounds, the two sides agreeing in mineralogical character, in inclination and thickness of strata so closely, that it scarcely requires an effort of imagination to fill up the very narrow chasms, or to join those masses which have evidently been once continuous. The micaceous schist continues in the high ridge on which the village of Pooree is situated, and for a few miles beyond it, when it is finally lost through the junction of the new rock, or is concealed by debris.

123. I have now traced the gneiss to its southern boundary in this direction, and have, in order at once to notice all the different patches of it that occur, encroached on the limits of the micaceous schist, the next rock in the order of description. But no arrangement of these observations can be entirely regular while nature herself so often presents us with irregularities, or at least what appear such in our imperfect systems. In fact the inconvenience is more imaginary than real, for in following out the extent of the next rock, the preceding details will be referred to as filling up part of the outline. No gneiss is found south of the point where the preceding description terminates.

124. It is necessary now to return to the route by the Borund Pass, in which gneiss was traced as far as the place of encampment in the Pubbur valley, about 10 miles above Janglag. The upper part of this valley, I should notice, is of great width, the left bank is steep and precipitous, consisting chiefly of bare rock, the river flowing at its foot. The right bank is an easy slope covered with a thick coat of peat, in which spring up at this season various European flowers, such as ranunculus, anemone, potentilla, iris, with many others that appeared new to me. Tracts of this nature afford the very finest pasturage during four or five months of the year. Very little rock is visible, only occasionally in the lateral glens, where the torrents from the snow have gradually made their way through this enormous mass of vegetable debris, and thus exposed it to view, or where a peak split by the expansive powers of the frost tumbles from its lofty base into the valley beneath, and scatters wide its fragments of every size. One such slip of very great extent may be seen on the road to Junglag, and of this all the fragments are gneiss; some pieces would afford hand specimens that might pass for granite, but viewing it in the large and almost innumerable blocks that lie here, the rock is readily pronounced a gneiss.

125. Descending from Junglag to the confluence of the two principal branches of the Pubbur, we find only gneiss. A fine section is exposed on the left bank of the eastern branch. It lies in distinct and well marked strata, from 5 to 8 feet thick, dipping to the S. E. The route continues along to the right bank of the united stream now swelled to a river, 40 feet wide and 5 feet deep. The coating of debris is of great thickness, but another section of the strata may be seen in

the bed of a small nullah that falls in from the west. The rock is gneiss, the inclination is small, and the dip obscure.

126. Hence, ascending and passing by the villages Dewtee and Sustwar, gneiss is still found projecting in many large masses; the mountain side being more steep, and consequently having less debris lying on it, no good observation of the dip was obtainable. Gneiss still continues up the lateral glen in which Kutsar is situated, and thence descending to Tikkaree near the latter place, fragments were observed of a dark blue colour and small grain, and in the eagerness to change the sameness of constantly recurring gneiss for some novelty, were supposed at first to be so, but the first stroke of the hammer corrected the mistake, and shewed it to be gneiss; a little unlike, however, the ordinary types of that rock. In the bed of the Kutsar glen, blocks of the porphyritic gneiss before described were observed, some of which had all the characters of a gneiss.

127. From Tikkaree to Senowlee, a distance of nearly 16 miles, the route is in the bed of the river, and in all this line there is but one instance of the rock in situ being exposed. It is a fine grained grey gneiss. In the bed of the river, fragments of all sizes are seen, but they consist almost exclusively of gneiss and quartz rock, some few of hornblende rock, and a very few of granite. The river bed is often wide, and in these cases is accompanied by a bank or flat of some extent, consisting of rounded stones. This bank is often 30 feet high, not less than half a mile in length, and 200 yards perhaps in width. These level spots are all cultivated, and it would appear, that they are particularly fitted to the culture of the poppy, which is carried on in this valley and its ramifications with great success.

128. This was the first instance of these beds observed in descending from the source of the river. Near Massoolea, where there is much level ground, occurs an immense accumulation; a lateral torrent which cuts through it to join the Pubbur, shews at once its enormous thickness and its composition; stones of every size, from 2 feet diameter to the smallest pebbles, all perfectly rounded, imbedded in gravel and sand; most of them are quartz rock, perhaps two-thirds of the whole, the other third consists of gneiss and hornblende rock, with a few of granite. These beds are so far different from the open level spots found in the upper part of the river vallies, in as much as their surface

is perfectly flat, while that of the others is rather undulating and irregular. The latter too are composed almost wholly of angular local debris, covered with a thick deposit of peat, while these, as already described, consist entirely of rounded fragments which project often at the surface.

129. From Sinowlee the road ascends one of the ramifications of the Chag Sheel ridge. At the commencement of the ascent, micaceous schist is found of a dark blue colour, and splitting into very thin straight laminæ. It is much stained with oxyde of iron. Gneiss succeeds to this rock, but in small quantity, and is again exchanged for a micaceous schist, with something of a talcose aspect, and of a lead blue color. This rock continues assuming more of the talcose character, and it is I think certainly a mixture of prismatic and rhombohedral talc mica with quartz. The laminæ become undulated, and it abounds in garnets. A vein is observed parallel to the layers, the centre of which was either granular quartz or a mixture of quartz and felspar, the sides were marked by prisms of hornblende thickly and confusedly disseminated. Many veins of glassy quartz, both white and yellow, were observed, but so fragile that no good specimen could be detached.

130. The rock continues to the village of Chupar, containing frequently veins, if they be so called, of gneiss. The veins never ramify, and they are always parallel to the laminæ of the containing rock; below Chupar gneiss is again found in mass, and beyond it again talco-micaceous schist, enclosing a vein similar to that described Art. 129, consisting of granular quartz or a mixture of quartz and felspar, with crystals of hornblende disseminated. This vein has a porphyritic structure, is a most singular rock, and affords by the definite nature of its character, a clue to the connections of widely distant masses. It will be seen hereafter of what common occurrence it is within this tract, and yet it is a rock I have never seen except in these mountains. The dip is pretty uniformly in this neighbourhood, N. or E. of N. wherever it appears uncomformable, it is but for a short distance.

131. Beyond the talco-micaceous schist, one with straight laminæ, containing garnets and oxydulous iron is met with. In descending from Bulor into a lateral glen, the glandular type of gneiss before noticed as occurring below Broang (Art. 80), and at other places, is met with, and in the bed of the stream is seen a talco-micaceous rock with

undulated laminæ. This rock is singularly hollowed out, whether by the action of the weather or by the dropping out of the loose materials of veins, that may once have traversed it, it is difficult to say, perhaps the former opinion is the more probable one; and yet as these hollows traverse the laminæ of the rock, it is not easy to understand why they should be subject to decomposition so partially.

132. From Murdal the rocks appear to be of an anomalous character. In proceeding along the declivity of the range which here forms the left bank of the Pabur river, there is an oscillation between gneiss and micaceous schist, the rocks occasionally assuming the type of the former, occasionally of the latter rock. The gneiss appears sometimes to contain clay slate as an ingredient, and in one spot of limited extent, is carburetted in a high degree, this modification was noticed, also as occurring above Gowree Koond, in the valley of the Kalee, (Art. 95.) In the bed of the stream below the village of Twalta, gneiss is found of a legitimate type, dipping to N. E. and having an angle of inclination of from 30 to 40°. This rock continues the whole way to the village of Dorchan, where may be seen some types of a granitic character, but viewed in all their relations, little hesitation is felt to class them as gneiss in general, this character only applies to small portions of the rock, and even there may be seen in the same continuous stratum to pass into the most ordinary gneiss, and often in a distance of a few feet. The laminæ of this rock are much undulated, and owing to the arrangement of the materials, it presents a striped appearance, the stripes following a waving outline. In some specimens, I observed the spangled mica at right angles to the laminæ, an arrangement that might too hastily be considered characteristic of granite, were it not borne in mind first, that they preserve their parallelism in layers, which the mica in granite never does; and secondly, that it is an appearance not uncommon in micaceous schist, as I shall hereafter have occasion to shew, contrary to the opinion of one of our first geologists.

133. In the descent to the Kotee gneiss accompanies us nearly the whole way dipping to the north or a little west of it, the inclination being but little. It is however seen to include a bed of magnesian clay slate, the approach to which is indicated by laminæ of that rock being contained in the gneiss. Adjoining the bed of clay slate, is one of quartz rock. The actual junction of these rocks is concealed by

debris. The change however takes place in the direction of the strata, and does not occupy 400 yards in lateral extent. The gneiss which succeeds the quartz rock continues as far as Gokul, a village in the same glen. In the ascent thence to the pass above Seras, the rock in situ is not observable; for a considerable distance fragments of hornblende schist are found, but not numerous; after crossing the stream a new rock is met with, which occupies some extent. It is a white rock of a saccharoidal aspect, occasionally so frangible as to crumble under the pressure of the finger, yet at the same time it has many and distinct changes, but nothing like a schistose structure. It is most probably a bed in the gneiss. It is composed evidently of talc and quartz or felspar, or both; some parts of it have so completely lost the mutual coherence of the particles, as to form apparently a bed of white clay; no doubt this would prove an useful ingredient in any attempt to manufacture a superior pottery.

134. On the summit of the Pass is to be seen a gneiss of an earthy character, and containing not only clay slate, as an ingredient, but carbonate of lime. Below the Pass occur fragments of chloritic schist, in such abundance as to justify the suspicion that there are extensive beds of it in the neighbourhood near; the village, a compound rock of an argillaceous character containing superadded carbonate of lime, imbedded pieces of quartz of a lenticular shape, and perhaps felspar; most probably the transition of the earthy gneiss above to an argillaceous schist; another specimen is a well defined clay slate with veins of carbonate of lime, chloritic schist of a dull green colour, and subgranular composition, united to the imperfect schistose structure, also occurs, after which quartz rock in all its types occupies the road in the descent to the Tonse River, and for some miles in its bed, proceeding upwards: when I say in all its types, I mean rather of colour than any thing else, for excepting in this particular there is no rock which possesses such uniformity of character, at least in this tract. It is sometimes bluish grey from clay slate, sometimes greenish grey from chlorite. Occasionally it is talcose, occasionally micaceous; the dip is pretty uniformly from N. to N. E. and the inclination from 25° to 30°; a very remarkable instance of the disruption of the strata occurs in the descent, something like that noticed Art. 94. The interval is also occupied by a stream, but of very disproportional dimensions. It is about

four feet wide and six to twelve inches deep, (15th of June after many days heavy rain,) the breadth of the opening from precipice to precipice is 200 feet, and the perpendicular depth about 100. The dip and mineralogical character correspond on each side, so as to leave no doubt that they were once continuous. The rock, as quartz rock almost always is, is one of great tenacity and hardness, and it seems very difficult to assign any adequate cause for the removal of so large a mass. There does not appear any dislocation or disturbance of the strata, nor any trace by which it can be judged, that the mass removed could have been the materials of a vein of less persistent character; many other instances of this kind will be noticed as I proceed in my description.

135. The Tonse is here crossed by a Sanga which measures 101 feet in the clear. The velocity in the middle of the surface was 12 to 13 feet per second, and the depth from 5 to 7 feet. These data give the discharge about 2000 feet per second. In the Doon before joining the Jumna it was determined to be nearly 3000 feet. In its immediate bed are found very large rounded blocks or boulders some even 3 feet in diameter. As in the bed of the Pabbur River, so here also they consist of gneiss, quartz rock, and hornblende rock. At the confluence of the small stream in the bed of which lies the road from Seras, there occurs a very extensive piece of flat ground, but whether it be composed of the boulders, and loose gravel noticed in the bed of the Pabbur is doubtful. Small deposits were however observed in the immediate bed of the river, having a thickness of 5 feet. The open and flat spots are very numerous in this part of the river's course, but of what materials they consist is rendered uncertain by the covering of vegetation, which clothes their slopes even to the water's edge.

136. From the bed of the Tonse the route proceeds up a lateral glen called Gurogar, from the village of that name, a very picturesque valley having considerable width, and much level ground in many different points of its course. The sides are sloping and covered with forest, which with the luxuriance of the vegetation spread over the floor of it effectually conceals the rock; in one quarter numerous fragments of quartz rock may be seen something of the character of the rock noticed in Art 129, as found on the ascent to Bouchakadhar. It contains talc, and is frequently very tender almost friable. They are scattered over a smooth grassy knoll, nor is it immediately obvious

whence they come. The mountains on this side have flat declivities, without any rock visible, and are covered with fine forests; on the opposite side, it is true they are precipitous, and appear to consist of this very rock, but as the river forms a deep chasm between, and not a very narrow one, it is not immediately understood how they should have fallen on this side: perhaps they had occupied their present place before this chasm was formed.

137. The valley widens considerably at its upper extremity, but constantly presents the easy grassy declivities, or patches of forest, which so entirely cut off all access to the rock. The ascent is easy to the Dharma pass, which separates this valley from that of the Koomoolda, commonly known as the Ramasera, (note, Sera is always applied to those vallies where rice may be cultivated.) The latter is a valley of some note, and is thought by the mountaineers, of these otherwise, rugged districts to be a smaller kind of *des*,* but their praises and description of it are greatly exaggerated; there are several vallies in Kumaon and to the westward of greater extent. Its extreme width cannot be taken I think at more than a mile, and the length of the wide part, — miles; towards its mouth it narrows considerably, and the Koomoolda, the stream which waters it, finally joins the Jumna by cutting its way through a narrow ridge which lies transversely to the valley, and which has all the appearance of having once formed a barrier to its waters.

138. On the Pass were found fragments of quartz rock occasionally containing talc, and of chloritic schist. The latter rock with bent laminæ and oscillating towards talcose schist, was found in situ half way down the Pass. In the valley again gneiss once more makes its appearance in very thin laminæ, and dipping to north. This gneiss is very probably connected with the mass which rises up into the lofty peak Kedar Kanta, in the sides of which both the Gurogar, and Rama vallies have their origin; on crossing the valley quartz rock and chloritic schist are the only rocks to be observed, and of these even very little, owing to the arrangement of the surface and the deep deposits, either of debris or peat, which every where conceal the rock. One very large mass was observed consisting half of quartz rock, half of chloritic approaching to talcose schist, there was nothing like transition observable between the two substances, the line

* The term applied by the mountaineers to the plain.

of junction being strongly marked; the quartz rock was perfectly amorphous, not a trace of schistose structure was to be observed, the laminæ of the schist were considerably bent or undulated, it contained fragments of the quartz rock, some of which were coloured green, some retained their white colour; no fragments of the schist however could be detected in the quartz rock; this mass which appeared detached was surrounded by several smaller blocks, some of which were found to be quartz rock, some chloritic schist.

139. The route passes round the head of a second valley, which falls into that of the Kumoulada, and crossing the lateral separating ridge descends into the valley of the Bunal, another glen containing a good deal of level ground, though not equal to Ramasera or the Gurogar glen. In the descent above the village of Kande, gneiss was once more found, but down the valley, the mountains, at least their summits, appeared to consist of limestone; this gneiss was talcose, approaching to earthy, and it is again found below this village in the neighbourhood of limestone beds, and containing a bluish semi-transparent mineral in grains similar to that described (Art. 126.) Here the gneiss formation is finally taken leave of, being succeeded by talco-argillaceous schist.

140. We must now proceed to the valley of the Kalee, and trace the southern boundary there also. The former account stopped at Ookemuth on the Kalee. In a glen a mile south of it, is seen a schist full of those flat veins or circular masses of quartz which are so common in micaceous and argillaceous schist; this rock dips 45° NE., and has an inclination of about 30° to 40°. Between the villages Jukh and Oakee again, gneiss is met with; below in the bed of the river is a mass of calcareous tufa with vegetable impressions. It is of a light buff yellow colour, is rather porous with a semi-crystalline grain. It is a very pure carbonate of lime, and affords an excellent cement by burning, which was used for the stone temples erected one at Kedarnath, at the foot of the great Soomeeroo Peak,* the other at Ookee Muth where the Raool, or chief priest, resides.

* This temple is situated at the source of the Mundaknee, a branch of the Dhaolee, in one of those expanded vallies described in Art. 95. The elevation of the place is — and it is unnecessary to say that during many months it is deep in snow, and consequently not habitable. There is even no village within 15 miles of the place; it it rather larger than the generality of these structures, and is handsomely built of hewn stone.

141. Chloritic schist is seen again at Kandara in the Greenduala glen, which furnishes a middling sized stream to the Kalee; beyond the chloritic schist-gneiss is again found near the village of Baroo, Amorphous patches of earthy granite may be observed, so soft and crumbling as to yield easily to the spade. On the summit of the Pass a talco-chloritic schist obtains, and continues to the mines at Pokree, fragments, however, of hornblende schist being scattered about in some numbers; beyond this point no gneiss was observed in proceeding south; we may therefore return to Mumdal below the Toaugnath Pass, where the account of this formation left off. (Art. 103.)

142. This village is situated in the high bed of the Dulalee river, which has its rise in the schist of the Toongnath mountains, and joins the Dhoalee just below Gopisur. The route leads down the glen to turn into the valley of the Dhoalee; very little rock in situ was observed, indeed only one patch, which was of too little extent to say precisely whether it was granite or gneiss, the toughness being such as to set at defiance the hammer, and consequently prevent its effecting a fracture of the rock, so as to judge of its mineralogical composition. It was a roundish amorphous mass with a few irregular seams projecting but little above the surrounding surface, and thus, from its want of sharp corners, increasing the difficulty, occasioned by its toughness, of detaching a specimen. Fragments of hornblende rock, of quartz rock, and of gneiss, are abundantly scattered over all this tract. One block, probably part of a vein, was observed, consisting almost entirely of that variety of hornblende called actynolite; part of the containing rock still adhered, being a fine granular mixture of felspar, quartz, and mica, the first ingredient in greatest quantity. The actynolite has rather a confused structure; apparently large concretions formed of radiating bundles of prisms. The specimens obtained were not remarkable for beauty.

143. A more remarkable phenomenon was the occurrence of a huge mass, composed apparently of very similar ingredients to the secondary sandstones. It was a solitary rock which stood in the bed of the Dulolee, the top being covered with grass and shrubs; strictly it might be called a conglomerate, containing many large boulders or rounded stones. The base was rather fine grained, consisting almost entirely of quartz sand, and apparently held together by the slightest

coherence. The friability and want of consistence of the substance, prevented the retention of any specimens, as they fell to pieces immediately on being detached, though the rock itself, of considerable size, seemed persistent. I am inclined to think it was merely part of a diluvial deposit and not a legitimate sandstone, no specimen of which I have ever observed in such a locality. In reality though the sandstones are often friable, and have little coherence, yet I have never seen any which exactly resembled this rock.

144. At Sikol, in the bed of the Dhaolee, I found large masses of quartz rock stratified, probably with great regularity, but the fissures of the strata so intermixed with cross cleavages, that it was difficult to separate them, and say which really was the plane of the strata. The colour of this rock was greenish, it is also seen near Masooa, rather a large village near the rope bridge by which the Dhaolee is here crossed. The dip was N. E., inclination about 60° to 70°; close by the bridge it appears to pass into micaceous schist. Further on in the valley of the Mundaknee, it appears to pass into chloritic schist.

145. I must not leave the Dhaolee, however, without saying some thing of those great accumulations of boulder stones, the very sight of which strikes the traveller with astonishment, and forces him to admit the action of some great rush of waters. These diluvian beds are here seen on a scale, which sets at nought any theory that should derive its agent from the body of water at present occupying that channel. These deposits seem always to be found in those parts of the river's course where the valley widens considerably, at least it has been so in all the instances I have yet had to notice. In the immediate bed of the river, the fragments consist of two kinds, the one perfectly rounded, the other subangular. The rounded fragments consist of gneiss, granite and hornblende rock, the other of quartz rock and mica slate, the two latter being the rocks in situ in the immediate neighbourhood of the rounded fragments; these are of all sizes from boulders of four feet in diameter to the small grains of sand. That the river in its greatest floods, and in some particular parts of its course possesses the power of moving these stones, is certain, from the deep hollow noises heard every now and then. That it can do little more than merely move them is equally certain, from the fact of these boulders always occupying the wide parts of the valley. There are tracts here of a mile in length, and

probably 300 feet wide, (the depth is not known), consisting of these huge stones, great part of them now far above the reach of the highest floods. It is not to be understood, if they had been moved by causes still in operation, why none of them should have travelled a little farther.

146. Ascending to Sooralee from the bed of the Mundaknee, chloritic schist is found established, extending for some miles beyond the village to the foot of the Okrooaree Pass, which separates the Purgunnahs of Budhan and Dussolee. It is as usual much intermixed with quartz rock; some specimens of a straight laminar structure have an emerald green colour, and an almost metallic brilliancy. This is a beautiful rock. On the descent from the Pass gneiss is found of a small grain, a very compact rock. The dip is N. 80° E. the angle of elevation 60°, hence passing by the village of Koon to Choptah, quartz rock and chloritic schist prevail irregularly mixed. The dip generally N. E., the inclination 25°. At Chobtah, they are exchanged for an earthy micaceous schist, which however must be of very limited extent.

147. Below this village, on the road to Jak, the rock is of a less definite structure, being an irregular mixture of dolomite and talc; sometimes the grains are small and the mixture intimate, sometimes they are larger, and the aggregation of a granitic character, *i. e.* each mineral perfectly distinct, though mutually impressing each other. These distinct concretions become so large, that each mineral may be found forming the substance of distinct blocks. This type of rock occupies but a small space, being found only on the right bank of the glen below Chobtah; on ascending the other side, fragments of a granitic rock are met with, but of peculiar mineral character. The ingredients appear to be a dark bluish grey felspar, quartz and talc, the grain is small, the rock exceedingly tough and hard, with an amorphous structure, although some specimens shewed something like a transition into the schistose. This rock was not seen in situ, only in fragments, and has near been observed in any other locality. It is a very beautiful rock, and would be extremely ornamental if cut and polished.

148. Near Jak, beds of hornblende schist occur, apparently graduating into quartz rock; on the quartz rock, which contains felspar, rests a bed of chloritic schist of scaly composition and unctuous feel. These two rocks are perfectly distinct, and the line of separation strongly drawn. The dip is N. 60. E. and the inclination 40. Below them in

the descent to the Pindar much quartz rock occurs, dipping always N. E., but having frequently a second set of cleavage planes equally distinctly marked. The only method of recognising them is the greater or less permanence, the false stratification if it may be so called, often vanishing within short distances. At the foot of a precipice formed by a beautiful natural section of a quartz rock containing felspar, is a patch of grey rock, amorphous, without any trace of schistose structure, and projecting in large round masses, very similar to those which granite is seen to affect. It is probably a mixture of hornblende and felspar. A whitish rock of a small grain, and similarly amorphous, is seen in contact sending veins through it, and reminding one strongly of the description given of granite veins. This white rock is similar in mineralogical character to the stratified rock above noticed, consisting of a mixture of quartz and felspar. The fragments in the bed of the stream are chiefly gneiss and hornblende rock; they are frequently increased by calcareous spar.

149. On descending into the valley of the Pindar a greenish grey schist is met with at the rope bridge. Character intermediate between hornblende and chloritic schist. It probably belongs to the former title, though the fragments and other indications beyond this place point to a formation of talcose schist. Fragments are also met with of gneiss and of hornblende schist. At Zubburkat, the rock is a gneiss, of a fibrous columnar structure, dark grey colour, and earthy aspect. It probably contains, if not hornblende, some magnesia or a mineral, probably talc or chlorite. It also contains grains of the blue semi-transparent mineral noticed (Art. 139.) Beyond this village immense blocks of a well defined gneiss are met with, resting on the mountain side, and some few of hornblende rock, but such is the thickness of the covering of debris and vegetable mould, this being the side of easy slope or quarter of the dip, that no instance of the rock in situ occurs till we approach the village of Chelinga; here may be seen a strata of gneiss, dipping N. 85° E. and at an angle of 40°. This gneiss agrees in character with that constituting the large blocks just noticed, and has an affinity to that seen at Zubburkat. It is a small granular mixture of black mica, greyish white felspar, and quartz, with distinct foliated grains of felspar superadded. The quartz is obscure, and indeed in all these mixtures of small grain, it is not easy to detect the nature of ingredients

so intimately mixed, without using some method of mechanical analysis, similar to that proposed by M. Cordier.

150. In the ascent from the village of Chelinga to the Goruldum Pass, no rock in situ is visible, but fragments of granite occur, of various sizes, strewed over a small flat at the commencement of the ascent. The source of these is not obvious. On the summit of the Pass quartz rock and chloritic schist, passing into micaceous schist are found in strata, the dip of which is a little obscure, but which seemed to be N. 60° W. Of the quartz rock, it is doubtful, whether it be not a transported block, but the schist is evidently in its place. On leaving the Pass in the descent to the village of Koolem, an earthy decomposing granite in amorphous patches is met with, of the same character as that noticed above Baree, in the valley of the Mundaknee, (Art. 100.) This rock is a very remarkable one, and requires a little detailed description. The proportion of felspar compared to that of the other ingredients is very great, and it appears to be singularly subject to decomposition, so much so, that the rock may be dug like a bed of clay or vegetable mould; the quartz and felspar, on a first appearance, form one uniform mass, in which, however, they are to be distinguished by colour, the quartz being greyish white and the felspar yellowish, and by their state of disintegration. The mica is of a dirty brownish green colour, and is disposed rather irregularly, as well as scantily. The laminæ are never parallel, a character by which it has been proposed to distinguish granite from gneiss, and which if it hold universally, will form an useful distinction, as being easily recognised.

151. On descending into the valley described in Art. 149, no rock is visible for a considerable distance, the soil being of great depth, and frequently overspread with forests. In the beds of streams however, may be observed occasionally the edges of strata, both hornblende schist and gneiss, and there are several patches of the decomposing granite also. In the ascent from Hath to Retorah villages, gneiss may be observed, at first of a very regular character, bluish grey, and strongly resembling the most legitimate gneiss of the Himmalaya. The gneiss appears gradually to pass into micaceous schist, which at Retorah is white, fine granular, and almost might be called slaty quartz rock. On the summit of the Hackena Pass, which leads into the valley of the Cossillah, it is of a dark greenish brown colour, very micaceous, and very

tender. The dip of the rock at Retorah was irregular, and the gneiss in the neighbourhood equally so, the strata having many undulations, but the rock observed in the bottom of the valley had a dip N. W.

152. Descending from this Pass quartz rock of an arenaceous composition is found. It contains beds of chloritic schist. Beyond this, near Mala, argillaceous schist becomes established, of great variety of aspect, of a purplish, greenish and light grey colour, straight, fissile, with rhombhoidal cleavages, and of a soft consistence, comprising every variety almost of the brightest colours. It contains beds of limestone, which are often highly argillaceous. Farther down in the valley of the Cossillah, micaceous schist is met with, and then an extensive patch of gneiss, which stretches across the valley, and is probably connected with other masses shortly to be noticed. Afterwards the micaceous schist again re-establishes itself, and continues to Almorah. Here for the present we shall break off this description, and return to the route from Sacen, in which gneiss was traced as far as Naneik, and to the bed of the Ramgunga below the village, (Art. 106.)

153. The route proceeds by Ratik, gneiss accompanying us the whole way; some fragments of a very peculiar rock were found, composed wholly of a substance which might be called intermediate in character between rhombohedral and prismatic talc mica. It was of a dark brownish green colour, and the foliæ of the mineral were placed in every direction, having the appearance of a confused aggregation. The same rock occurs rather abundantly in the ascent to the Soor Doora Pass, but always in fragments, while the rock in situ continues to be gneiss as far as the village of Soor. Beds of hornblende schist, and of micaceous schist occur in the descent to the bed of the Sirjoo river; the gneiss being, however, the containing rock, and continuing to some distance beyond the village of Soope.

154. Here the rock begins to change, the gneiss appearing to pass into a fine grained mixture of talc and quartz, which may also perhaps contain felspar. This is succeeded by quartz rock, which again becomes talcose, and incloses small beds of talcose schist. It passes into chloritic schist also, the quartz becoming at first green. The latter rock contains veins of quartz, and on one a particular concretion of so remarkable a shape and appearance, as to have the strongest resemblance to a rib-bone. In endeavouring to detach it, the resemblance was des-

troyed by fracture. On the Pass of Chowr Bunaik, the talcose rock is fairly established, being occasionally schistose, occasionally amorphous or massive. It is of a white colour and beautiful nacreous lustre. Descending thence, various mixtures of this mineral, (prismatic talc mica,) with quartz, are found sometimes inclining to a green colour, and apparently allied to chloritic schist, sometimes to a blue, and passing into argillaceous schist. Alternating beds of the green schist and quartz rock were observed, very regular and well-defined.

155. In the neighbourhood of the village of Kurrimee, the rock is a mixture of white granular dolomite and talc. The latter is sometimes found in beautiful nacreous scales, disposed in nests or nodules, at other times intimately mixed with the particles of the dolomite. In the latter case, the rock is extremely friable, and resembles very strongly the dolomite of the Alps. This rock is succeeded by a schist of an argillaceous character, very soft and tender, and of a dark blackish grey colour. The schist is occasionally green in the ascent to Tobne Binag, where the view of the mountains discloses several beds of talcose schist of a whitish colour; descending to the village Bugur in the bottom of the glen, limestone is the rock. It is often very impure, being highly charged with argillaceous or siliceous matter. It is regularly stratified, dipping N. 48° E. at an angle of 60°. The strata are sometimes curved.

156. This limestone continues in the ascent to the high Pass of Cheeoonga Binag, the whole of which ridge is composed of it. With occasional patches of schist of an argillaceous character, it still accompanies us by the village of Ingthana to Bynsaree, in the route down the glen in which those villages are situated. The strata are sometimes fissured and cracked in every direction, and in some cases so fragmentary, that large masses have fallen out, thus giving rise to extensive caves. From Bynsaree, the route passes up a lateral glen to Soomchala, crossing an elevated ridge. On this ridge and the immediate ascent to it, argillaceous schist is found of a reddish brown colour, earthy composition, and splitting readily into rhombohedral fragments. This rock is sufficiently exposed also in the descent to Soomchala, where it is remarkable for its many changes of colour, within a small space; as also for the rhombohedral cleavages passing into the straight schistose.

157. As far as Darimket, the route lies in a succession of glens, in which no trace can be found of the rock in situ at that village. It ascends, and immediately a talco-micaceous schist is met which continues to the foot of the descent into the valley on the other side. This latter is one of the many branches which fall into the great one of the Gaomootee, described, Art. 65, and as such, partakes of the open and level nature of the latter. At the foot of the descent fragments of hornblende rock occur in great abundance, and a little further, the rock in situ is found to be an earthy gneiss, extremely soft and crumbly. This rock continues to disclose itself in different parts of the river bed as far as Byznoth; and at the foot of the ascent to Retora a grey gneiss of very perfect character is seen dipping N. E. In the ascent to Retora, this route coincides with that described Art. 65.

158. We have now to take up our account of the gneiss at the village of Dampa, Art. 105 where it is described as of a remarkably regular type, and disclosing itself in extensive masses distinctly stratified. From Dampa to Munsaree, this rock continues, and near the latter place and above it, are enormous blocks of this rock scattered about in the wildest confusion. Thence ascending to the Betoolee Dhoorah Pass, the same rock is occasionally found, and occasionally beds of hornblende schist. At Munsaree there occurs a bed of a very beautiful rock, being a mixture of white granular limestone and talc, (prismatic talc mica,) the latter is occasionally diffuse. Amongst this the carbonate of lime occasionally occupies distinct layers, passing into the argillaceous schist. This rock furnishes excellent roof slate, being very fissile. In the bed of the Gurjeea river below Munsaree, the rock is an earthy brown, tender, micaceous schist in descending the bed of the Gurjeea, as succeeding to the gneiss.

159. Descending from this Pass, quartz rock occurs in extensive masses distinctly stratified, dipping N. 15° E. Other fissures at right angles, at distances of five feet, are extremely distinct, the whole mass being thus divided into rhombohedral or cuboidal masses. This quartz rock is seen sometimes plain, sometimes green from the addition of chlorite, and sometimes blue, probably from an admixture of argillaceous schist. On the Kalee Moonnee Pass and the descent to Girgaon, the rocks are rather of an anomalous nature, and comprise beds of very various and varying composition. Talc slate, yellow, white and blue

carburetted clay slate, blue ditto, talcose quartz rock, and talcose limestone are the most marked types, and they succeed each other in the most sudden and unexpected manner. In general, however, the formation may be said to have a talcose character, that mineral forming more or less of the composition of each rock, but I think that it is surmounted, or at least surrounded, by the same gneiss which accompanied us from Munsaree, and which appears in all the larger masses and the more elevated ridges. In the bed of the nullah below the village, rounded blocks of this rock are seen of an enormous size, which confirm the above idea. Beyond this point, it is not found till we approach Almorah, and the masses in that neighbourhood being connected with the granite beds there, will be better described when we come to the details of the latter.

160. The preceding comprises all my observations of the localities of gneiss within these mountains, with some trifling exceptions hereafter to be noticed. It will now be necessary to proceed to the next formation in the order of succession. It is of a schistose structure, but very variable in mineral character, comprising micaceous chlorite, talcose, and even argillaceous schist. My observations are not yet sufficiently multiplied to determine, whether all those schists form one member in the succession of rocks, or whether the three first are to be considered as most intimately related, and the argillaceous band as the distinct term in the geological series. Some anomalous appearances, which are inimical to the latter view, may perhaps be explained by the intrusion of the granite masses in the middle of argillaceous strata, but it would be premature at present to decide either way. We may for the more convenience of description, consider them all as members of the same formation, as each in its turn is conterminous with the gneiss.

161. Beginning with the most western route, we may take up the description where the micaceous schist in succession to gneiss was again exchanged for chlorite schist. Near Laké, the latter rock may be seen, though from its transitions it ought perhaps rather be called a magnesian clay slate, (talco-argillaceous schist.) It has a N. E. dip. It extends to the foot of the descent into the bed of the Salung river. There may be seen an impure limestone associated with a clay slate, the two rocks being found not only in alternate layers, but also occasionally intimately mixed in the same layer. The fragments in

the bed of this river consist of granite, gneiss, micaceous schist, and hornblende rock, all of them substances at present found in situ only at a considerable distance.

162. Ascending to Reowthul, numerous indications are observed of a limestone formation; clay slate does not entirely disappear, but the higher ridges in the neighbourhood, judging by the outline and general appearance, are evidently limestone. This rock affords one of the instances in these mountans in which disposition of form and colour is an unerring guide to the nature of the rock, forming a series of irregular terraces or ledges, the faces of which are always precipitous, and stained with black and yellow, the outline of the summit presenting a rather flat curve; it is impossible to confound the limestone of these mountains with any other rock. There is certainly a local physiognomy in rocks, if I may so express myself, which enables a person familiar with them, frequently to determine correctly their nature, from the mere view of the mountains in which they are formed. But there is no truth in the opinion that would extend these local phenomena to a wider sphere, so as to make them instances of a general law.

163. At Reowthul, there are several smelting houses for obtaining iron from a hydrated peroxide, (prismatic iron ore,) which is found in the neighbourhood. I had not time to visit the place whence the ore is obtained, but I examined the specimens of it which they had brought for smelting. It is a light scoriaceous yellowish brown crust, and very similar to deposits of the same ore which I have seen in other localities as originating in streams, permeating argillaceous schist, and strongly charged with ferruginous matter. The iron is said to be in repute.

164. From this village the route passes round the brow of the range to the Pass immediately above Surara, and in this line wherever the rock is seen it would appear to be limestone, with some trifling exception in the occurrence of a micaceous argillaceous schist. At Surara again, the rocks are all limestone, presenting that appearance so common to this class, of huge amorphous masses united to others often honeycombed or irregularly varied in surface or regularly stratified, or even schistose. Yet I would say on a large view of the phenomena, that this rock seems to be always most regularly stratified when most impure, and vice versa. Another appearance remarkable in this limestone is the aries

that seems to attack lumps small of it, changing the outer surface to the colour, grain, and consistence of chalk. This change is the more remarkable in a rock, which like this is of a blue colour, and possessed of considerable hardness.

165. In the descent from Surara to the bed of the Syrij river, limestone is the only rock seen, ascending thence to the ridge which forms the right bank the same rock prevails of a less pure type, and occasionally of a schistose structure. In the lateral glen in which the village of Ureea is situated, the rock appears to be mica slate, or a transition between that and clay slate; the limestone is in general impure; when otherwise, it appears to undergo that superficial caries already noticed. It must be rather an extensive bed, for most of the surrounding ridges were also observed to be composed of this rock, as recognised in its characteristic ledgy precipices. This limestone is also seen in the descent to the Bangur, and also in the bed of that nullah, distinctly stratified and dipping N. E., the reverse of the micaceous argillaceous schist near Ureea, which is S. W.

166. On ascending from the bed of the Bangur, an anomalous rock is seen, in amorphous patches of a greenish colour and considerable hardness, very possibly ferruginous quartz rock. A black type of the same rock occurs in fragments in the bed of the nullah, and with disseminated iron pyrites, (rhombohedral iron pyrites,) argillaceous schist then establishes itself, being occasionally of a magnesian character; occasionally (below Sookowlee,) of a micaceous. The route here passes over the several ridges which ramify from the Chandpoor peak, the rock of which is micaceous schist, and this line appears to be the junction of the two formations, to judge by the frequent transitions and oscillations. It may be observed, that the strata appeared pretty regular, and with exception of the rock at Ureea, appeared to dip conformably.

167. In the vicinity of Sokanda, the schist assumes a micaceous character. Near Dharee, limestone protrudes in limited quantity, and we have then the argillaceous schist with its usual variableness of character continuing to the bridge over the Tonse at Mywar. It is at one time a blue smooth laminar slate, (talc argillaceous schist,) again a fine grained slate approaching to compact (argillaceous schist,) which is succeeded by a fine grained greywacke, slate (micaceous

argillaceous schist). Just above the bridge, nodules of limestone are seen, but the rock appears to have no extent.

168. In the bed of the river, a very perfect type of argillaceous schist is seen, distinctly stratified, and dipping conformably. It passes into a rock, having the strongest resemblance to reunited angular debris. It is in this rock that the Uyar lead mines are situated. The rock is so soft, as to afford great facilities in excavation, but unless well supported by wooden framing, it is liable to the accident of falling; has happened more than once, and several miners have been crushed. The ore is a steel grey fine granular galena, (hexahedral lead glance,) and is often found in veins traversing quartz; it is accompanied by iron pyrites, (rhombohedral iron pyrites.)

169. At this place the river is crossed by a bridge formed of a single rope, on which a block with the passenger or baggage attached, traverses. It is a very tedious, though perfectly safe method of crossing a river. On the right bank about one and a half mile lower down is the lead mine of Mywar, belonging to Tounsar, one of the reserved districts. That at Uyar belongs to Sirmoor. At Mywar, the same ore is found and accompanied by the same minerals, and the containing rock is there also a clay slate, though occasionally very calcareous. The galleries are very numerous; in some, sulphur is obtained. In others, the vein is a blackish friable earth, in which the galena is in nodules.

170. The route to Borrela from this place turns back to the northward, ascending along the right bank of the river. In crossing the Ventijar, which here falls in the Tonse, argillaceous schist is seen in its bed in situ, while the round stones are all limestone. These boulders continue to the height of 300 feet above the bed of the river, and are united with a calcareous conglomerate, which is, however, of a very limited extent. Argillaceous schist is thence the prevailing rock, but mixed with occasional patches of limestone; above the village of Joktan the latter rock establishes itself in larger masses, constituting whole ridges, and extending with very little interruption thence to Borela.

171. It is in this rock, which in its lower strata appears to pass into argillaceous schist, that the lead mines of Borela are situated. The ore is in every respect similar to that found at Uyar and Mywar, and is also accompanied as there, by iron pyrites. The number of galleries here, as well as at Mywar, is truly surprising, and shews the perseverance of

these people, even with their imperfect means. They told me they were in number eighty, many of them of great length, and yet the village is small, and does not contain above forty inhabitants of every sex and age; but there are several other villages that have a joint proprietary right, the assessment being made on the small purgunnahs or hundreds, as they might be called, and not on the individual villages.

172. The limestone of Borela continues to Haje, with very little interruption, and through a varying level of at least 1,500 feet. It very often contains veins of a pure white calcareous spar, sometimes it is fœtid, and then it always appears to be less pure. In this latter case, it is occasionally found to contain veins of white granular limestone, and not unfrequently also, to pass into a flint slate or schist. It has its subordinate and limited masses of local breccia, and conglomerate accompaniments, which this rock is never seen to want. It is a good deal intermixed with quartz rock, and has occasionally, as might be expected, a silicious character. With regard to its stratification, it is when at all impure, distinctly marked by parallel seams, and when pure, as often amorphous. This indeed is a remark I think universally applicable to limestone. A very remarkable curvature of the strata is seen on the ascent from the Mator nullah, which separates Haje from Borela; some indications of argillaceous schist were also observed here.

173. Near Haje, the rock may be called a well characterised argillaceous schist, which afterwards becomes micaceous. This is succeeded by a series of types of quartz rock of very various character. The most remarkable feature in this rock is the suite of colours it exhibits: grey, green, red, purple, and brown from the extreme shades, and in their transitions, a great variety of intermediate tints are produced. In general, it has a granular composition with considerable hardness. The structure is occasionally cleavable in three or more directions, occasionally it is subschistose. In the latter case, the rock is observed to pass into an argillaceous schist. In general, this quartz rock owes it colours to indurated clay, or a basis of clay slate, and it contains, superadded to this ingredient, scales of mica, never in any abundance. The composition is never of that decidedly granular appearance which distinguishes the sandstones; frequently it is evanescent where the proportion of quartz is a little less predominant. I think this rock might

be considered as a greywacke; some of its transitions into argillaceous schist are doubtless entitled to that designation.

174. On the border of this rock, we find another of so anomalous a character, as to require some illustration from investigations in other parts of the line of strata. It consists principally of indurated clay and quartz, and contains grains of a green pellucid mineral, very much resembling some varieties of actynolite. It also contains mica in notable proportion. It is in fact one of the many aspects under which the above described quartz rock is found to vanish. I have sometimes thought that this rock has some connection with one occurring on the road from Bheemtal to Almorah, and which will be afterwards described. Like this, it is connected on the one side with quartz rock, on the other with clay slate. In this quartz it is succeeded by a small patch of slaty limestone, which speedily gives way to the prevailing rock of distinct argillaceous schist.

175. This schist presents a great variety of types, as may be seen on the road to Deao. It is sometimes compact, sometimes granular, often heterogeneous in composition. The granular types are seldom perfectly fissile, some not at all. In those which are so, the laminæ are almost always undulated. It is further remarkable for the quartz veins by which it is intersected in every direction, not only in that parallel with the laminæ of the schist, but also transversely, and in every possible angle of obliquity. These veins, as has been often remarked, never appear to interfere with, or disturb the arrangement of the parallel layers. In one instance, where dip has occurred, a bed of local debris (alluvium of descent) of fifty feet in thickness is observed resting on a highly carburetted type. It is not improbable, from this and other indications formerly observed, that graphite exists in this neighbourhood. I ought not to omit noticing, that the dip wherever observable was between N. and E.

176. This schist continues in the descent to Kalsee, and under such protean aspects, as renders the study of its relations extremely interesting. It is at one time a green slate, with smooth laminæ, which by a gradual change, passes into a rock, that in hand specimens could not be distinguished from a greenstone. The transitions into this rock are remarkable for affecting a rombohedral cleavage. Within a few yards it again appears as a shattered slate, consisting of very thin and scarcely

adhering plates confusedly united, as if they had been crushed, or at least suffered some violent pressure. The ordinary type is seen to pass into a veined one, the veins being quartz, and this gradually into a quartz rock of a dark colour, highly charged with the indurated clay of the slate, and still intersected, as that was, by veins of pure quartz. The laminæ of the most perfect slaty varieties are very often bent; small patches of limestone, evidently the traces of included beds, occur along the whole line.

177. At Kulsee, the rock is still argillaceous schist of a very perfect type, dipping E. of N., that is, at the bungalow belonging to Major Young on the hill; but in the descent to, and in the town, the rock in situ is concealed, and it is not till after having passed it a mile or so, that a new formation (sandstone) is observed to be established. The strata dip S., and a little further on, are vertical. From this position they gradually passes to a dip E. of N., but possess still a high inclination. The character of the rock is perfect, and leaves no doubt that the argillaceous schist has here terminated, and is succeeded by a totally different formation. I shall therefore defer my details of the new rock till I follow out all the details of the former one, and trace it in a similar manner to its boundary in every other quarter in which it has been examined.

178. I shall take up my description at the point below the village of Kande in the Burral district, where the last patch of gneiss was found, (Art. 139). It was noticed that the ridges above appeared, by their outline and arrangement, to be limestone; a few traces may also be seen in the bed of the stream, and fragments of the local conglomerate which always accompanies limestone. The rock then becomes a talco-argillaceous schist, being frequently distinguished for its beautiful pearly lustre and pleasing colours. This type is further remarkable for its smooth gently curved laminæ, and the minute undulations or furrows of their surface. These latter I have almost invariably observed in slate that contains a sensible proportion of magnesia. Besides this well marked variety, there occurs another of an earthy character, which gradually passes into hornblendic schist.

180. The dip of the strata in this glen, (Burral,) was uniformly W. and N. W., and therefore not conformably to what I suppose the general dip of the formations throughout these mountains. Nor is it an

irregularity confined to a small extent of country, for the surrounding ridges and peaks are all obviously conformable in dip to that observed in the valley itself. In the Rama Sera glen again, it was observed to be,* which is something more approaching to the usual dip. In this case the principal effect due to the disturbance of the strata, (if they really be disturbed,) would be found in the Burral glen. It is to be observed, that both the Burral and Comoulda rivers spring from the furrows which intersect the sides of the great Kedarkanta peak elevated — ? feet. This peak is remarkable for its shape, and for the arrangement observable on the summit. The shape is that of an immense truncated cone, which appears to have an oblique position, owing to its greater slope on one side, and precipice on the other; the summit is flat and of some extent; at one end is a considerable hollow, in which are wedged together, in utter confusion, enormous blocks of gneiss, the rock of which the mountain consists. The strata appear to dip N. W. What connection the peculiar character of this peak (if any) may have with the irregularity of the dip, it would be vain to enquire without a more detailed examination of the vicinity.

181. At the mouth of the Burral glen is an extensive flat, communicating with a similar one in the valley of the Jumna, and very little higher than the present level of the latter. It is observed to terminate in the bed of the Jumna in smooth rounded elevations, which on the river side are cut down vertically, and exhibit, in the precipice facing the river, their structure in the most complete manner. This precipice is about 120 feet high, and is composed of loose gravel and sand, with numerous round stones of every size sticking in it, some of them half projecting. On the opposite side of the river appears a similiar bank, composed of similiar appearances, and of the same height. The intermediate space, to judge by local appearances, must have been once filled up; for so narrow is the gorge, that no possible slope at which they could lie would clear them of the river bed. Indeed, the one is washed by the waters of it, and at the foot of the other, the path is not more than a few feet wide.

182. The right bank sinks, as I have said, gradually into the broad and level flat at the mouth of the Burral glen, the slope being, like the latter, covered with verdure. The left bank continues of moderate

* Blank in MSS.

width to a point below the affluence of the Burral, and then gradually subsides about half a mile. Below this point occurs a third similar flat, doubtless composed of the same materials, and containing about half a square mile of level ground. It is worthy of remark, that the three are, as nearly as the eye can judge, of the same level. It should also be noted, that in the two, the structure of which appear, nothing like strata or a division, nor distinction of deposits occurs; the great and small boulders are indiscriminately mixed in every part, and the whole has the appearance of being the effect of some very powerful, but sudden or short-lived cause. The fragments most abounding are quartz rock of all colours, next to this is hornblende schist, with very few of granite or gneiss.

183. The last rock observed in the Burral glen was a bluc talco-argillaceous schist, with a pearly lustre. In the bed of the Jumna, close by the suspension bridge, a mass of limestone occurs. On crossing the river, a rock of limited extent is met with, and of very anomalous character. It is probably a mixture of chlorite quartz and felspar, the latter not abundant, or the green ingredient may be some variety of hornblende. The structure appears to be laminar, yet the fracture is such as to indicate the amorphous. It is a tough rock, and breaks with sharp corners. It is succeeded by extensive strata of a talco-argillaceous schist, the prevailing colour of which is an olive brown. The dip appears to be N. W. the same as that in the Burral glen,

184. From Burket to Bimsa, the prevailing rock is chloritic schist, often inclining to argillaceous, often soft and decomposing, intermixed with beds of quartz rock which generally incline to a green colour. The earthy, or decomposing and the more perfect straight laminar types, are often found in the compass of a few feet, nor can there be any doubt of the unity of this formation when we view it in nature; although a collection of the specimens, unless extremely numerous, might exhibit some very striking contrast. Frequently, the laminæ are extremely thin, quite flaky, and in this case they are seldom separable of any size. From such a rock, it is impossible to detach a specimen, for on the application of the hammer it flies into showers. When the colour inclines to green this rock is generally soft, when to blue it is hard. No good examples of strata are met with on this line, the rock seldom appearing but in surface patches of no great extent.

185. From Bimsa the road ascends a lateral ridge, and thence descending upon the village of Tevan, crosses the Bunnee glen near Kateel. On the summit of the ridge, or rather just below it, there is an exposure of the rock, (in a space little exceeding ten square yards,) of the following very dissimilar substances :— 1. a light bluish grey mixture of talco-argillaceous schist and quartz, this changes to, 2. a more perfect schist, with bent laminæ, the colour still bluish or grey, the aspect a little talcose ; 3. a true chloritic schist, with similar bent laminæ ; 4. a dull green earthy compound without lustre, has a subconchoidal and uneven fracture, splits into thick flags, and is subcleaveable ; it is probably a mixture of hornblende and felspar, or of chlorite and felspar, or possibly all three ; 5. a light bluish green talcose schist, with curved and straight laminæ and considerable lustre. These types will also serve for a description of the rock as far as the ford over the river, occurring in various propositions and successions, which it would be a waste of time to attempt to devolve, the whole being united in the clearest manner, and constituting but one formation.

186. The ridge just crossed in its prolongation, puts on the appearance of the limestone precipice described, Art. 181, and on crossing the Bunnee river, there is little doubt but that these appearances are indicative of a limestone bed. It continues for about two miles, when argillaceous schist establishes itself, extending over the Gooddur Kuttal Pass to Moolla, a small village in the Gooddur glen. This schist is certainly not at all talcose in its aspect. It is of a fine granular or earthy composition, is very soft, and is remarkable for splitting into prisms, not laminæ or slates. They are sometimes of considerable length, slightly flexible, and would form very excellent slate pencils. It is of a great variety of colours, black, bluish, greenish, yellowish, olive brown, reddish, &c. &c. It contains numerous beds and veins of quartz. Below the village of Moolla, it passes into, or is replaced by a true chlorite, dipping N. W. with an inclination of 35°.

187. From Moolla to Horinsee, the argillaceous schist prevails, none of a chloritic character being visible. Close by the latter village, there is a mass of rock deserving of examination. It appears to be in one spot of a fine blackish greywacke schist, with scales of mica disseminated ; the composition fine granular, the structure well marked schistose. It is in contact with, and passes into a reddish brown rock of

coarser composition, with a structure amorphous, or at least only subschistose. Adjoining the latter, a greenish grey rock of fine granular composition, the structure entirely amorphous, and having a high specific gravity; consequently containing either hornblende or augite. The three types are all included in a single mass of no great extent, and on passing them, argillaceous schist of the usual character is found.

188. From Horensee, the route passes down the Bhudree glen, which is of some width, and encloses a good deal of level ground. In consequence, the rock is not often visible. Close to the village of Kol, there is a sudden descent, in which strata of schist appear intermediate in character between argillaceous and micaceous schist. It is accompanied by quartz rock, which as usual, forms a series of transitions into the schist. A little beyond Koree, a pale bluish grey subschistose rock, a composition probably of indurated clay and quartz rock, comes to the surface. It is succeeded by a dark blue argillaceous schist, containing nodules of quartz, the laminæ of the slate being bent round them; a bluish grey rock of a subschistose structure, not very quartzose, becomes then established. If it were not that it wants the decided appearance of a mechanical origin, I should feel strongly inclined to call this a greywacke. But the erroneous application of the latter name is the more to be guarded against, since it has become certain, that some of the rocks which have been distinguished by this appellation, are identical with the red sandstone, a rock of which no trace is found in this quarter. Under the title of argillaceous schist and quartz rock; it cannot lead to any false conclusions, and as such, it may be described until our nomenclature of rocks be more discriminative of them than it is likely for a long time to be.

189. It continues as far as Koodæon in the valley of the Aglar, forming the whole of the ridge which separates the Bhudree glen. In the bed of the Aglar, a very similar rock prevails, but on the ascent it acquires the more characteristic aspect of a true clay slate. Infaceous conglomerate is also seen in isolated masses, and occasionally a blue limestone. Near the village of Ramon, the latter rock becomes established, to the exclusion of the slate. It is, however, of very various aspects, sometimes it is a black, hard, non-effervescent rock, fœtid when struck, and possessing scarcely any resemblance to limestone. This is its condition generally in the vicinity of the masses of gypsum which are here found; at other times it is highly siliceous, and though bearing

the appearance of limestone, might from its non-effervescence, be called schist; the pure blue limestone is, however, also found, and in considerable quantity.

190. The gypsum which is associated with this limestone, is of a saccharoidal aspect, the colour being beautifully white, and the grain fine. No crystals, except the most minute, have been observed. It is found neither in beds or veins, but in superficial amorphous patches, presenting an appearance of considerable singularity and interest. It is always connected with the black non-effervescent rock described in the preceding paragraph. The latter has very often the appearance of reunited fragments, and the gypsum sometimes contains nodules of it. Without doubt some connection exists between the origin, or at least the present place, of this gypsum and this very singular rock, always found in contact with the former, and not observed hitherto anywhere but in the immediate vicinity of it. There is not the slightest appearance of stratification in either rock.

191. From Ranon to the summit of the ridge, (Mussooree Tuba,) limestone prevails, and the varied and picturesque disposition of this mountain sufficiently attests the character of the rock. In all countries it has been observed, that not only are the limestone districts most fertile and productive under the labours of agriculture, but that also when abandoned to the hand of nature, they furnish the most picturesque and beautiful scenery. The summit is composed of the same rock, and constitutes one of the most romantic spots within the circuit of the mountains.

192. Advantage has been taken of the elevation, and the consequent coolness of the climate, to establish a nursery garden at Saharunpore. This is intended for the purpose of naturalising the more hardy plants of the interior, that otherwise would languish and die, under the fervors of a tropical sun if too suddenly transplanted. It promises to be eminently successful, though as it had only been just begun when I visited it, this opinion must rest on other grounds than experience; no doubt a favorable feature in the plan, though accidental, and not a disposing reason for the original choice, is the nature of the rock; the argillaceous and micaceous schists, the only rocks besides limestone from which the selection lay, furnishing a very poor and meagre soil for almost every description of produce.

193. From the garden, the road descends obliquely along the face of the range to the village of Juree Panee, in this line the limestone is lost almost immediately, and argillaceous schists succeed. They are of various colours, many of them very bright, red, yellow, green, grey, olive brown, purple, &c. This change of colour is characteristic of this rock, which is further remarkable for its different degrees of consistence, being at one time soft and diffusible in water like clay, at others hard, and though not furnishing good roofing slate, yet very similar in mineralogical character to that substance.

194. At Juree Panee, limestone again appears, but in small quantity; some specimens were observed of it containing veins of fibrous gypsum. These were of the most regular type, and had no resemblance to the black scoriaceous rock before noticed, as associated with the gypsum near Ranon. The argillaceous schist again establishes itself, and continues to Rajpoor at the foot of the descent. In this line it is rather harder, in general, than that above described, and inclines more to blue, purple, and green colours. It contains masses of quartz rock often strongly impregnated with the matter of the slate. At the foot of the descent, the structure appears to change to that already described Art. 184, as consisting of thin foliæ or leaves scarcely adhering, and of very limited size.

195. The mountains which bound the Doon to the north, and which stretch from the Jumna to the Ganges, are all composed of argillaceous schist. Beds of limestone occur similar to those already described, but never of any great extent. Gypsum also similar to that at Ranon is found, and under similar relations at two other places, and it is probable, will be eventually discovered at many more. In the bed of the stream in which the Sunsar Dhora, or Dripping Cave, is situated, and about a mile higher up, may be seen the remains of a very large bed of this substance, the greater part having been removed by quarrying. It lies in the same kind of superficial amorphous mass, and is associated with the same fœtid anomalous black rock as at Ranon. There are two varieties which lie in contact, and between which, a kind of transition takes place. The one is of a beautiful saccharoidal aspect, of a snowy white colour and fine granular composition. The other is of a dirty white colour, approaching to yellowish grey, and the composition is finer, almost impalpable; nor are the minute crystals discoverable in

it, which may be seen to constitute the grain of the other, being in fact dull and earthy, like chalk. It is the more abundant of the two, and indeed may be had in almost any quantity. It would probably answer for the preparation of plaster of Paris, though certainly not for statuary.

196. The other locality is in the bed of a small nullah, which falls into that in which the Dripping Cave is situated. There are some springs in the bed of this stream, which have a strong odour of sulphuretted hydrogen, and I should notice that the water of almost all these streams deposits carbonate of lime. The gypsum at this locality was described to me as forming a mass incumbent on clay slate, and not in contact with either limestone or the black rock so often mentioned. This mass had a flattened form, and might be called a bed; a perpendicular fissure in the slate was filled with gypsum continuous with the upper mass, thus giving the idea of a deposit. In my attempts to find the place I was not successful, but I met with many loose masses, and some of rather impure appearance, entangled with the angular debris which had rotted from above, and settled into banks of different heights at the foot of the mountains. It was associated in such a manner, as to leave no doubt that it had been in a state of fluidity when it assumed its place there, and thus we might pronounce with some certainty on the comparative ages of these masses of gypsum, which in this instance at least must have been posterior to the formation of this local debris.

197. We have now again descended to the Doon, where a totally different order of things prevails. It may be useful before proceeding to the Eastward, to notice different detached points at which the same formation of argillaceous schist has been observed. At Riki Khes and along the banks of the Ganges, as far as Deoprag, no other rock is seen. In the route too from Dehra to Teeree, the residence of the Gurhwal Raja, it equally prevails, the several types corresponding accurately to those already described. In particular may be seen the soft variety of various bright colours in the ascent from the village of Manjgaon in Sikimana pergunnah. Excellent roofing slate is general throughout this quarter, nor are the houses ever covered with any other materials; along the whole valley of the Aglar, it was equally general, occasionally presenting however a patch of limestone. The Byrath range, which

shuts in the Umloo, is also composed of it, frequently containing beds of quartz rock. In the valley of the Tonse, argillaceous schist is traced as high as the village of Kande. In the route from Calree to Jytull, little other rock is seen excepting limestone, which in the neighbourhood of Kangra is abundant.

198. From Jytull again to Subhattoo, the road, passing along the summit of a ridge, carries with it, the whole way, argillaceous schist. In this tract, no limestone beds are found, but quartz rock is common from Subhattoo to Bar; in descending to the plains the same rock continues. In passing to the north road to Kotgurh, it is equally constant, at least as far as Lunla; how much further it continues in that direction, or where the junction with the mica slate takes place, I have no means of judging. From Subhattoo to Joonug, the residence of the Ranee of Kyoontal, it is equally constant, and extends probably much further. In the route from Nahun to the Choor mountain, clay slate prevails to within a very short distance of the latter, containing extensive beds of limestone, which in detached masses stretch along the crest of the Sacen range, dividing the valley of the Girree from that of the Jullal; connected with their beds are probably the masses which form the summits of the Rajgurh and Krol mountains; at the feet of these the schist reappears, continuing to extend as far as Subhattoo. Finally, the valley of the Sutlej between Koomharsen (or a little below it) and Soonee contains this formation.

199. It is time now to return to our details on the Kedarnath road, which were broken off at Almorah, (Art. 152.) At that place we have seen micaceous schist is the rock. But the details of it I shall postpone for the present, to trace out the limits and relations of the argillaceous schist in descending to the plains. There are two routes in which these have been examined, the Pass by Chilkeea, and that by Bhumooree. In the first of these, micaceous schist extends a few miles south of Turkhet, the second stage in the route from Hawal Bagh to Chilkeea. Between Turkhet and Pepul Point, it is gradually exchanged for an argillaceous schist of peculiar character. It is occasionally quite soft, white, and talcose, being rather meagre than unctuous. The micaceous schist again makes its appearance after a short interval, and then a very fine-grained gneiss in the ascent to the Bukar Mundal Pass, on the summit of which is a dirty brown-coloured micaceous schist

of an arenaceous composition, which is succeeded by a magnesian clay slate accompanied by quartz rock. The former frequently contains patches of a soft white clay, which evidently originates in a decomposing talcose schist, as the latter occurs in contact with it.

200. The quartz rock is most abundant as we approach Peepul Point, and immediately above the place of encampment there occurs a set of appearances which I think deserve description. It is so seldom in these mountains, that we can trace the junction of two rocks, that no opportunity should be lost where it is accessible of recording the phenomena. Fig — will render the following description more intelligible; it is anomorphous rock, apparently one of the numerous types of argillaceous quartz rock. It is seamed in every direction, as this rock very often is, but exhibits no trace of stratification. C. which adjoins it, is perfectly distinct, the line of junction being strongly marked. It is a white arenaceous rock covered with brown spots, crumbly, and with little consistence, but feeling gritty in the mouth. It is probably quartz, or a mixture of quartz and felspar, and the iron-stained spots may arise from decomposing pyrites. It passes below into a tolerably hard rock. D. is a series of thin foliæ or leaves (they can hardly be called slates) of argillaceous schist, of a plumbaginous aspect; they are soft, and soil paper. The series in its progress upwards gradually diminishes in thickness till it disappears; it is a quartzose argillaceous schist, stratified distinctly, the strata lying parallel to the preceding, nearly vertical. This latter, like A, are types of the ordinary rock, which seems to oscillate just here, between quartz rock and argillaceous schist.

201. The character of the rock C. (I can hardly call it a vein,) affords strong promise of the existence of graphite in this quarter. This mineral belongs to formations of the earliest æra, as anthracite has been referred to the suppositious transition class, and coal to the æra of secondary rocks. It is remarkable too, that the deposit from which graphite of the best quality is procurable, and which indeed furnished nearly the whole civilized world with the variety used for pencils, that of Borrodale in Cumberland is situated in a clay slate on the border of primary mountains. There does, it is true, appear some doubts as to the real nature of this formation, for some insist that it comprises rocks of the trappean type; however this may be, it is not the less certain that argillaceous schist is known often to contain very valuable beds or veins of graphite.

202. From Peepul Point to Okuldoona, the route is in the bed of the Casilla river, the latter being crossed eleven times; every where it is full of the rounded stones so often noticed, and their accumulations are sometimes observed to attain a height of 150 feet even, above it. It may be stated, generally, that where the river bed, or valley is narrow, there they attain to the greatest height; and where sufficiently wide, the extent is greater, but their height less. What the depths of those accumulations in the immediate bed of the river are, I have no data to determine accurately, but there are several reasons for believing it to be very great. They seem to be all of a very uniform character, modifications of quartz rock, more or less impregnated with clay slate.

203. The rock in situ here is of a rather singular character, but it will be here afterwards seen, that it is found in many distant parts of these mountains. It is in fact a quartz rock, but contains talc instead of mica. The strata are very obscure, although it is traversed by numerous irregular seams. In one instance I observed a mass of clay slate of a lenticular shape, inclosed in it, the length of this included nodule was about 10 feet, the thickness one foot; something like transition was observed at the junction. This rock has a considerable extent in the stage to Ookul Doonga. It is succeeded by a black amorphous rock of almost impalpable composition, which is traversed by veins of quartz. This passes into a talco-argillaceous schist with thin laminæ, but so tender, that no specimens are obtainable. Quartz rock of an ordinary character next succeeds; the strata very irregular and contorted. It is of a reddish colour, and almost compact, and in mineralogical aspect strongly resembles the boulder stones found at the foot of the hills. Fragments of the talcose quartz rock which I have just noticed, and which is not seen in situ in the intermediate space, have been observed at Dhikoolee, a distance of at least 18 miles. This rock is so remarkable, as already noticed, that its fragments are recognised with the greatest certainty, and we are thus enabled to trace the course which these boulder stones took, as also to judge of the distance they were transported.

204. Ookul Doonga is situated on rather an extensive flat; the bed of the river is composed, as already noticed of these rounded, stones. The rock is not therefore visible for a distance of a mile and a half; it is then seen in the river bed, and has the character of a micaceous fine-grained sandstone, stratified distinctly, but not at all schistose, or at

least not readily fissile. The fracture is difficult to obtain, as it splits in various directions with a kind of cleavage, on the face of which it is difficult to discern the mineralogical structure; the strata are frequently curved, and the dip sometimes reversed. On it lies a rather thick bed of a rock of an argillaceous character, rather one of the shales than a schist. It is loose and unconsolidated, having the appearance of a soft and tender rock which had been crushed; nothing like marks of stratification are observable. Its colours are various, and with this shattered appearance, characteristic; i. e. green, white, black, purple, red, yellow, all of decided tone, and changing often within a limited space. On this lies the diluvian deposit of rounded stones and gravel, which notwithstanding all the inequalities of the ground, and they are great and numerous, has its upper surface perfectly even and almost level. It is to be remarked, that wherever these beds are visible in their lowest limit, they are always found resting on these shattered masses of shale, and never in any instance on the sandstone.

205. In this rock we take leave of the argillaceous strata which we have now to follow out in the route leading from Almorah to Bhumouree. The micaceous schist beds, the details of which, as before observed, we will postpone till we come to the description of the granite, continue beyond Powree, the first stage, to within a short distance of the halting place, Ramgur, on the summit of the Sohakatee Pass. It is exchanged for a very hard bluish grey rock, with much of the external aspect of limestone, but non-effervescent, or very rarely so, and in a low degree. It is marked with stripes of a darker colour, breaks with a sub-conchoidal fracture, the grain of which shews it to be a composed rock, but so small is it, that there is difficulty in determining precisely what are the ingredients. Mica and quartz are evident, and a dark mineral, which may be either indurated clay or hornblende; some specimens contain also carbonate of lime. It forms a lengthened mass in the micaceous schist, being observed to descend to the bed of the Ramgur, and rise on the opposite side, holding an oblique course across the valley for a considerable distance, which is easily traced, owing to the peculiar surface character of the rock. From all the characters of the mass I am very much inclined to consider it as a vein.

206. Below the Pass, we have a white schistose quartz rock of rather arenaceous composition. It may contain a small quantity of felspar.

In the bed of the Ramgur, the rock is of a light grey colour, with black specks disseminated. This rock evidently contains talc, (prismatic talc mica,) as well as quartz, and perhaps some felspar. Near the Bungalow, the character becomes more regularly that of gneiss, and at the foot of the ascent to the Ghagur, specimens are obtained which however, unlike the Himalaya gneiss, are yet equally entitled to the name, at least in the present state of our terminology. This gneiss which constitutes the whole of this range, at least in this quarter, is deserving of a detailed description.

207. This rock may be said to be characterised: 1. by its small proportion of felspar; 2. by the predominance of a talcose or argillaceous ingredient; 3. by the singular types under which it sometimes appears, or in other words, its transitions into very anomalous rocks. It is of a schistose rather than a slaty structure; has a talcose aspect, varying in colour from a greenish to a yellowish grey, soft though tough, and of the peculiar composition which entitles it to be called gneiss, though of so small a grain as to occasion the separate ingredients to be not always easily recognisable. Besides the felspar and talc, it contains quartz, and occasionally hornblende, (Hemi prismatic augite spar.) The two most singular types into which it passes are; 1, a white schistose rock, probably composed of talc quartz and felspar, and 2, a dull reddish brown amorphous rock of earthy composition, and of a cleavable structure. This passes into a harder type of a darker colour, which is equally remarkable for its cleavable structure, and want of the schistose. This latter is found on the summit of the Ghagur, and has all the appearance of a perfect greenstone.

208. Below the summit on the south side, the same talcose and schistose gneiss is again found as in the ascent from the north; but in the descent to Bheem Tal, it appears to pass into an argillaceous schist, which occasionally seems to oscillate towards hornblende rock. In the latter case, instead of being schistose, it is always cleavable, the joints of the cleavage being of a copper brown colour, and exhibiting no marks of the internal composition, which can only be observed in the cross fracture so difficult to obtain in this rock. At the Pass near Sumket, which may be considered as the foot of the Ghagur, a rock occurs very much resembling some greywackes. It is a granular mixture of quartz and clay slate. At Bheemtal, the cleavable rock is prevalent.

209. The strata of which the Ghagur is composed, dip very regularly, at some points varying between E. and N., the inclination generally small, though sometimes as high as 40°. The cleavable types are, if at all, very indistinctly stratified, but they are traversed by rents or cleavages in every direction. The two types may be seen everywhere passing into each other, nor can there be a doubt of their geological identity; yet it is impossible to have specimens of greater dissimilarity in mineralogical aspect than are furnished by these rocks, a proof, if it were wanting, of the mischief of adopting the geological relations of rocks as the basis of our classification.

210. Between Bheem Tal and Bhumouree, some interesting phenomena are to be observed. The rock continues to be in its general character an argillaceous schist; some specimens of a purple colour and very perfect type being procured a little below the former place. In the vicinity of this is seen a small amorphous mass of a tufaceous character, and dark greenish grey colour; and at no great distance again, a huge block of the most compact quartzose conglomerate. In this latter, the cement is of a hardness and compactness which rivals the imbedded portions. No other sample of this rock is seen, the mass is evidently not in situ, but there are no circumstances in the vicinity to give any clue to its origin.

211. In the bed of the Nullah, half way down, round blocks are seen of a greenstone, in which the crystals of hornblende, (Hemi prismatic augite spar,) are distinct. The specific gravity of this rock is 2.9. That of the purple slate is 2.58. The latter passes into a dark blackish rock of a fine grain, and less perfect schistose character, the specific gravity of which is 2.7. The determination of these evidently points it out as a transition between the greenstone and slate. Fragments of toadstone are found in the same neighbourhood, having the same, specific gravity of 2.7. These consist of a dark, greenish grey ground, with white oblong spots, occasioned probably by imbedded crystals of felspar. The base evidently contains hornblende or augite, but the composition is impalpable, and to appearance, even with a magnifier, homogenous.

212. A little below this a rock is found something resembling the transition between the greenstone and the schist, but of a lighter colour, it may probably be called a fine greywacke. It is distinctly

stratified, dipping 10° N. W., the angle of inclination being 44°. It gradually passes into a most perfect micaceous sandstone, which is found occasionally to contain small nodules of greenish grey clay. The transition is observed to a great advantage, as the whole of the strata are exposed, nor have I seen in any part of the mountains an appearance that more interested me.

213. A little below this, we descend to the Balleea Nuddie, where the sandstone is again found, and resting on it various coloured and shattered rocks, described in Art. 204. In the bed of the Nullah, the fragments are, some limestone, some clay slate of a hardness approaching to that of jasper, but the greater part quartz, more or less impure. Near the bridge may be seen blocks of the blackish amorphous rock before noticed, and which in one solitary instance has been observed to have a partially cavernous structure; some of the cavities being filled with a zeolitc mineral, (Kouphone spar.) This rock certainly appears to pass into the purple argillaceous schist, but as so often remarked, access is wanting to the junction of the rocks in order to establish this fact with certainty.

214. In this vicinity, (a little below the Buleea Nuddie,) I picked up fragments of a perfect greenstone of a large grain, very similar in fact to that of a granite. The ingredients were compact felspar and quartz. I have never found any thing like this rock anywhere else, nor have I been able to trace it to its original site. Sandstone, irregularly mixed with conglomerate, then continues to Bhumouree, where also it is to be seen, (in the bed of the Nullah,) dipping to the North at an angle of about 25°. Bhumouree is situated at the foot of the hills, in the Bhabur or elevated part of the Teraee.

215. I must now return to a route, the details of which ought to have been given before the last two, but the omission is not one of any

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of the gneiss to very near the summit of the ———— Pass, below which it is replaced by chloritic schist: fragments of hornblendic schist being also very common. The former continues to near Pokree, occasionally giving place to talcose schist, occasionally to talcose quartz rock. Near some of the old galleries of the copper mines worked here, are beautiful specimens of an emerald green straight laminar slate with high

* MSS. defective.

lustre. It passes so gradually into talcose schist of the palest colour, as to leave no doubt of their being but coloured modifications of the same rock. In the rock in which the galleries at present worked are situated, a flesh coloured schist is found, of a mixture of talc and quartz. It passes into a subschistose rock of a similar composition, the latter ingredient being in greatest quantity; in fact a talcose quartz rock. This is exchanged a little lower for a dark olive green soft rock, of a schistose structure, but not laminar, the aspect of the fracture being scaly. I think it consists chiefly of hornblende.

216. The copper mines here are situated in the quartz or talc slate just described, a rock of so soft and tender a nature, as to form a very strong objection to the efficient working of them by its frequent failures in the different galleries. At the time I visited the place, they had all fallen in, and consequently no specimens of the ore were obtainable, except such as could be gleaned from the rubbish lying at the mouths of the several galleries. These pointed to vitreous copper, or the sulphuret, the richest ore known. Copper pyrites was also observed, and blue and green copper in small quantity; whether the ore is in the form of veins or beds, it is impossible to judge in the present state of things. The water which issues from the galleries has a specific gravity of ————, is impregnated with the sulphate, and deposits sulphate of copper on the stones over which it flows. These mines evidently have been very productive, to judge by the extent to which they have been worked.

217. On the ridge from which the descent to Boomot commences, micaceous, or perhaps rather an impure talcose schist occurs. It contains a good deal of quartz, below this a decided talcose schist appears, of a greenish hue. In the bed of the torrent, at the foot of the ridge, blocks are found of hornblende rock, containing pure hornblende in bundles of needles, and glassy actynolite, in contact with a reddish felspar. I did not, however, succeed in detaching any good specimens; some rolled pieces of hornblende were found, having the closest resemblance to charcoal, in all save specific gravity. In these, the apparent fibre was most commonly curved, the lustre always dull. The rock from hence to Boomot is entirely talcose, being either a granular mixture of talc and quartz, (talcose quartz rock,) which occasionally becomes quite soft, and disintegrating; oc-

casionally a perfect talcose schist, which oscillates, as the rock always does, towards chloritic schist. A granitic mixture of hornblende and quartz is also found in limited quantity, the type in fact of a greenstone.

218. At Boomot, which is situated on an extensive flat, we find the rounded stones so often described, the flat being entirely composed of them; the height above the river is 200 feet, and the extent considerable. The rock in situ is seen, however, at the third of the ascent, and it is chloritic schist, which appears on the other side to pass into greenstone slate. On the left bank a larger flat is seen, being upwards of two miles long, and half a mile, or more, wide in the broadest part. This is also composed of the same rounded stones; these beds can never have owed their origin to any body of water so limited in quantity as the present supplies of this river; and besides these table lands are in reality 200 feet above the present bed. There occurs here an appearance which is of considerable interest; there are two levels, and a considerable difference between them in height, the lower table being nearest to the river. This condition of things certainly reminds one of parallel roads, as they have been called, in some of the glens in Scotland. Similar appearances have been observed by Captain Hall in Chili. The resemblance is the more interesting, because I believe it is now a generally received opinion, that the latter owe their origin to the successive burstings of a lake, at distant intervals of time.

219. On crossing the suspension bridge, a rock very like greenstone slate is found, it passes into the chloritic schist observed below Boomot, and through that, on this side, into a perfect talcose schist, of white, yellow, and blue colours, &c. On the flat no rock is visible, but again in the bed of the stream, which comes down from Dhunpore, the granite rock, which I have called greenstone, is again detected, occasionally passing into a greenstone slate. It contains nests of indurated talc or potstone. The schists are always conformably stratified, that is, they dip to N. E., but the greenstone is generally amorphous. The schistose rocks continue, often verging on chloritic schist, and interstratified with quartz rock as far as the route lies in the bed of the Nullah, which is of great depth and narrowness, the sides of mural steepness laying open, in beautiful natural sections, all the particulars of the rock worthy of notice.

220. It was observed, that sometimes the change from the green schist to the quartz rock was sudden; sometimes a real transition is seen. In general, the schist has a stronger resemblance to the chloritic types, though it is also found a perfect hornblende schist. The dip and inclination of the strata present great local irregularities, the former being sometimes reversed within a few hundred yards, and the latter not unfrequently 90°. The direction appears to follow a curved line, being in the first instance observed as conformable, *i. e.* N. W. It is then seen to run N., from which point it gradually changes to N. 35° E. In the first case the dip was as usual N. E.; as the direction changes, the strata become wedge-shaped, and assume a vertical position, till at length it is found that the dip is reversed, being finally S. E.

221. From the bed of the Nullah, the route ascends to Dhunpore, where are worked the most valuable and productive copper mines in the mountains. The rocks which are found in the ascent to the Koangola Pass and descent thence are various in character, and a more enlarged examination of this neighbourhood is required to determine their true relations to each other. In the ascent to Dhunpore, quartz rock is the prevailing substance, which passes on the summit of the ridge into a very thin slaty rock of a yellowish colour, exceedingly hard, and composed apparently of quartz with some talc. The laminæ of this are not above a tenth of an inch in thickness. They separate with greatest clearness, are often bent or curved, are rather brittle, and consequently not obtainable of any size. This type might be called slaty quartz rock, in contra-distinction to schistose quartz rock. It passes into the pure amorphous type; argillaceous schist, then succeeds, variously intermixed with limestone more or less pure. The former occurs here of an intense black colour, similar to that of basanite. It has a schistose structure, but never separates into thin slates, the attempt to obtain such generally producing a conchoidal surface, or at least one more or less uneven. It is moderately hard, of a fine grain, receives a good polish, would form a most superior description of writing slate, and is not even inapplicable to the purposes to which basanite is applied. It has a cleavage, or set of natural joints, the surfaces of which present the appearance of a slight iridescence, or pavonine tarnish. This cleavage is most commonly, or at least very often, transverse to the direction of the schistose

structure. It is in contact on two sides, with an argillaceous or siliceous limestone, which in its immediate neighbourhood passes into a perfect rotten stone. What the nature or cause of this caries is, which so often appears to attack rocks of the greatest solidity, no one has yet explained in a satisfactory manner. The unchanged rock is of blue colour, impalpable in composition, with a conchoidal fracture, and in appearance resembling perfectly the most regular limestone. It is, however, a very impure one, being highly charged with argillaceous or siliceous ingredients, or perhaps with both, occasionally it even strikes fire with steel, and approaches the nature of schist. In its passage into the rotten stone it is observed, first to change a little in colour, becoming gradually more tinged with the peculiar mud colour of the latter, which is so far different from the rotten stone of Derbyshire, as to be of a more yellowish than a brownish tinge. The grain is observed gradually to make its appearance, and the rock to be full of joints or cleavages, till at last it is found of a dirty yellow colour, fine grain, very friable, and with a specific gravity of only 0.9. A series of specimens connecting the two extremes has been collected, which shews the progress of the change with great clearness; a rotten stone of bright colour appears to originate in a real argillaceous schist.

222. The rock in the neighbourhood of Dhunpore is, as I have already stated, a quartz rock, it is distinguished for its peculiar shattered and fissured aspect, no trace of stratification being observable except on the great scale. The irregularity of the strata is great, and the change of dip frequent. A mass of red dolomite appears in the middle of it east of the village, and it is in this latter rock that the copper mines are situated. This dolomite is evidently connected with the siliceous limestone on the Dhobree side, in which also a mine is worked, but the produce is inconsiderable. This mine is remarkable, however, for furnishing lumps of limestone, apparently changed by a similar process to that which produced the rotten stone, the result in this case being a perfect chalk; such a change in the surface of limestone fragments is common, and has been noticed in the preceding details; but excepting at Dhobree, I have never met such large pieces so perfectly changed to chalk. These fragments are used as a flux in the reduction of the copper ores.

223. On the Telkhunnee Pass, a brown schist is found, and thence descending to the village of Bissona, various modifications of the same passing occasionally into argillaceous quartz rock. Near the village, a granular rock is seen composed of quartz and indurated clay, having much the aspect of a greywacke. Here a mass of reddish limestone is found imbedded in the slate, in extent about 50 yards by 10, and capable of furnishing a very beautiful marble. Schistose rocks continue to Kirsal, where traces of limestone occur in local conglomerates, in tufaceous masses, and even as an ingredient in the more compound schists. The prevailing type approached to that of stone slate, being of a composition almost impalpable, moderately hard, and of colours varying from greenish grey through yellowish grey, to reddish and purpleish grey. These specimens are seldom of a perfect slaty structure, the cross fracture is easily obtained, and it is often conchoidal. Below Kirsal, these schists assume more of a chloritic or talcose character, and become more decidedly compound at the foot of the descent. Argillaceous schist is established of a very regular type, though it is found intermixed with the green schists also, which are of a chloritic character.

224. There is another route tending from the Boomot suspension bridge to this point in which the rocks have been examined, and it will be more in place to record the particulars here. This route ascends by the village of Acend, in which the talcose schist observed in the vicinity of the bridge is exchanged for quartz rock, containing, it would appear, nests of indurated talc. At the village, a decided chloritic schist is found. The dip in all the schistose rocks is conformable, but in the quartzose or granular types, the strata are obscure. Between Acend and Jak the same rocks continue with an occasional appearance of brown tender micaceous schist. From Jak to Bendoolee, the transition into the latter is more frequently observable, and it also assumes an argillaceous character. The granitic rock which I have for distinction sake termed greenstone also occurs, forming as usual a transition into the green schist.

225. From the village, the route descends to the bed of the Bendoolee Nullah, the rock being still chloritic schist, verging on argillaceous, and enclosing huge masses of quartz rock, the relations of which to the schist appear very interesting, and deserving of further developement. From what I could observe, it struck me, that these masses were

very large veins, their breadth being inconsiderable compared with their length, and their course oblique to the direction as well as to the planes of the strata; nothing like the marks of stratification can be seen in them, but they are traversed by seams in every direction, very similar in this respect to the smaller and less equivocal examples of quartz veins. One of these masses is observed to descend the mountain side into the bed of the stream and ascend the opposite side, always keeping the same direction, limited in breadth, and easily traceable by the eye for many miles.

226. In ascending the bed of the stream which descends from the villages of Ketee and Mulsee, and here joins the Bendoolee river, the chloritic schist is gradually exchanged for more decided argillaceous types. These are sometimes straight laminar, easily splitting into slates, sometimes sublaminar and schistose, in which case the cross fracture is easily obtainable. The former are more frequently of an iron black, the latter of a purplish, reddish, or greenish hue. The two routes here coincide; below Ketee a green schist occurs, remarkable for having two sets of divisions distinctly marked, forming an angle of 45° with each other, the one being parallel to the schistose structure; above Ketee again, quartz rock of a bright Orkney yellow occurs, fissured and seamed in all directions, so that a specimen of any size cannot be obtained. The slates too in great part when tried under the blowpipe, fuse into a slag obedient to the magnet. These indications point to an iron mine which is in the neighbourhood, but which I had not an opportunity of examining. The dip in this glen is always N. E., but the strata are nearly vertical, being frequently observed from 70° to 80°.

227. On the summit of the Pass Dewaluc Khall, quartz rock occurs, and descending thence to Murara, it is found to contain talc; fragments are observed here, which are a mixture of compact felspar and quartz, but the rock has not been observed in situ. Below Murara, micaceous schist is established, the dip being S. 35° W., and inclination 24°. It is full of small garnets; traces of felspar may be found in it, and I am not without an opinion, that gneiss is to be observed on the summit of the ridge just passed, although in the immediate route quartz rock alone may be visible. The micaceous schist continues to appear along the bed of the Ramgunga. Near Agura, a mass or bed of limestone,

of a siliceous or magnesian character occurs; it contains crystals of dolomite, (brachytypous lime haloide,) and traces of green carbonate of copper (hemi-prismatic habroneme malachite,) also of copper pyrites (pyramidal copper pyrites.) A mine was formerly attempted to be worked here, but either from want of skill or perseverance, was abandoned without any profitable result.

228. A rock occurs here, but in no large masses, which may with perfect propriety be termed a gneiss. It is of a curved or undulated schistose structure, and the composition is heterogeneous or mixed. The ingredients are so disguised, that it is difficult to speak with perfect precision, but it appears to me to contain quartz, felspar, mica and indurated clay. The second ingredient is the most doubtful, and exists in least quantity. Close by this rock is found one of a brownish yellow colour, structure amorphous, composition simple or uniform, and earthy like chalk, tender and friable, traversed by veins of a darker colour, but the same in every other respect. This rock also occupies but a limited space, and is succeeded by a micaceous schist of a blackish blue colour, apparently much charged with argillaceous matter. I should note, that the summits of the surrounding ridges are limestone, recognised with great certainty by their peculiar outline, and mural precipices stained with yellow and black.

229. The preceding particulars apply to the immediate neighbourhood of Mehul Chowra, the halting place below the Pass of Prendooa Khal. In the ascent to the latter, quartz rock and siliceous limestone are found; still higher up, a purple argillaceous schist, containing mica, which graduates into a yellowish white micaceous schist; fragments were found of iron stone and of indurated talc. On the Pass, limestone often highly siliceous or argillaceous prevails, and it is accompanied, as it always is, by its local conglomerates, and its tufaceous deposits or incrustations. On descending from the Pass, a great deal of the same rock is observed, but down in the river valley, it is seen to rest on argillaceous schist, the limestone still continuing to run along the summits, and occasionally descending lower down. It is in the junction of these two rocks that the beds or veins of iron ore occur, which are annually worked, during the healthy season, by emigrants from other parts of the country, who all quit the valley in May, when it is said to become unhealthy.

230. These mines are said to produce metal of a better quality than any others within the mountains, and this circumstance I attribute to the ore having generally a proportion of calcareous matter, which it is well known is one of the best fluxes, the ore itself being of the most common kind, red iron ore, (rhombohedral iron ore of Mohs.) The clay slate in which most of the galleries are situated, is of a peculiar character. It is generally of a reddish or purplish hue, fine grain, not compact, splits into wedge-shaped schist, and with remarkable facility. There is also a cross cleavage which prevents the acquisition of large pieces; the spotted delineations which are sometimes observable in it, when viewed hastily, resemble imbedded nodules. They are always of a lighter colour than the general ground, being usually white or peagreen. The shape is elliptical; when they become very numerous the slate passes into an amorphous rock, which has all the aspect of a conglomerate.

231. From Katsaree to Mehul Chaura, the route turns up a lateral glen, the bed of a feeder of the Ramgunga. The debris is however thick on the mountain sides as well as in the valley, and the rock can only be guessed at; limestone is seen occasionally at the summit of the ridges. Between Mehul Chaura and Dooara, however, the rock appears in the bed of the stream. The first occurrence is that of the purple scaly schist, which seems of a nature intermediate between micaceous and argillaceous schist. It dips to the East of South. This is succeeded by an earthy and subschistose gneiss, which dips S. W. 10°, micaceous schist is then found, and resting on it a granitic gneiss which is connected with the series of granite beds so often alluded to, and which will be described presently. The fragments in this valley consist of clay slate, quartz rock; and latterly mica slate, gneiss and hornblende rock, as also chloritic schist.

232. We may now return to Punnae, Art. 67, from which place is another route that has been examined, leading down the valley of the Aluknunda. The granitic rock which I have called greenstone, was noticed, as occurring in the bed of the Dhunpore Nullah; beyond that point the talcose-granular scaly rock is seen to occupy great extent, similar to that which has been described, Art. 221

It is remarkable here for containing much larger concretions than usual; some of them have a perfect resemblance to rounded nodules im-

bedded, and indeed they can be detached from the including base. The rock is therefore certainly of the nature of a conglomerate, and this fact is further proved by the occurrence of rounded nodules of clay slate in an adjoining quartz rock. The concretions of the talcose granular scaly rock are always quartz, but of a peculiar resinous lustre, very unlike ordinary quartz, and in colour always inclining to blue or purple. This rock is a good instance of the deficiency we labor under, from our scanty nomenclature of rocks. It is very well characterised, and has consequently been recognised by me in many and very distant localities, yet we have no name by which to designate it, unless we call it quartz rock. It is singular, that in two of the localities where it has been traced, pieces of clay slate are found imbedded in the adjoining rocks, a phenomenon I have no where else observed. It here passes into the more ordinary quartz, which is occasionally chloritic.

233. The rock at Nugrasoo is the same quartz rock, and it possesses the usual fissured aspect so often noted as characteristic, it being very difficult to detect any thing like the appearance of strata even on the great scale. In proceeding to Tirnee, at one of the lowest points in the route chloritic schist is found dipping to the E. at an angle of 56°. Whether a solitary included bed or connected beneath with the extensive strata observed near Punnae, Acend, Jak, and Bendoolee, (Art. 224) is difficult to say, for want of that full access to the junctions of rocks which so often interferes with observations in the mountains. From the little I have myself observed, I am of opinion, that chloritic schist is more generally a member of series than a single formation in itself, at least when we speak of the more decided types, they being seldom found of any extent compared with micaceous or argillaceous schist. The quartz rock passes into the talcose granular scaly rock, thus proving its geological identity; but this would no more absolve us from giving it a name, than it would the several other rocks that graduate into each, but which yet have their distinctive appellations. An imbedded nodule was observed here, (being the largest seen,) weighing at least two and a half pounds, and it was readily detachable after fracture. The existence of conglomerate rocks amongst primary strata has been contended for by many geologists. De Saussure and Mr. Weaver are amongst the best authorities I can just now recollect. Assuredly the aspect of these rocks is at once sufficient to separate them from the

secondary conglomerates, nor could the merest tyro on being shewn both, hesitate to discriminate between them. The most obvious distinction is the less earthy or mechanical appearance of the basis and the greater rarity of the imbedded pieces. Is the conglomerate structure, such at least as it is found in crystalline rocks, one which can in any instance be explained by chemical composition, as affected by the many disturbing causes which may well have been supposed to influence the results? In particular, can we derive any explanation of such a phenomenon from the galvanic energy which we may suppose would be developed by the interstratification of so many heterogeneous, and consequently in some degree anti-polar substances? Assuredly this cause has had more effect than is generally attributed to it in many of our geological phenomena. Whether the present be one which falls within its domain, remains to be determined.

234. Limestone begins to shew itself in detached masses and fragments; and before reaching Tirnee it occupies considerable extent, and is seen crossing the river valley in well marked strata, which dip N. E. It is generally very impure, being mostly argillaceous. At Tirnee, I found blue argillaceous schist; on ascending a ridge the limestone again appears, always argillaceous; descending thence, argillaceous schist is once more established, and continues to Poondaroo village, opposite Roodur Prag, the confluence of the Kalsee with the Aluknunda. It presents some curious appearances, which require a little detail. It is at first of a perfectly white color, soft and earthy, similar in fact to chalk, in all save its schistose structure, and in this respect it perfectly resembles the hard blue slate into which it gradually passes. Below the point where this change has taken place, a mass of the greenstone I have so often had occasion to notice may be seen. There is not any transition to be seen between this rock and the blue slate, but it passes into a green slate, whether chloritic schist or greenstone slate, is difficult to determine. The specific gravity is rather in favor of the latter. That of the greenstone is 3.0, it contains therefore evidently either hornblende or augite (hemi-prismatic augite spar.) Besides this, a light yellowish green mineral may be observed, very much resembling serpentine.

235. In its lower limits it appears to pass into a green quartz rock, coloured no doubt by the same mineral to which it owes its character.

This quartz rock is permanent for a long distance, but assumes various changes of colour. It occasionally appears to pass into a tender green slate, occasionally to oscillate towards the greenstone, and even to hornblende rock. It is sometimes so hard, as to defy the hammer completely. One type appeared to contain felspar, another, a schistose fissured grey rock, containing a few amygdaloidal cavities. It passes into a greenish grey rock, with rombohedral cleavage, and fine granular composition. These several changes extend as far as Hurkonda glen, in the neighbourhood of which argillaceous schist is again met with, and occasional masses of calcareous tufa and local conglomerate, shewing the proximity of limestone. The schist continues nearly to Soocet, near which a mass of quartz rock occurs. It is seen to descend to the river bed and across it, rising on the other side in strata nearly vertical, the direction E. and W. and the dip if any thing South. The slate again appears, and in the immediate neighbourhood of Soocet, where the valley narrows, it is exchanged for limestone of a very cherty type. It contains crystals of dolomite, (macrotypous lime haloide.) At Soot, the schist is once more established, but appears to have changed its character.

236. It may be seen in the bed of the small Nullah which runs below Soocet, of a perfect talcose aspect, the colors bluish grey, the structure straight laminar, the lustre metallic pearly, and so soft, as to be scratched by the nail. It dips S. 5° E., at an angle of 48°. It is succeeded, in proceeding towards Sreenuggur, by a greenish grey talco-argillaceous schist, approaching to the character of chloritic schist. The laminæ are sometimes very much contorted, being in one particular instance bent up into a saddle-shape, even within the compass of a specimen. This rock is always recognisable by the minute wave-like undulations with which the laminæ are marked, and which are peculiar to it. The dip is South along the whole line to Sreenuggur, but the rock so seldom visible that much stress cannot be laid on this determination.

237. Enormous beds of diluvium, or rounded stones and gravel, may be observed here, forming the floor of a valley remarkable in this rugged country for its extent and beauty, though it be but five or six miles long, and no where a mile wide. These accumulations rest on different sides of the river in different parts of this line, so that small as it is, it is not even continuous. Their height above the river bed is gc-

nerally 60 to 100 feet; but with regard to this point it may be observed, that in the widest vallies these beds have least height, and vice versa. Their face generally forms a precipice, in which all the several sizes of stones may be seen sticking in a loose basis of gravel and sand. Sometimes two or three terraces are formed, the last being of inconsiderable height above the bed of the river. In the latter, may be observed the same kind of stones that compose the terraces, leading to the inference that the present opening was once filled up, and that the river must have flowed so much higher than its present level. It is a very remarkable circumstance too in these beds, and shews that there is some connection between their accumulation and the system of rivers, that they increase in extent as the river advances towards the plains; very limited deposits occurring in the upper part of the course.

238. The magnesian clay slate is found at the suspension bridge over the Aluknunda, south of Sreenuggur, while close to the town, in the bed of the river, a rock approaching to the character of micaceous schist prevails. Perhaps it may more properly be called micaceous quartz rock: it also dips to the southward. On ascending from Sreenuggur are seen the accumulations of rounded stones above the present bed of the river, as determined by Barometrical observation. The rock is the magnesian clay slate, which continues the whole way to Pooree, a village on the high range which shuts in the Chipul river. It oscillates both towards micaceous schist and towards talcose, its affinity to the latter being greatest, but no genuine argillaceous schist is produced in any of its changing types. The dip is in general conformable, *i. e.* between N. and E., excepting immediately on the ascent from Sreenuggur, where it was observed to be S. 10° E., the inclination being 60°.

239. From Pooree to Olee, the road passses along the range above-mentioned, crossing over it near the latter village which is situated a little below in the bifurcations of a glen. Half way the slate is exchanged for quartz rock which appears stratified, dipping 65° N. E., at an angle of 50°. Here also this rock possesses the veinous character, appearing to traverse the other strata in masses much more remarkable for their length than their breadth. It is seen to cross the valley here, and continue its course on the opposite side; occasionally it appears to contain felspar. It passes into a green type, which gradually changes

to the greenstone so often noticed; but which occupies a very limited space. The quartz rock again becomes established, and continues from Olee to Bidholee, and thence to Milcee, which is situated in the valley of the Nyar river. Near the latter village, a subschistose argillaceous rock occurs, and in the ascent up the valley of the Pilgad, which joins the Nyar below Milcee, the tendency to an argillaceous character increases. In this part of the route, two types seem to divide between them the rocks observed; one may be characterised as argillaceous quartz rock, the other as quartzy argillaceous schist. The first cleaves into rhombohedral fragments, has a conchoidal fracture, the composition impalpable; the second has a schistose structure and small granular composition. They run naturally into each other, and may be considered, geologically speaking, as the same rock. The first is seldom stratified, always seamed; the second is generally stratified, although the strata are irregular and appear under that relation termed wedge-shaped. One observation gave the dip N. 45° E. with an inclination of 36°. Not far from this the dip was observed N. 80° to 90° E., inclination 40°. The quartzose type prevails to some distance above Bidholee, and is gradually changes in the ascent from the bed of the stream to an argillaceous schist of more decided character. The latter passes into chloritic schist, which conducts us to strata of gneiss connected with the series of granite beds, to which we shall presently come.

240. In the meantime, it will be necessary once more to look back and take up the thread of our description broken off in Art. 159, and to trace the argillaceous strata in another direction at the village of Girgaon where the last traces of gneiss were lost, although in the river-bed beneath occur numerous blocks of that rock. The character of the formation which succeeds is argillaceous, including, however, extensive beds of limestone; sometimes there is a kind of transition observable between them. This continues without much variation as far as the hot spring below Rumaree on the Ramgunga, into which the Jankoola river (below Girgaon,) falls. At the bridge over the Ramgunga the rock is clay slate, and dips N. 15° W., at an angle of 35°. The ridges appear to consist of limestone stratified distinctly, and dipping also N. W. Above Rumaree, argillaceous schist occurs of a lead blue colour, containing quartz; fragments of a conglomerate are then met with, and latterly in the ascent to the Pass above Sama, a brownish granular

schist, which might be called a greywacke. On the summit of the Pass, there is no rock in situ, and fragments of micaceous schist are to be seen. Thence to the village of Sama, we are accompanied by ordinary blue limestone distinctly stratified, and of a sublaminar or slaty structure, which is not, however, developed without weathering.

241. From Sama to Buret, the same rock prevails, frequently remarkable for the white vein by which it is traversed. Sometimes the two colours, form alternate layers, the rock having thus a striped appearance. It is occasionally very argillaceous, and passes into a shattery thin laminar rock, very like that described in Art. 226, the only difference being a black or blue colour, instead of red, green, or purple. In this state, it no longer effervesces with acids. In the bed of the stream leading down from Sama, the fragments are either blue limestone or crystalline dolomite, or of clay slate a very few; but at the bifurcation below Mawgaon, immense blocks of gneiss, similar to those observed below Girgaon, are to be seen. Their source is evidently in the glen, which here joins the Suma glen, and they shew the proximity of the boundary of the gneiss district.

242. From Buret to Kubkot on the Surjoo, limestone still accompanies, as passing down the Ramgunga to its confluence with the Surjoo, and then down the latter river. It appears to be stratified distinctly on the large scale, the strata being always best marked where the rock is most impure. They appear sometimes to be vertical, and the direction, as far as it could be ascertained, is S. 20° E. Sometimes it contains talc in notable quantity, and then the rock is highly fissile. The rounded fragments in the bed of the river are numerous, and many of these are white crystalline dolomite, (macrotypous lime haloide.) Near Kubkot, the dip was observed to be Southerly, so that there must be evidently some great irregularity here. The sameness of the limestone features continues to Gryket, also in the bed of the river, the surrounding ridges bearing testimony by their appearance to their identity with the lower strata, occasional patches of argillaceous schist then diversify it, although it is still the prevailing rock. The fragments in the river bed consist of limestone and quartz rock. A small patch of black argillaceous schist is found a few miles above Bagesur, the place being further remarkable for the deep bed the river has worn in the limestone, hollowing it out into caverns and deep holes, in some of

which it has a depth of perhaps 30 feet or more; although at Bagesur, some miles below this point, it is fordable, being scarcely three feet in depth. The tendency of this rock to be worn into caverns and hollows is a very curious feature, nor am I aware that any satisfactory explanation has been given of it. The dip at this place was observed to be S. 30° W., and the inclination 52°.

243. Hence to Bagesur, one of those extensive flats so often formed in the river beds prevails, nor is any rock in situ discoverable; at that place the strata are quartz rock, and they dip N. E. The river bed is full of rounded limestone fragments, but below the confluence of the Goamuttee, which originates in the valley described in Art. 65, the fragments are as often gneiss and quartz rock. Another extensive flat reaches from this point for nearly two miles, and debars access to the rock. At its termination, calcareous tufa and conglomerate are seen, but not apparently of great extent. A third flat then occurs, and after passing it, argillaceous schist is established, and it continues in the ascent to the Cheer Nullah, a small stream which comes down from the range separating the vallies of the Surjoo and Cosillah. We have then a limestone of a yellow color and fine granular, containing a large proportion of talc, and a little higher up, nests of indurated talc are found of a light buff colour. Thence, argillaceous schist and limestone are irregularly mixed, the latter forming the summit of the range. It is of a magnesian character when pure, being in fact a compact dolomite; but is generally so much charged with siliceous matter, as to become a kind of chert. In its pure magnesian state too, it has no inconsiderable resemblance to the latter rock. The colour is a bluish grey, which occasionally changes to flesh colour. It contains veins of galena, (hexahedral lead glance.) The strata when observable, appear to dip N. 60° E., at an angle of 60°.

244. In descending from this range, argillaceous schist is again met with of a very soft type, and of various bright colours, similar in fact, to the rock observed in the Cosillah, (Art. 152.) The strata are so irregular in dip that no mean result can be attained. It sometimes contains quartz. In ascending to the Kurnyud Pass, micaceous schist occurs, and occasionally with felspar; fragments of gneiss are abundant. Descending from this Pass into the Suttralie glen, we find an earthy gneiss, very similar to that described in Art. 134, which prevails in the

Goamuttee valley. This rock dips S. 33° E., at an angle of 38°. Here also may be seen a brown amorphous rock, of a very anomalous character, the true relations of which further enquiry is wanting to develope. A little further, micaceous schist, covered with an aluminous efflorescence, dips S. S. E. This latter rock continues to the foot of the ascent, occasionally taking in a little felspar. In the ascent to the Pass above Bhynsoolee, gneiss is again found in strata nearly vertical, containing beds of hornblende schist, and having here again come upon the tract connected with the series of granite beds, we shall once more leave off, and pursue two other short lines of route, which yet remain to be described previously to entering on those details.

245. The first of these leads from the bridge over the Kalee at Joolghat to Lohooghat, the cantonment of the 2d Nusseree Battalion of Ghoorkhas. At the bridge, strata of a very pure limestone occupy the bed of the river, and form unexceptionable natural piers for this structure. The dip was N. E. In ascending, detached masses of compact limestone and conglomerate, (enclosing pieces of quartz rock and clay slate,) are seen; a good deal of stalagmitic and stalactitic incrustations are noticed, shewing that masses of limestone are doubtless prevalent, though from the nature of the surface not always visible. At Booralee, or a few miles before coming to that village, a purple argillaceous schist makes its appearance; some of the types are granular, and might be called a greywacke schist. It also passes into a compact slate of a light yellow or greenish colour, very similar to hone slate; as such it has been used, and found to answer. These rocks occupy the road as far as Petorahgurh, and the dip is generally N. or a little W.

246. At Petorahgurh, patches of limestone are found in it of a pure type and blue colour. This rock, as has been often observed in limestones, has a sublaminar structure, weathering so as to have often the appearance, in detached pieces, of a series of layers or thick leaves joined together. It sometimes divides into thin slabs, which are, however, very unlike the slates of an argillaceous character, as they admit of a cross fracture with great facility, which is as usual conchoidal, and not hackly like that of the latter rock. The schist here is very variable in aspect, yet never loses its argillaceous character. At the cantonment, it is quite soft, and might pass for a yellowish clay were it not disposed in slates, which however will not bear handling, as they fall to pieces

immediately being minutely intersected by cleavages, the effect of which is to resolve them into rhombohedral fragments on the slightest impulse being communicated. The small hill on which fort Loudon is built consists of this rock, and on its summit, lay some very large boulders of a very tough and hard greenstone, the removal of which occasioned the Officers employed in clearing the ground, not a little trouble.

247. This rock I call greenstone, for it has not the smallest resemblance to hornblende rock in appearance. I have already mentioned its frequent occurrence in tracts of argillaceous schist, and I shall endeavour here to collect all the particulars I have observed with regard to it. It is a composite rock, consisting of two distinct substances, the one a dark olive green, the other a lighter colour, more perhaps of a greenish grey. The structure is small grained granitic; that is to say the minerals are obviously distinct, while yet they are in perfect contact throughout. The fracture is subconchoidal, taking its character in the small from the size of grain which it discloses. It is very hard, and in toughness I know not its equal. The specific gravity is upwards of 3.0, sometimes as high as 3.2. It is very fusible under the blow-pipe, and will bear drawing out into threads similarly to glass. If there be really a distinct species of felspar which has been hitherto described as the compact, I should be inclined to view the lighter coloured ingredient as an example of it. The dark one is either hornblende or augite, but the grain is too small to allow of a satisfactory determination.

248. This rock is not seen here in situ; these blocks being the only traces of it, but in other places, as already detailed, regular gradations occur, uniting it with the most ordinary schistose rocks, very frequently the transition is made through quartz rock; altogether it is a very interesting member of our mountain strata, and the full developement of all its relations is a task the execution of which I expect will throw considerable light on some interesting questions in geology.

249. From Petorahgurh in the descent to Surjoo, argillaceous schist is the prevalent rock, indeed the only one, with the exception of a few beds of limestone. It is mostly of the type just described, (Art. 246), but some others are also met with. In particular one, having a suite of colours between olive and bright red, in hardness about equal to gypsum,

splitting generally into slates of moderate thickness, but which are often curved, smooth to the feeling, and having a slight degree of lustre. I think this type owes its peculiar character to the magnesia it contains. It is found between Petorah and Goon; near the latter place, it is succeeded by a yellow rotten stone, which has apparently originated in an argillaceous rock of a less schistose character, or perhaps even in calcareo-argillaceous strata. It is remarkable for its rhombohedral cleavages, breaking into fragments of that shape on the application of the hammer. It is of arenaceous composition, and its specific gravity is very low, about 1.5. In its vicinity are found small masses of a soft argillaceous limestone, of a light olive colour, which might perhaps be of use in lithography. They form the only type of limestone I have met with in these mountains which hold out any prospect of being available for the purposes of that art. In general, the lithographic stones used in Europe are derived from the secondary strata, and even in these, the properties essential to the most perfect specimens seem to be peculiar to a very small tract in Germany, neither France nor England having yet furnished stones to compete with those of the former country.

250. The soft magnesian clay slate of different colours, which is found near Goon, also prevails at Doodar. On the ascent to the Thakil Peak, which lies a little to the left of the route from Petorah to Lohooghat below that village, a bluish grey schist, of a shining lustre is found, traversed by white veins. In ascending from Doodar to the Peak, the rotten stone noticed near Goon, and of a bright ochrey, colour occurs, but undistinguished by the peculiar structure of that rock, the present one giving an amorphous irregular fracture. Above this, lies a fine greywacke schist of a dark blackish grey colour, which passes into a rock that strikes fire with steel. The summit of the peak is a silicious limestone that occasionally passes into schist. It projects in amorphous weather-worn nodules, and is full of veins of flint (var. rhombohedral quartz.) This is not a common mineral, at least in the form of veins, to be found in limestone. It is of two kinds: the one a dark brown, exactly similar to the ordinary gun flints, the other a white opaque substance, occasionally becoming translucent, and not very unlike the mineral called cacholong. These veins are more persistent than the bulk of the rock, which indeed appears

to be singularly subject to atmospheric wear; the consequence of this difference of durability is the projection of these veins on the surface of the rock, giving it a singularly rugged appearance. It is probable also, that particular parts of the rock not veinous in appearance, partake of this durability, and thus occasion that nodular aspect so characteristic of this limestone.

251. Is there any connection between a primary limestone with veins of flint, and the chalk strata enclosing rolled pebbles of the same mineral? The occurrence of flint pebbles in chalk has always appeared amongst the wonders of geology to the uninitiated. The difference of composition between chalk and primary limestone is perhaps as great a one, and not a little difficult to account for. The primary limestones we see, however, are subject to a caries, which as far as it goes, produces a perfect chalk. In that state it is obvious that the action of any of the numerous causes of the disintegration of rocks will be more powerful. If we then suppose that the flint being set loose, splits into numerous fragments of all sizes, and will, by the same cause that transports the loose chalky matter, be worn down on its edges and at last rounded, we shall perhaps have an explanation not at all improbable. If this be not an exact account of the phenomena, it at least, by shewing how natural and simple the process which might have produced the actual state of things, serves to take off some of the edge of our wonder.

252. In descending to the Surjoo from Goon, we find argillaceous schist occasionally of the same character as that observed in the ascent to the Thakil Peak, (greywacke schist.) It is, like that, of a dark grey colour approaching to black, and is remarkable for splitting into prismatic fragments on being struck. A good deal of calcareous stalagmite occurs, and a soft white or light grey schist, intermediate between clay slate and talc slate. Latterly, limestone is abundant, and in the bed of the river we have gneiss and quartz rock, with fragments of hornblende rock in addition to those of limestone and the two preceding. The gneiss continues from the bridge upwards, at first of a fine grain afterwards coarser, and containing superadded amygdaloidal concretions of felspar, similar in fact to the type described, Art. 80. Beds of mica slate and of quartz rock are contained in it; the latter furnished the only observation of the dip which was S. 30° E. and inclination 60°. At Burakot, argillaceous strata again prevail, and furnish some very anomalous rocks

in their several changes of type. A dark grey almost amorphous rock, with fine granular composition, conchoidal fracture, very hard, but rather brittle, which occurs near Burakot, is one of the most remarkable. Were it not for the decided absence of the arenaceous structure, I should be inclined to term it a greywacke. It contains, I think, carbonate of lime as one of the ingredients. It passes into a perfect roofing slate, which is found in great abundance just below the cantonment. Here we come upon the line of route which belongs to the description of the granite formation, and we must therefore return to Petorahgurh, to finish the details of the route thence to Almorah.

253. In the ascent to the ridge just above Petorah, the new road gives excellent views of the strata, and it were much to be wished, we could elsewhere gain the same access to the rocks as we do here. The soft and clayey rock of the cantonment appears to pass into a dark black rock of sublaminar structure. It breaks with an uneven, irregular, rather than a conchoidal fracture. It is often stained in the interior of a light ash grey colour, very similar in appearance to a piece of half-burned charcoal. At the summit of the Pass dolomite of a large crystalline grain occurs. It contains veins of indurated talc, (var. prismatic talc mica,) and also of very fine large rhombohedral crystals of dolomite, (macrotypous lime haloide.) The indurated talc is of various colours, but most commonly jet black, a variety not noticed by any of our mineralogical writers. It assumes a very good polish, and would form a very beautiful material for small ornaments for a table or chimney piece. It is not however in any quantity.

254. The dolomite is evidently a bed in the slate, for almost immediately on descending the Pass, the latter rock again occurs. It is here of a white colour, and of micaceous composition, but still slaty in structure. It is again exchanged for the black rock with light grey stains. The debris here consists of a very fine ochrey clay of a good colour, and which might be useful in the arts if prepared properly; besides the bed of dolomite, beds of talc slate are found, and in this rock is situated the copper mine, which is, however, worked on a very small scale, producing only 50 Rupees per annum. The argillaceous schist continues down this valley, (Shor Goorung,) irregularly intermixed with dolomite, which is very often compact, containing veins of the crystallised mineral, and very often appears to pass into the slate. It can seldom be seen in

well-defined strata, rather appearing like amorphous projecting masses, unless when impure, and then the strata are as well marked as those of the better defined schists. In two instances, the dip was observed N. E., inclination 20°, and N. N. E., inclination 32°. The first of these was a purple arenaceous rock, containing a good deal of carbonate of lime, the second was an almost pure compact dolomite of a light grey, and remarkable for its conchoidal fracture, toughness, and hardness.

255. In the descent to the bed of the Ramgunga, chloritic schist of a perfectly pure type occurs, being in fact green talc slate; it contains metallic copper disseminated, but no attempt has been made to work it. In the bed of the river a schist occurs, which may well be called talcose schist, being a mixture of quartz and talc. It bears the same relation to talc, (prismatic talc mica,) as rhombohedral talc mica. It is in this particular place schistose, and distinctly stratified; but in other quarters, it passes into a massive rock, bearing the same relation to it, which ordinary quartz rock bears to the above schist. It is in fact a talcose quartz rock, as we may call the ordinary type micaceous quartz rock. The titles talcose and micaceous schist might be confined to the schistose types of this compound rock, and that of talcose slate, to the slate composed entirely of indurated talc. This would introduce some precision into our account of rocks. In like manner, chloritic slate should be reserved for the pure mineral, and chloritic schist for the compound types. Without a reform, terminology will never make any real progress.

256. From the bed of the Ramgunga, the route ascends to Gungolee Hath, on the valley of that river from that of the Surjoo. The talcose schist passes into a quartz rock in which the talc is gradually lost, until it at length very closely resembles a sandstone in appearance, argillaceous schist then establishes itself, but whether by transition or per saltum, the state of the surface does not admit of deciding. The dip was observed to be N. 7° E., inclination 45°. Towards the summit of the ridge, magnesian and siliceous limestones begin to prevail, and the crest is entirely composed of a flesh-coloured dolomite, with purple clouded delineations, which I think would form a very handsome material for various ornamental works, as it takes a very high polish, and is not more difficult to cut than ordinary marble. It is traversed by veins of a purplish brown calcareous spar with curved

cleavage, and so strong a pearly lustre, as to be at first mistaken for dolomite spar, (macrotypous lime haloide,) but its specific gravity and ready effervescence with acids, shew it to be rhombohedral lime haloide: veins of a resinous quartz; bluish, black and white, are also observable.

257. In descending to the Surjoo, a little blue limestone is seen, and one patch very beautifully variegated with yellow veins of carbonate of lime. The prevailing rock, however, is argillaceous schist; a good deal of what might, in following up the distinction, (Art. 246), be called clay slate also prevails, soft and distinguished by its series of colours as well as by its patches of a different colour from that of the ground. At the bridge, the rock dips S. W. In ascending from the river, an impure hornblende rock begins to appear, remarkable for its numerous cleavage places, which render it so difficult to distinguish the lines of the strata. Hornblende and actynolite schist are found, and a white massy rock, which from a cursory examination, I supposed to be a compound of tremolite and quartz, as the three substances, hornblende, actynolite and tremolite really constitute but one species, (hemi-prismatic augite spar,) there is nothing improbable in this opinion. I have to regret in this, as in many other instances, the want of access to the specimens collected, in drawing up this paper, which prevents me from revising particulars of this description, stated hypothetically in my note book.

258. The hornblende schist ceases a little above the village of Neoolagoon, and is succeeded by gneiss, which is of a porphyritic type, containing superadded prismatic nodules of felspar. This mineral in every case appears to be of greater durability than the basis or ground, and the nodules consequently remain projecting after the other has in a measure disintegrated, giving the rock an exceedingly uneven and rugged surface. The dip was observed to be S. W. Near Jagesur, this gneiss is succeeded by micaceous schist, dipping to S. S. W., with an inclination of 60° above Jagesur. On the Pass the dip had changed S. W. This rock continues to Almorah, and presents nothing very worthy of remark along this line. Near Chandeswur, it dips to S. S. E., with an inclination of about 15°. A few miles from this, it contains beds of brown iron ore, (prismatic iron ore,) which are said to furnish a very good metal. The ore contains a little manganese, rolled pieces composed of grains of quartz sand, and octohedral crystals of magnetic iron ore (octohedral iron ore,) are

found scattered about the surface of a hill in the vicinity of this mine, but no trace could be obtained of a deposit in situ. These pieces are all natural magnets, and have two or more poles according to their shape. Under Kaleenath, the schist becomes highly carburetted and soils strongly; some pieces are white, and on the summit of the ridge where the carburetted type entirely prevails, nodules of graphite are found. The dip in this vicinity changes to N. 44° and N. 22° W., the inclination being 45° and 30°. The rock is latterly extremely like a sandstone, and so friable, that no specimen is obtainable.

259. A short line yet remains to complete the details of the schistose band of rocks, previously to entering on the description of the granite beds. It is the route followed in an excursion from Petorahgurh to visit the copper mines. At Seera, argillaceous schist prevails for the first few miles, to which succeed dolomitic rocks of very variable appearance and grain. Occasionally, they are of very loose aggregation, and crumble to pieces in attempting to procure a specimen, occasionally though these latter are chiefly fragments. In the bed of the river they are so hard and tough that the hammer will scarcely make any impression on them. In every case the grain is crystalline, but very various in size, even within the limits of a hand specimen. Clay slate occurs of a deep iron black colour with straight laminæ, very hard and very brittle. It has a kind of iridescent tarnish, sometimes, on the face of cleavage. Near Kinder Besool, the limestone rocks, less decidedly dolomitic, continue mixed irregularly amongst patches of slate.

260. The route now ascends to Dhurmgurh, situated on the ridge which overlooks the Seera valley, carrying clay slate along that line, and then descends to the mines, which are immediately below the Pass. They are situated in a formation, or bed I should rather call it, for the former term is too general, in which indurated talc, (potstone and talc slate of geologists,) and crystalline granular dolomite are irregularly mixed. They must indeed here be considered as the same rock, geologically speaking, for they mutually interfere, and hand specimens may be obtained in which both substances are separately observable as well as in mixture; access is wanting to the junction of this bed with the surrounding slate, so that its exact nature cannot be ascertained, that is to say, whether it be really a bed or vein. The copper ore is most commonly copper pyrites, (pyramidal copper pyrites,) and it is

associated with iron pyrites, (hexahedral iron pyrites.) These minerals, particularly the latter, are often found imbedded in the potstone. Some part of the galleries are cut in the dolomite rock, part in the potstone, as the two rocks are continually interchanging, so that a gallery begun in the former will, after 20 or 30 yards, be found to be in the latter. The copper evidently traverses both rocks, and as far as the miners' accounts can be trusted, is in veins.

261. Till the publication of Professor Moh's system, great confusion existed on the subject of these two mineral species. We have in some of our most approved system-mongers, long and laboured articles, consisting of many pages of description, tending to shew, that massive talc was something different from potstone, and these again from soapstone; yet if we examine their several qualities, we shall find them identical. Professor Mohs, with the judgment which he has shewn throughout his work, at once rejected futile distinctions that were without differences, and has not hesitated to connect, as mere varieties, scaly talc and potstone. The truth of his views, if they required confirmation, would be found every where in these mountains, where an uninterrupted series of gradations may be traced, from the most perfectly amorphous potstone, through talc slate to the scaly mineral, usually considered a distinct species. Previously to the publication of that excellent work I had found so much difficulty in reconciling the contradictory accounts of mineralogists, that I determined to form a collection of the various types of this mineral, and in consequence, had satisfied myself, that there is in reality no difference whatever in essential character amongst the varieties, which hitherto have figured as distinct species. The inaccurate determination of specific gravities by early writers, servilely copied by their successors, has been partly the cause of this and many other of the opprobia of mineralogy. The following determination of this element, obtained from the specimens above alluded to, will serve to shew, how absolutely the same it is in the different varieties, and to confirm the accuracy of the limits fixed by Professor Mohs, viz. 2.7, 2.8.

White potstone, (Seera Mine,)	2,712
Black ditto, (Shergarury,)	2.76
Greyish ditto, (Seera,)	2.76
Yellowish soapstone, (Kuree,)	2.79
Do. very steatic, (ditto,)	2.74

Indurated talc, (Government Collection,) 2.77
Ditto, a second specimen, ... 2.7765

All these had precisely the same degree of hardness.

262. The dolomite has been equally well discriminated, and correctly fixed by the Professor. The accounts of previous writers only serve to confound the student with tenfold perplexity, from which he is only extricated by his clear views, and precise determinations. That they will very much tend to raise the character of a science, which till his book appeared was but empiricism, is obvious. Of their utility to the student I can myself bear witness, and this very mineral, as well as calcareous spar affords many instances. The limits of the latter are fixed at 2.5 and 2.8, of the former at 2.8 and 2.95. The following are some determinations I made :—

Grey compact dolomite, ...	2.826	Pass, road to Bagsar above Belowree.
Greyish white dolomite spar, ...	2.850	Goorung.
Yellowish grey ditto, ...	2.99	Bed of Mahepore.
Dolomite spar large rombohedrals, ..	2.83	Shor Gorung.
Compact dolomite, purple, ...	2.83	Gungolee Hat,h.

Of these the third only exceeds the limits, and this by so small a quantity, that it is very likely a revision would bring it equally with the others under those limits. The veins of purplish brown calcareous spar, which are found in the Gungolee dolomite, have the external characters of dolomite spar quite perfect; that is to say, pearly lustre, opacity, and curved or ill-defined cleavage. Being also contained within a magnesian rock, I naturally placed it amongst the specimens of dolomite, but in determining its specific gravity as one of the above list, I found it to be only 2.67. A re-examination and the test of acids satisfied me, that it was really calcareous spar. This is one amongst a hundred instances in which external characters alone are found perfectly inefficient to discriminate minerals, nor is there any thing in the history of science more truly surprising than the pertinacity with which mineralogists have hitherto resisted putting their system on the secure basis of numerical determination.

263. Below the mine, very beautiful massive talc of a snowy whiteness occurs, mixed with unequally white crystalline dolomite. The former is, however, intermixed by rents or fissures, preventing the acquisi-

tion of a small piece even applicable to the purposes of the arts. It passes into a yellowish grey talc slate, in straight laminæ a very beautiful rock. The white indurated talc is also found associated with nodules of quartz, the former being disposed in layers round the latter. A blue limestone succeeds in nearly horizontal strata. It contains disseminated talc. We have then a talco-argillaceous schist, and thence siliceous limestone, and white fine granular dolomite in various intermixtures and transitions to the foot of the great Dhuj Peak. Nearly half way up, we observe a talco-calcareous schist in moderately thin laminæ of a yellowish colour, the dip being to E. It is crowned by a purplish grey micaceous schist of well marked character. In descending on the other side, a very beautiful white fine granular dolomite, clouded with green tints, is found, a rock that would furnish a very elegant marble. Argillaceous schist is then established, and continues very nearly to the descent into the valley under Petorahgurh. Limestone then occupies the ground just at the edge of the descent, and on this side the valley, argillaceous schist, as before noticed, is again the rock.

264. It is now time to consider the granite beds, and we may do so in the most regular manner, as well as fill up some details still wanting in the schists, by pursuing a line from Chumpawut to the point where we left off in Art. 231. This route forms almost a straight line, and it is singular enough, that it is parallel to the direction of the mountain land and of the strata, as may be seen by examining the map. Such a coincidence, to say the least, is curious, and cannot fail to excite in a speculating mind a desire to trace in this common relation, some evidence of a community of origin. At Chumpawut, the most eastern of our beds of granite makes its appearance. It would seem to be precisely the same rock that in Cornwall is called granan, being a loosely aggregated amorphous mass, with the ingredients and structure of granite, but so soft, as to bear being dug like clay or mould. It is remarkable for its great proportion of felspar, and small quantity of mica. This soft ground is strewed over with large imperfectly rounded blocks, of a very hard and beautiful granite. It is of a smaller grain than the granan, and much more crystalline. The felspar is white, the mica black, and the quartz yellow or brown. The blocks are sometimes observed to have a superficial layer or crust separating

from them, not in any thing like a decomposing slate, but equally hard and equally beautiful with the body of the mass; nor is it easy to understand, what is the cause of this separation. Some further details will be brought forward when we come to the Dhee bed. At present, we may go on to say, that the eastern boundary of the Chumpawut bed has not yet been traced. To the West, it is succeeded by micaceous argillaceous schist, which passes immediately into well-defined argillaceous strata. These continue to Lohooghat cantonment.

265. It is scarcely necessary, after the long details already given of this rock, to enter into any more; it may be therefore sufficient to say, that it is a fine, granular, grey, compact, blue, chloritic, arenaceous and earthy, most probably the result of decomposition, as though perfectly soft and little differing from clay, it has yet the laminar structure distinctly marked. Near the cantonment in the bed of the stream by the bridge, it approaches to a greywacke, and is full of quartz veins. It contains, I think, felspar, certainly mica and quartz, but the composition is arenaceous. It dips to N. E., and at an angle of 54°. In the cantonment as before noticed, excellent roofing slate abounds, of which circumstance the officers have taken advantage in building. The granular type containing much quartz, and sometimes chlorite, continues as far as the bed of the stream below Furkah. There a quartz rock is seen distinctly stratified, dipping N. E. 15°, at an angle of 54°. This rock contains felspar, and might almost be called a quartzose gneiss. Ascending hence to Farkah, the granan begins to establish itself, till at that place it is perceived that we are arrived at another granite bed, situated almost exactly in the hypothetically drawn line through Chumpawut, parallel to the direction of the strata.

266. The character of the rock which composes this bed, is precisely that already described. The same excess of felspar, the same soft crumbly material, in fact a perfect granan. In the vicinity of Furkah, there is a mass of limited extent, consisting almost wholly of felspar, which it would seem is stratified; but with this exception, the whole of the country for many miles, presents the same roundish projecting amorphous masses. The large blocks are not so common in this tract as at Chumpawut, but towards Dhee they become very numerous, and of enormous size. Here it is that the circumstances of their desquamation may be best studied, and some light thrown on their nature and

origin. The ground is still the same granan, equally soft, equally abounding in felspar as at the two former places; but the blocks are of superior hardness, and have not any sign or trace of disintegration. The crusts may be seen in every stage, just beginning to separate, or having made considerable progress; a large layer, of a thickness seldom exceeding half an inch seems waiting any impulse, or perhaps the further action of the same cause to detach it entirely. These form the only means of obtaining specimens, so hard and so round are the blocks where this phenomenon is going on. The view of the process in all its different stages satisfied me at once that these boulders originated in the granan being but the harder and more durable nodules of a soft rock, which has gradually wasted away, and left them as monuments of the extensive waste the surface has undergone. This view is confirmed by an examination of a very large one that lies to the S. W. of the temple, and which presents a set of appearances worth recording. It is of an irregular sphero-rhombohedral shape, and not less than 60 feet in diameter. It rests on the granan, and its connection with the latter is the circumstance which forms the interest. The block itself is very hard at its base; it is well-defined by a seam which separates it from a layer of a softer granite that is divided by seams into numerous flakes, which all follow the curvature of the boulder. It is not the change of hardness that forms the boundary of the latter, but a distinct seam or separation. The flakes immediately adjoining it are very thin; they gradually increase in thickness as they diminish in hardness, till in a space of five or six feet the seams disappear, and the soft granan of the surrounding surface is established. The rock is in some measure overhanging, the soft layers having been cleared away probably for the purpose of forming a cave or shelter for the numerous flocks and herds that graze here at particular seasons, so that the structure and arrangement of the thing is perfectly exhibited. My figure may give a clearer idea than any verbal description can.

267. The correct boundaries of this granan tract have not yet been fixed on every side, but it is inferred that the extent of it is very limited in a North and South direction. In proceeding to visit the iron mine at Muglig, which is in the latter quarter, I found it pass into a very regular micaceous schist, in a distance of 6 miles. This schist dips to the North, that is, towards the granite, and at rather a

high angle, of 55°. At Kande, a small village about that distance below Dhoora Peak, mica slate is established, and continues to the mine where it contains a bed of limestone, in which rock the mine appears to be situated. Some of the best specimens of calcareous spar are obtainable here, though great part of the limestone itself is very impure, containing 20 per cent. of foreign matter. At the mine, it appears to be stratified, and dips 55° N., at an angle of 34°. The ore is in the form of a vein, to judge from the miner's descriptions. It is of a brownish black colour, granular composition, very hard, and breaks with a conchoidal fracture. It is not magnetic, or at least only very slightly. The specific gravity is 3.7 to 4.0, but as it is obviously contaminated with some foreign ingredient, this determination is too low. It is most probably (the pure part) titanitic iron, (axotomous iron ore.) It is very imperfectly smelted, and sold in a spongy impure state, at the rate of a maund for a Rupee.

268. A remarkable feature in the granan is the number of veins it contains. These consist almost wholly of felspar and quartz, the former mineral forming the larger proportion, for it is always of an opaque aspect, apparently impure, very cleavable, so as to prevent the acquisition of specimens of any size. This structure I think it owes to its impurity, and that it is the intervention of the quartz which occasions its separation into fragments. There are other veins which are to be observed also in the hardest blocks This is a granite of a finer grain, which is sometimes seen to traverse the great boulders, or large round fragments, and they are like most veins separated by a strong line from the surrounding base or ground. Some few imperfect quartz crystals have been found. Epidote has occurred in company with ill-defined large crystals of white opaque felspar; schorl is found in abundance. In one instance it forms a very large vein in a bed of quartz rock. But the most interesting inhabitant of this singular rock is yet wanting to complete its resemblance to the granan of Cornwall. Tin has never been found in it, though as the oxide and sulphuret of this metal are so unlike the general run of metallic ores, it is possible the non-discovery of it may be owing to the ignorance of the people concerning the value or appearance of such mineral.

269. The granite continues to Sarput-ka-Dhoora in a direction a little beyond which it gives place to gneiss, and this to mica slate,

which appears to pass into a greywacke. About half way between this spot and Dhol, (the regular stage,) a number of rocky masses occur, very striking both by their magnitude and apparent disorder. They are all fragments of gneiss strata, one (the longest) has something of a pyramidal shape, very similar to a rock noticed by Dr. Macculloch (also of gneiss,) in Skye. It here performs the part which he supposes the Skye rock would, were it transported to the plains of Hindoostan. It is worshipped under the title of Nag Deo. It is at least fifty feet in height, and twenty to thirty broad at the base, and has no fissure or line of strata, or separation throughout. Gneiss in situ is also found in this neighbourhood, mica slate again succeeds, of an ordinary type, and continues nearly to Dhol.

270. At Dhol, it passes into a singular rock requiring a little detail. This rock is of an earthy composition, and quite soft, though preserving the appearance of strata, and of laminar or schistose structure. It contains in its transitions into ordinary mica slate more or less of this mineral; but in its best defined types very little, if any, is to be seen. It is of various colours: black, red, yellow, grey, white, always bright and well defined. The black is the most abundant, the white the least so. It is very absorbent of water. In a piece weighing 205 grains, it amounted to 28 grains; on another of 191, 30 grains; allowing for the absorption the specific gravity was found to be 1.95 and 2.01. The black variety generally dull, but occasionally with some lustre, is infusible, burning under the blowpipe to a white ash. Some portions, however, do fuse into a black slag, attractable by the magnet. It is slowly soluble in borax, occasioning effervescence, but imparts no colour to the bead. The red variety under the blowpipe turns black, and with a continuation of heat, part fuses into a magnetic slag, part burns to a white ash; muriatic acid, whether concentrated or diluted and even with the assistance of a boiling heat, has no effect. Of the existence of a very large proportion of carbon in this rock, the foregoing particulars leave no doubt. The inference that it contains beds or veins of graphite is a natural consequence, rendered almost certain by the occurrence of the mineral in a similar rock to be noticed afterwards. The great variety of rather decided colours in it gives this district a peculiar appearance. So bright are the reds and yellows, that I think very excellent colours might be manufactured from them. The

people of the country had their attention excited by this circumstance, and attempted to obtain iron from it, which they supposed to be indicated by the red, yellow, and black colours. Failing in this, they do not appear to have sought for any thing else.

271. The micaceous schist again assumes its ordinary character on the road to Bandunee Dihee, and is observed to dip N. E. 25°, at an inclination of 35°. On the summit of that Peak, which forms a plane 200 by 20 yards, strata of garnetiferous schist are seen projecting. The dip 30° N. E., inclination 35°. In the descent to the stream, it changes to a talco-micaceous schist, of a pale lead grey colour, very soft, and almost steatitic, with curved laminæ, and passing into a white clay. It contains nodules and grains of glassy quartz. The dip is North, the inclination 30°. In the bed of the stream, the strata which are of the ordinary character, dip 14° S. of E., the inclination being only 17°. Ascending thence, we have micaceous schist, which continues to the cantonment; the dip being generally between N. and E., and the inclination small. This schist is remarkable for its great variety of type, even within the limits of so small a space as the cantonment; 1. yellowish brown, scaly, tender; 2. quartzose, grey, in tolerably straight but thick slates, the two materials being disposed in layers; 3. less quartzose, in thick large schists, with an undulated surface; 4. blue or dark grey approaching to the character of gneiss, and occasionally containing very small portions of crystalline felspar; 5. a soft arenaceous mass, which on exposure to the air, falls into sand. These are amongst the most remarkable. The addition of garnets introduces many other varieties. This schist is also to be noted as containing veins of granite of a very regular type, and also of felspar in a semi-disintegrated slate, and of snowy whiteness. The latter might be also called a granite, as it contains quartz, and even mica; but the former is in small quantity, and the latter consists of a few solitary scales disseminated.

272. The ridge on which Almorah is situated, rises into the Peak of Kaleenath, and in the ascent thereto the above described schist is observed to pass into the same kind of soft earthy black rock, which was described at Dhol. It was here that the graphite was discovered, (alluded to in Art. 270,) lying on the surface in lumps, the fragments of kidney or egg-shaped nodules. The largest specimen obtained, however, was an oblate spheroid perfectly rounded, and having

a diameter of about three inches. This latter contained small veins of quartz. The aspect of this graphite till scraped or abraded was dull; in the latter case it was metallic. The composition was fine earthy. The fracture uneven, specific gravity —. It appeared to be of a middling quality as applicable to the arts. At the time the discovery was made, I was on the point of leaving Almorah in prosecution of some other views, and I have not since had an opportunity of prosecuting a search after larger supplies by excavation.

273. The mica slate again resumes its ordinary aspect on passing the Peak, and near the village of Betholee has a dip to S. W., being immediately succeeded by a strata of gneiss with a similar dip. This mass is probably connected with that in the valley below, noticed, Art. 269. If so, it would appear to be more of the nature of a vein having considerable longitudinal extent, while a few yards bound it in breadth. In the ascent from the village to the Pass it is again lost, being replaced by micaceous schist. But on the descent gneiss reappears, accompanied by hornblende schist, and extends for some distance. Perhaps after all, these two patches are connected beneath the surface, the micaceous schist of the Pass lying on them. It is possible even that they may both be connected with the Jagesur gneiss, as the latter may be with that observed at Ramesur, and again on the other side with the rock in the valley of the Goomittee. Well devised sections would throw light on this point, and probably develope the general arrangements of these detached patches of gneiss.

274. The Almorah ridge towards the southward, terminates in a mass of granite and granite gneiss, the latter being most abundant. By this term I mean a rock, which in structure seems to be intermediate between gneiss and granite. It is remarkable for containing prismatic nodules of felspar, which gives it a porphyritic character. There is also a good deal of the granan, and there are the same blocks strewed over the surface of the hill as at Dihee. In fact, there is no question but it is the same rock as the two patches observed at Chumpawut and at Dihee. It extends in the east quarter across the valley of the Sowal, ascending the ridge on the opposite side, where it is succeeded by the black and red earthy slate already described, Art. 270. To the south it terminates in the descent to the con-

fluence of the Cosillah and Sowal, being exchanged for micaceous schist, which gradually passes into a talco-argillaceous schist, and latterly, a perfect clay slate. To the westward, it descends the valley of the Cosillah, rising into the lofty peak Seahie Dabee, which is nearly composed of it, and bounded on that side by micaceous schist. A few very narrow veins traverse some of the vallies beyond the limits of this patch, but their connection with it has never been satisfactorily traced.

275. The micaceous schist of Almorah occupies the descent to the Cosillah, with the exception of the narrow strip of granite just noticed. The road to Hawulbagh is in the same rock, and it continues in the route up the valley of the Cosillah, till it is exchanged for the patch of gneiss noticed in Art. 152. On the road to Gulee Busoor, it also prevails, being most commonly of a bluish colour, and containing garnets abundantly. This rock is further remarkable for being traversed by a vein of a singular nature, no name or description of which I have even met with. Near Hawulbagh an instance occurs: It is of a porphyritic character, consisting of thin needles or prismatic bundles of needles of hornblende, imbedded in a white granular paste of felspar and quartz. On the Pass above the village of Aeena, leading from this valley into that of the Sugos, the rock is of an earthy type and very singular aspect. The dip of the schist here (on the Pass) is N. E. 22°, the inclination 50°. Below the village of Aeena, it occurs of a lead blue and full of garnets, the dip being N. E. In this neighbourhood are many of the porphyritic veins just noticed. Micaceous schist more or less differing in character continues to Mernee, near Dhooara Hat'h, great irregularity being observed in the dip with frequent reversals; near the Sugos it is S. W., which on going a little farther is exchanged for a N. E. dip. In the bed of the river it is again S. 25° W., inclination 34°. The porphyritic veins are abundant in this neighbourhood. The S. W. dip continues to the junction of the mica slate, with a gneiss which lies conformably; but which is the superior rock, it is impossible to say for want of access to the line of junction, especially as the change takes place in the direction of the strata.

276. This gneiss is introductory to a large patch of granite similar in character to the three beds already described as occurring at Chumpawut, Dihee, and Almorah, and what is still singular, in the same straight line with them; the direction as before observed, being parallel to that

of the strata and of the mountain land. There remains nothing to add to the particulars already given of this rock at those places, as it is here precisely the same in grain, consistency, overlying, amorphous appearance, &c. It appears to pass on its borders into a gneiss. The change at Mernee has just been noticed. Another takes place in the descent to the glen to the N. W. that leads into the valley of the Ramgunga, (Art. 106.) To the N. E. it is I think connected with the gneiss in the Cosillah, (Art. 152.) To the south it is succeeded at no great distance by micaceous schist, but the boundary line was not seen. The schist was observed to dip N. 27° E., inclination 41°. To the west it passes into the pseudo-porphyritic gneiss, noticed at Almorah, and which near Mythana is succeeded by a black micaceous schist. Near Palee, however, the gneiss is again seen, containing nodules of quartz, and some very singularly lustruous veins of a material, the same essentially as the basis, only much harder. At no great distance on each side, micaceous schist is recognised.

277. In the descent to the Ramgunga, micaceous schist reappears, and continues as far as the confluence of the Beneegunga. In the bed of the former river, the number, size, and variety of the rolled stones is quite surprising. They occur at a height of 200 feet above the present bed of the river, and many of them are of a totally different nature from any of the rocks in the immediate vicinity. The micaceous schist continues in the Beneegunga; at its mouth it dips 32° N. E., the inclination 31°. Beyond Tamba Dhar, it is again succeeded by gneiss, which is distinctly stratified, and dips N. to N. 13° W., at an angle of 52° to 57°. It is worthy of remark, that part of this rock is a perfect micaceous schist, containing no visible traces of felspar, yet there is no separation, nor any transition in the usual sense, nor disturbance of any kind. To the eye, it seems to be part of the gneiss, but on examining it, the characteristic ingredient is found wanting, while in the remainder of the mass, it is obvious enough lying in lenticular imbedded nodules, which on the cross fracture, give the rock an appearance not to be mistaken.

278. Another observation of the dip, a little beyond this point, gave N. 22° W., the inclination 43°. Quartz rock and micaceous schist next succeeds, and continues to Deoghat. At this place, the route turns up the bed of a feeder of the Beneegunga to Ketureea, and in

this line a rock oscillating between granite and gneiss continues the whole way. It appears to divide into cuboidal masses, or rather into parallelopipeds, one of the surfaces of which, apparently coinciding with the planes of the strata, gave a dip of N. 22° W., inclination 36°. Near the Dawk chowkee, it is observed in immense rounded masses lying in the bed of the river, and I think having more the character of granite than the masses in situ. In this the felspar, which is of a greenish grey colour, and its lustre being highly translucent, is very remarkable for the size of its concretions, and their imbedded appearance giving the rock very much the appearance of a porphyritic granite. This rock has an analogue at Almorah, and on the summit of the Choor Peak.

279. The gneiss continues to put on the appearance of being divided by several sets of seams into more or less regular masses, and its structure becomes less decidedly schistose. An observation of the dip gave N. 10° W., with an inclination of 72°. It contains the same felspar that I have just noticed as occurring in the rolled masses of granite, a little beyond the 243rd kos stone* the dip was observed S. 20° W., inclination 50° to 60°. Latterly near Thanna, it gives way to a micaceous schist, remarkable for the great size and imperfect shape of the garnets it contains. The round blocks of granite of great size appear still in the bed of the river. From Thanna to Muse, and again in ascending the high range over which the road to Ran leads, no rock but micaceous schist is seen in situ. Above Masoo, it occasionally contains kyanite, but not in any quantity, or of any size or beauty of appearance. On the summit of the Pass, the same rock is found dipping N. E. at a considerable angle. Half way down the descent, blocks of gneiss in great number and of great size are seen, many of them occupying such situations as will not admit of our supposing for an instant, that they have ever been in motion, or occupied other than their present sites. At the village of Ran, micaceous schist is the rock dipping N. E.

280. From Ran, the route descends to the bed of the same nullah in which micaceous schist is still observable, and thence ascending to Kunyoorbut near the latter place, we come again upon a district of gneiss

* The Goorkhalee Government had erected these stones at distances of a koss along the line of road from Katmoondo to the Sutlej.

rocks, which occasionally appear to pass into the common earthy micaceous schist, occasionally into an amorphous granite. It contains schorl occasionally in nests. The boulders are very numerous, and the granite is in places a perfect granan. The gneiss, when well defined, contains garnets. Hence to Dhout, the latter rock and micaceous schist may be considered the prevailing rocks. On the summit of the Pass above, gneiss is also found of that type, which inclines rather to micaceous schist than to granite. Hence descending, the granite is again met with, but under relations which will bear a little more detail.

281. The appearances I am going to describe may be seen a little to the east of the village Dhooeet. In a geological sense, the rock may be called a gneiss, but it exhibits small patches, (forming regular transitions amongst themselves,) of the most regular micaceous schist, (earthy type,) and again of the most legitimate granite, (granan). These three rocks, so different in composition, in mineralogical character, and in supposed geological origin, may be here observed in the compass of a few yards, all naturally interchangeable, while nothing like a veinous appearance can be attributed to any of them. A long zone or belt is marked by huge boulders of gneiss or granite, (for I could not examine them closely,) strewed over it, and such is the declivity of the mountain side, that we cannot for a moment suppose that they have rolled into their present places. They are in fact like those of Dihee, the harder nodules of a rock many feet in depth, which has disappeared owing to the power of waste. The dip of this rock, which in its gneiss and mica slate types is regularly stratified, is N. 48° to 55° E., inclination about 48°. In the descent from this village, we find the chloritic argillaceous schist mentioned in Art. 116.

282. The whole of these beds are upon the same line, which is, as before observed, parallel to the direction of mountain land and of the strata. In prolonging this line to the westward as far as the Sutlej, only one other locality of granite is met with. This is the Choor Peak, a mountain which rises to the height of twelve thousand feet, and which has no equal or rival within a circle of sixty miles diameter. The shape is that of a long block or ridge running N. N. W. and S. S. E., about one and a quarter mile in length, which rises suddenly on the N. W. extremity into a sharp rocky peak many feet higher. To the S. E., it sinks suddenly into a well-wooded range, where the

rock is with difficulty accessible, but from the indications observable, I should judge it to be micaceous schist. This rock indeed surrounds the base of the high ridge which itself is composed of granite, occasionally of a highly crystalline grain. It appears to contain two different kinds of felspar, one of which assumes that arrangement which may entitle the rock to the appellation of porphyritic. It is a very beautiful rock. The mountain is conspicuous from every other quarter, and in every view of it the summit patch of granite is at once distinguishable from the micaceous schist below by its peculiar rocky aspect and bareness.

283. I have now to give a few details on the occurrence of the sandstone formation which bounds the mountain tract to the South towards the plains. This rock assumes many different aspects here as it does in Europe; upon the whole, the resemblance is sufficiently striking to allow of our identifying it with the newer red or saliferous sandstone, (the red sandstone of English geologists.) It is either a hard red gravelly clay distinctly stratified, or the same clay enclosing rounded stones, or a micaceous sandstone, which in hardness varies from loose sand to a rock that will strike fire. This type is again modified by the admission of rounded pieces passing into sandstone conglomerate. These two rocks form the principal part of the formation. The sandstone is always micaceous in a high degree; it is most commonly of the ordinary colour, but sometimes it is found of a dark bluish grey, in which case it seems to loose its appearance of a schistose structure, and becomes amorphous, breaking equally in every direction. The type is farther remarkable for containing kernels of superior hardness to the base, which itself is more compact, and I might say clayey, than the ordinary sandstone. It also contains less mica. This grey type also passes into the conglomerate structure; besides these, which are the most marked types that have any extent, there are innumerable varieties of very anomalous appearance, chiefly towards the upper part of the rock. The yellowish grey ordinary sandstone often alternates with a rock that might pass for a perfect greywacke. The latter is seldom marked with the strata lines like the sandstone, but is conformable and parallel to it. One of the most remarkable features is the occurrence of ellipsoidal-shaped cavities in the middle of sandstone strata. They are of different sizes. One which I observed measured six feet in its longest diameter, and was quite smooth and regularly curved in its interior.

284. I shall now mention the different places where this sandstone has been observed, adding any other particulars which appear to require it. At Bhumowree, it is seen in the river bed, dipping N. E., at an angle of about 30°; but it has here scarcely any development, and nothing is to be learned regarding it but the above fact. At the Chilkein defile, we have more access to it. It there forms very extensive strata, chiefly of the red clay type, between Chilkee and Dhikoolee. In the bed of the Cosillah, occasionally rounded stones are contained imbedded. The strata appeared almost horizontal, or at least very slightly inclined. At Dhikoolee, the conglomerate character is perfect, the basis being still the red clay, but sometimes indurated in a high degree. The strata here dip to the North. They are covered by a deposit of loose rounded stones. From this point, the rock is concealed till we reach Chookoom, and there we find a greenish grey sandstone with mica dipping S. W. It is covered by a loose shattered rock of various bright colours, indicative as I have observed elsewhere, of this formation; beyond this point, that is above it, I have not met with it.

285. Specimens brought from Kaloo Shaeede's tomb, at the outlet of the Ramgunga, belong to this sandstone. They were of the grey type, with conglomerate structure. At Hurdwar, it may be studied to great advantage, and all its characteristics examined on the Beemghora Pass, where the construction of a beautiful road, by order of Government, has given two admirable sections of these strata. They are here mostly of the sandstone type, neither the red clay or the conglomerate being common. On the opposite side of the river, however, Chundee Puhar is almost entirely composed of these types. A singular circumstance is the opposite dip of the strata observable at these two places. At the latter, they dip on the Hurdwar side S. 35° W., at an inclination of about 30°; while on the other the dip is the N. E., the inclination much the same.

286. This formation has also been examined in the Kheree Pass, leading from the Dhera Doon into the plains. In this quarter, the dip is very regularly to the N. E., or to some point between N. and E. The first strata observable, and which may be supposed uppermost, is the red clay that lies on a stratum of red conglomerate. The Pass is cut through this latter, and a good section of it obtained. The stones are most commonly quartz rock, more or less coloured; pieces of granite

also are observable. Farther on is a perfect sandstone conglomerate; specimens were obtained in appearance perfect greywackes, traversed by quartz veins. The grey type is common, and often appears to pass into a sandy clay, with mica disseminated. Similar phenomena are visible in the Timlee Pass, the other entrance to the Dhera Doon, and in the ascent to Nahun. The Pinjore Doon is shut in to the southward by a low range of hills, composed chiefly of red clay and red conglomerate. West of this point, the formation has not been traced, but it probably extends to the Sutlej, having a greater development where the vallies separate it from the primary strata, and vice versa.

287. There now only remains that I should notice the extent of the deposits, consisting of rounded stones, gravel, and sand. I have already mentioned in the course of the preceding details, the several accumulations that are to be observed in the beds of rivers. But their greatest extent is on the borders of the plain country lying at the foot of the mountain ranges. At Bhumowree, they may be seen resting on sandstone. They reach to Tandaha, a distance of fifteen miles. In great part of this line, the deposit is of enormous thickness, a well having been sunk half way between those places to the depth of 150 feet, without passing through it. At Chilkeeah, they are again seen reaching from the foot of the mountains to Haldoorea, a distance of twelve miles. Here also the deposit must be of great thickness, as ineffectual attempts were made at Chilkeeah also to sink a well; sixty feet was the depth penetrated to, without passing through them. Again at Hurdwar, they have been traced as far south as Bhogpoor, a distance of ten miles, pieces of granite being observable amongst them. On the Kheree Road, they are seen for an equal distance to the southward, and on the Beput Road the same. But the most extensive collection of them by far is in the Dehra Doon, the whole of that valley being, as it were, filled up with them. A well which has been sunk there by the Hon'ble Mr. Shore, attained a depth of 220 feet, before a good and plentiful supply of water was met with; even at that great depth, the nature of the deposit was the same as at the surface. Mr. Shore has preserved notes of the particulars observed in the course of the work, and has kindly allowed me to take a copy of them. I shall here give them, as forming a very interesting contribution to our knowledge of the geology of these mountains:—

Feet.	*Total.*	
5	5	Fine black mould, with a few stones.
4	9	Reddish earth, mixed with gravel.
9	18	Loose sand and gravel, large stones.
2	20	Ditto, with reddish clay.
3	23	Stiff reddish clay.
8	31	Stiff yellow clay.
$3\frac{1}{2}$	$34\frac{1}{2}$	Sand and gravel, mixed with a little red clay.
$1\frac{1}{2}$	36	Stiff reddish clay.
2	38	Sand and gravel.
22	60	Stiff red clay.
2	62	Clay sand and gravel mixed.
16	78	Sand and gravel.
12	90	Stiff yellow clay, with a little sand.
35	125	Sand and gravel, a few round stones.
3	128	Sand, large blocks of conglomerate north and west side.
3	131	Ditto.
13	144	Sand and gravel, with tolerable sized stones.
5	149	Ditto ditto, stones larger.
9	158	Ditto ditto, with pieces of conglomerate.
4	162	Ditto ditto, with enormous stones.
6	168	Conglomerate on three sides, gravel the fourth.
3	171	Sand and gravel most; occasionally pieces of conglomerate.
3	174	Conglomerate, blocks of.
$3\frac{3}{4}$	$177\frac{3}{4}$	Layers of sand and gravel, pieces of conglomerate.
$4\frac{1}{4}$	182	Sand and gravel.
$\frac{1}{3}$	$182\frac{1}{3}$	Conglomerate 4 inches thick, under it water, but scanty.
$2\frac{2}{3}$	185	Sand and clay.
$\frac{1}{3}$	$185\frac{1}{3}$	Conglomerate.
$18\frac{2}{3}$	204	Sand and gravel, rather loose, occasionally pieces of conglomerate, occasionally solid blocks 160 lbs. in weight.
5	209	Sand and gravel, very moist.
$\frac{1}{3}$	$209\frac{1}{3}$	Conglomerate, over half the well water.
$1\frac{2}{3}$	211	Red clay.
7	218	Sand and gravel, very moist, water.
$3\frac{1}{2}$	$221\frac{1}{2}$	Blackish clay, with angular fragments of clay slate.

288. The extent of these deposits has not been traced so recently to the westward, but no doubt is entertained, that they attain there also an equal extent, judging from the recollection of former journies. Below Nahun in particular, and near Munta Dihee, at the exit from the Pinjore Doon, very clear traces of them are to be seen. That the Pinjore and Kyarda Doons are, equally with the Dehra Doon, composed of them, I have no doubt. It ought to be stated, before concluding, that in the Dehra Doon, the great thickness appears to be in the centre where the ground is highest. Towards the vallies of the Ganges and Jumna, they diminish very much in thickness, and in the beds of those rivers, may be observed resting on sandstone.

289. Southward of these rounded stones, a very extensive deposit of the red clay, which is very similar to the red strata of the sandstone, prevails. It has often small patches of loose sand. This red gravelly clay lies in a blackish clay of a purer character, very stiff and tenacious at different depths in different places. This latter appears to change to a lighter colour as we descend, and becomes more arenaceous, till at length it changes to a grey sand. My enquiries and observations have not yet been sufficiently general to allow me to identify these deposits with any thing like certainty, indeed it is only very lately I have been able to turn my attention to the subject, and the recent arrival of the boring engine I had ordered from England, precluded the possibility of constructing a proper apparatus and scaffolding for using it with effect, unless the operations were delayed till the ensuing year. I was therefore obliged to content myself with such results as could be obtained without the proper means, and was not able, in consequence, to penetrate beyond twenty-two feet in any of the bores I made; but I hope on my return to the field duties, that I shall be able to continue these enquiries with greater effect.

290. In the meantime, it may be interesting to give the particulars of the few bores I made. The first was at Moradabad, but being new to the operation, it took several days to bore sixteen and a half feet, the particulars were as follows:—

Feet.	*Inches.*	
4	0	Superficial sandy loam forming a very productive soil.
2	5	Brick earth. This is the red clay, which prevails so extensively in Rohilkund, and which so often comes to the

Feet.	*Inches.*	
		surface, forming a substance of a singular hardness, and excellent materials for roads.
3	7½	Reddish micaceous sand. The temperature at this depth 16½° was found to be 76° 5′; a thermometer in the shade marking 58°, and the surface of the ground being 56°.

291. The next boring was at Kusherpoor, where the red clay has a very extensive superficial development. It forms the step described in Arts. 59 and 73, which gives so deceptive an appearance to the direction of the fall or declivity. The spot where the boring was made, was about twenty feet below the surface of this red clay, and the following were the particulars :—

Feet.	*Inches.*	
2	3	The superficial red clay.
1	3	Green sandy clay, water.
4	6	Black clay, extremely tenacious.
1	6	Light blue sand. The water was in such abundance, as to prevent any further progress; it speedily rose to within a few feet of the surface. At Huldoon, seven miles north, nearly similar results were obtained.
5	6	A ferruginous sandy clay or loam, latterly becoming more stiff.
1	6	A greenish clay, getting latterly blackish.
2	0	A bluish grey clay, partially sandy, not so tenacious, and quite moist. Gravel under this. The water rose rapidly, and prevented any further proceedings.

292. At Jusspore, nine miles N. W. from Kusheepoor, a third boring was made, but the place was injudiciously chosen, being in a hollow, evidently the dry bed of a jeel. The following are the particulars :—

Feet.	*Inches.*	
5	0	Surface sand, which gradually changes to a stiff red clay.
2	0	Red loose sand, damp.
2	0	Variegated sand and clay, spotted.
3	0	Yellowish sand, changing to light grey, twigs and roots were found at nine feet, water at 12.

293. At the next place we find the same deposits as at Kusheepoor and Huldoon.

Feet.	*Inches.*	
2	0	Superficial loam.
3	6	Clay; temperature 68°.
1	6	Sand.
1	6	Clay again.
1	6	Sandy clay, twigs.
2	3	Stiff clay, latterly blackish.
1	6	Ditto, of a darker colour and more pure.
1	0	Grey sand.

Water rose to within a few feet of the surface.

At Afzulgurh, the following particulars were noted:—

Feet.	*Inches.*	
6	0	Superficial loam small nests, and veins of a semi-carbonised vegetable matter.
2	6	Red sand, a quicksand.
4	0	Blackish stiff clay.
3	6	Stiff clay, latterly sandy.

The quicksand falling in prevented any further operation. The black clay proved to be an excellent potter's clay, and baked without changing colour. It formed a very porous article, and was very acceptable to the potters, who were ignorant of the existence of any such clay in their neighbourhood.

294. At —— the following particulars were noted:—

Feet.	*Inches.*	
7	6	The superficial loams yellowish, and more sandy latterly. It forms an excellent soil, and is known by the provincial term *muteear*.
2	3	White micaceous mixture of sand and clay.
1	6	White clay, a little sandy.
1	0	Brownish black clay, containing semi-carbonised vegetable matter.
2	6	Dark bluish clay, very stiff, when wet almost black, latterly veins of light blue.
6	0	Clay much iron shot, and passing to sand.
1	6	Dark bluish clay, as before.
5	0	Sandy clay, much iron shot.

The temperature was observed to be 73°, once at six feet, and again at eight feet, that of the surface being 59°.

295. I have here concluded the geological details; some few particulars have been omitted in their places, but will be hereafter inserted with fresh matter, which I hope will render it something more complete. I have principally to regret, that the circumstances under which these papers have been prepared, have prevented the execution of the original design of referring in the account of the occurrence of rocks by number to the particular specimen collected. Such a practice will be of very great advantage, and will indeed give the above detail far more authority, than it could possible otherwise have. I shall now proceed to state, in a few words, the general results to which they lead.

Section III.

RECAPITULATION.

296. In the details just given, I have necessarily entered into a minuteness of description, which to the general reader must be tiresome in no small degree. The paper being intended as a record of observations, it was necessary to be particular; but I shall attempt in this section to throw together the general results, comparing them afterwards with received opinions, and illustrating the whole in the best manner my limited reading will permit.

297. It appears then, that in these mountains gneiss occupies the greater part of the surface, forming a band of 24 miles in breadth, and including within its boundaries all the elevated summits, but one, of the table, at Art. 39. Of these all that have been approached sufficiently near to determine the point are certainly gneiss, that is, if distinct, thin, and well-marked strata be any ground for deciding. Other evidence there can be none, as it is impossible, by actual examination, to ascertain what rock is at the summit. It rises then most probably to the height of 25,709 feet,* while the lowest point is only elevated 2,800.

* Captain Webb gives 25,669 as the height above the sea—Journal of Science. The paper by Major Hodgson and myself in the 14th Vol. As. Res. has 25,749. I have taken the mean.

If we suppose the lower strata continuous across this tract, and allow for the inclination, we shall have eight miles for the extreme thickness of this formation, and about six for its mean value.

298. The direction of this zone of gneiss is generally, I might say almost always, North 60° West, being thus parallel at once to the direction of the line of greatest elevation, and also to the general bearing or tendency of the mountain land. The inclination lies between 20° and 30° in by far the greater number of instances. It is, however, sometimes, though very rarely, as high as 50°, and in one solitary instance was observed to be 56°. There are very few reversals of the dip, at least towards the centre or middle of this zone; but along the southern boundary, which is very irregular in its outline, forming various incursions into the adjoining zone of schists, there do occur several irregularities both in dip and inclination, and the former is sometimes reversed. That it is pretty regular in general, however, is proved by the fact noticed by all travellers, of the uniformity of aspect in the sides of slopes and precipices in these mountains.

299. The character of this rock is highly crystalline, and it appears to consist almost always of the regular ingredients, and united in the usual regular proportions. It is surprising how few varieties present themselves in so extensive a tract of country, and in general, these varieties differ more in colour and grain than in mineralogical character. The occurrence of imbedded minerals is rare, and of these only, the most common have been observed, as quartz, garnet, and kyanite. It is almost equally barren in beds, containing only some very small ones of hornblende rock, quartz, limestone, and mica slate. Of the two last, I do not know more than one or two instances of each. In fact, there is a character of sameness throughout this formation, extremely tiresome to the geological traveller, as continually disappointing him in his hopes of meeting with something new and interesting.

300. Veins of granite are numerous, particularly towards the central or highest parts; but no beds have yet been found, the granite of Wongtoo being supposed to be veinous. Towards the boundary, however, there are some patches, which would appear to have some connection with a series of beds found beyond the limits of the gneiss, and surrounded generally by rocks of a more earthy and less crystalline character. These latter beds have been described as occurring at

Chumpawut, Dhee, Almorah, Shaee Debee, Dooara Hath, Palee, Dhoeet, and Kunyoor. They are situated in the zone of minimum elevation, and a line passing through them has a direction of North 60° West, the same as that of the strata and zones of different elevation. West of the Ganges, no such beds are found, unless we suppose the Choor granite, (which is certainly on the prolongation of this line) to be one, and then it will be the only one. Another anomaly which the granite of the Choor presents is, that it occupies the highest point in all the mountain tract, south of the zone of greatest elevation, whereas the eastern beds are situated in the lowest ground. A third difference is in the character of the rock, which in the case of the Choor granite, is highly crystalline; in most of the others, earthy and decomposing. Yet it must be confessed, that they present some differences of aspect in this respect, and that at Chumpawut, Dhee, and Almorah, very hard and crystalline granites are procurable, though at the two latter places in limited quantity.

301. The grain of the veinous granites is, as has been often remarked, large; in variety of composition too, they form a singular contrast to the uniformity which distinguishes the gneiss. In this respect, they also differ from the beds of granite, which are strikingly alike in mineral composition, colour, and size, and arrangement of grain. In these particulars, the Choor granite is almost precisely that of Almorah, though separated by such a wide interval. What distinguishes this granite at first sight is, its porphyritic structure, and it evidently contains two distinct varieties, if not species of felspar.* This variety is seldom found in a crumbly decomposing state. The only other well defined type is that which is so remarkable for its rapid disintegration, in which the ingredients appear to be united in the usual irregular manner. This contains a large portion of white opaque felspar, and it is well distinguished by its granite boulders, the true nature and history of which have been so well laid open by Dr. Macculloch.

302. Smaller veins have not been observed to affect the appearance of the including rock, but the vein at Wangtoo, the only large one

* The existence of several mineral species hitherto confounded under this title, has been now clearly established, and I anxiously look forward to a period of leisure, when I may submit the different granites to a particular examination with reference to this point.

I have seen, certainly is in contact with a rock forming a transition between granite and gneiss. With regard to the beds, they also present in general the appearance of a thin band of gneiss surrounding them, and outside of this is found mica slate. The whole being included in clay slate, no change in the latter rock has even been observed. It is almost unnecessary to say that none of these beds are stratified,* that is, the central nucleus; but as before stated, they appear to pass into gneiss on their boundary. The only imbedded minerals are schorl and quartz, (rhombohedral schorl and rhombohedral quartz.)

303. Conterminous with the gneiss may be found a series of different rocks all possessing the schistose structure, micaceous, chloritic, and talcose schists; whether all to be included under one head, is a point for the determination of which data are as yet wanting. But it is perfectly certain, that there is no such thing as a general and continuous formation of micaceous schist (the next rock in our systems) analogous to that of gneiss; several large patches of micaceous schist occur, but they are separated by equally large tracts of other schists. Perhaps the above three schists might be conveniently considered as one formation, although we should even then find our systematic views disturbed by the intrusion of schists of an argillaceous character. These latter may be seen even in contact with the gneiss. Thus we shall be forced to modify a little our ideas of the exclusive nature of formations, and in admitting argillaceous schist as a member of the series, we shall establish, as succeeding the gneiss, a zone of schistose rocks of nearly equal extent, but not presenting the same appearances of regularity of position, or uniformity of mineral composition.

304. In considering the subject, I have been certainly inclined to view this latter account as most consonant with the phenomena. But it is possible that a more particular examination of the boundary of the gneiss may establish the first view, and in this case, the gneiss with which the argillaceous schist is in contact, would belong to a different era from that of the zones of greatest elevation, whereas I have suppos-

* The stratification of granite, a favourite tenet of one of the rival schools of geology appears to be losing ground every day. Mr. Greenough long ago, in his critical examination, shewed the extreme laxity with which this term stratification had been used. In the sense in which most unlearned people understand it, I apprehend that granite can never be said to be stratified. After all, however, it is a mere dispute about words, and seems, whichever way determined, to throw no light on the subject of the origin of rocks.

ed them to be connected. This is one of the difficulties attending so early an attempt to generalise; for the present it may be sufficient to view all these schists as constituting one formation. This formation will then be found to be of nearly equal extent with that of the gneiss, being in breadth — miles, and stretching, as that does, from river to river, it will terminate in those mountains which form the northern boundaries of the several Doars, and in the line connecting them.

305. In this method of viewing these rocks, it may be stated, that there is but one general formation (of primary rocks,) besides that of the Himmalaya gneiss,* and it is worthy of remark, that they divide the whole tract pretty equally between them. The schistose formation is no doubt stratified, though, it is thought, not so regularly as the gneiss, and its strata are often much more inclined, much more contorted, and present greater irregularities, both of curvature and reversal of the dip. It is, however, to be noted, that mountains of this formation do not present the same facilities for examining the strata, as those which are composed of gneiss. Being in general so much more subject to decay, they have a very thick bed of local debris which effectually conceals the rock in situ, and in such cases, the character is necessarily taken from that of the debris. The effect of this is to give these mountains a rounded and softened contour, which distinguishes them at once from the serrated and bare rocky ridges of the gneiss formation.

306. The mineralogical character of these schists is variable; but this is not only true of the whole formation, viewed as comprising rocks to which distinct titles have always been allotted, but also of the varieties which are referable to any one of those titles. And the many anomalous rocks produced by the intermixture, and transitions of these, form a numerous band, strictly speaking, belonging to none of them considered by itself, and therefore strengthening the view I have taken of the

* In confining the number of primary formations in so extensive a tract to two, I may be thought to indulge in too large a generalisation. It may be said, that many of the beds I mentioned as contained in the clay slate, may be in fact formations. It is proper, therefore, that I should explain what I mean by a bed; for half our mistakes in geology are occasioned by using words in a wrong sense, frequently in no sense at all. By a bed then I mean, a mass not veinous, which is surrounded on every side by the same rock. It may be stratified or not; it is unnecessary to add the term subordinate, as this definition includes that idea. It has another advantage, that it involves no theory.

entireness of this formation. These varieties, at least all those that required it, have been described already with sufficient minuteness. It may be here a sufficient recapitulation to say, that the argillaceous schist, as it covers the greatest extent, so it presents the greatest vacillation in character. No opinion can be more void of foundation than that which supposes the several varieties of clay slate to be arranged under four different, distinct, and well marked types, the produce of four different eras, and distinguishable by characters mainly dependent on colour; so far from dividing into regular zones, or even isolated patches, the different varieties are found in every part of this extensive tract. Excellent purple roof slate; stone slate passing into flinty slate; a black almost arenaceous rock, with patches of white resembling the ash of half-burned charcoal; a white arenaceous rock with scales of mica; a soft schistose clayey rock of various bright colours, and a granular yellow rotten stone; all these are found in a space of not three miles square. From my own very limited experience, I would say, that of all distinctions, colour in clay slate is the most vague, and least to be depended on.

307. This tract of schists contains numerous and extensive beds of limestone, frequently enclosing veins of galena, (hexahedral lead galena of Mohs,) beds of dolomite (macrotypus lime haloide,) and potstone (prismatic talc mica, the massive variety,) either singly or in conjunction, and containing in each case veins of copper and iron pyrites, (pyramidal copper pyrites and hexahedral iron pyrites,) purple and grey copper (octahedral copper pyrites and tetrahedral copper galena,) beds of red and brown iron ore (rhombohedral and prismatic iron ores,) veins or beds of graphite, (rhombohedral graphite mica,) and superficial amorphous masses of gypsum (prismatoidal gypsum haloide.) But the most remarkable of all its subordinate mineral masses is the greenstone, which is so often met with, though limited as to extent. Connected probably with this rock is the series of fragments, obtained near Bhumowree, presenting types of amygdaloid and porphyry. But the whole subject is as obscure, from want of observation, as it is interesting, and the fact of the only series of lakes within these mountains being found in the neighbourhood, enhances the interest extremely. Indeed, it is not a little difficult to restrain our premature efforts to connect these facts with a well-known theory, remarkable for the origin it assigns to these rocks.

308. Southward of the great belt of argillaceous schist, which forms the plainward termination of the series of schists, we find a narrow strip of secondary rocks, mostly, if not entirely, the newer red or saliferous sandstone. This formation presents little to interest us, excepting in the promise which its position here gives of more valuable deposits further South. It is always stratified, and the dip is most commonly conformable to that of the primary strata. At Hurdwar, the strata on opposite sides of the river dip in opposite directions. It differs extremely in character, being sometimes a red clay, which occasionally contains rounded stones, sometimes a regular sandstone conglomerate, often loose sand. It is remarkable for the quantity of mica it contains, and for the series of bright colours it presents often within a very short distance. It contains brown coal (bituminous mineral coal,) but in what quantity is not known.

309. Lastly, we have lying at the southern foot of this sandstone range, and also occupying the several vallies bounded by it, a deposit of great depth, but not disposed in strata, consisting of gravel and sand, including large boulders or rounded stones of every magnitude up to three feet diameter. The extent of this diluvium, as we may call it, is very great, it occupies a track 192 miles in length, and nearly 10 in breadth. But the length is probably much greater, as it is not unreasonable to infer, that it is conterminous with the sandstone range, which certainly extends from the Indus to the Burhampooter. Outside of the tract of diluvium, a red earthy marl is found intermixed with patches of sand, and a blue clay, very similar in character to that of the London clay, is found to underline these. In the neighbourhood of Hansee, a fresh water limestone is met with, containing perfect shells of the genera melania and planorbis.

CONCLUSION.

Section IV.

310. From the particulars given in Section I, may be collected the fact of a considerable difference of physical aspect between these mountains and the Andes, the chain with which it has been most usual to compare them. Instead of the confused and irregular appearance, the

endless and complicated ramifications, the ragged and steep acclivities, the total absence of vallies or level ground, the lofty summits and deep ravines there described, we have in the latter an arrangement of two parallel chains or ridges running for a distance of 500 miles, and enclosing between them a broad and elevated table land, constituting one of the finest countries in the world; again the numerous volcanoes, extinct or igneous of the Andes, the terrible earthquakes, the torrents of mud and water so frequently discharged from openings suddenly occurring, and the uprising of considerable mountains; all these circumstances belong to a totally different order of things from that which prevails in the Himmalaya.

311. The difference in physical features is not greater than that which appears in the geological character of these two rival chains. In the Andes, as we learn from Humboldt, there is an extraordinary developement of porphyry and trachyte, the more elevated points being composed almost exclusively of the latter rock. Trachyte is confessedly a volcanic production, though the rival schools are at variance with regard to porphyry. Yet, M. Humboldt in his latest work, appears to incline to the opinion of its also being of igneous origin.* We may further notice the great deficiency of primary formations.† Granite and gneiss are only found in masses of any extent near the sea coast and at low elevations, while the transition clay slates and secondary sandstones attain a developement and an elevation, of which there are no other authentic instances.

312. In the Himmalaya again, we have seen that neither trachyte nor porphyry, nor indeed any volcanic or trap rocks are to be found. The whole series, as is evident from the details in Section II., is composed of primary formations, and chiefly if not entirely of gneiss,

* Or ought we not rather to admit that the domain of volcanic action has been too much limited, and that these porphyries are, with respect to their origin and relative age, connected with trachytes, as the trachytes formerly confounded with trap porphyries are connected with basalts, and real lava ejected by burning volcanoes? Humboldt Gisement des Roches, English Translation, page 157. Again, "In Equinoxial America, the limits between transition porphyries and real trachytes known to be volcanic rocks are not easy to fix." Idem, page 155. For other instances of this opinion, see page 156 to 160.

† In the Cordilleras of the Andes, of Peru, Quito, Grenada and Mexico, among that innumerable variety of porphyritic rocks of which the masses attain from 2,500 to 3,000 toises in thickness, I did not see a single porphyry that appeared to me decidedly primitive. Humb. Giss des Roches, English Translation, in p. 124.

succeeded on each side by an extensive band of schistose rocks, enclosing a variety of subordinate beds, the whole being of the clearest primary character. Organic remains are, it is true, stated to have been found at a great elevation northward of this chain, but nothing of the kind occurs within the zone of greatest elevation, nor within the mountain tract south of it. It is, however, believed, that with regard to the great elevation of the transition and secondary formations, parallel examples to those of the Andes may be found in the prolongation of the mountain barrier to the north. The subject has not yet been fully investigated, but there are presumptions in favor of this opinion deducible from the arrangement of the strata. The following particulars may be stated as the sum of what is actually known on the subject :—

318. No organic remains have even been found within the tract which I have asserted to consist of primary formations. But they have been brought from a place north of the zone of gneiss, and though there are doubts as to the localities of some of these specimens, it is quite certain that in one instance, ammonites have been observed in great numbers, at an elevation exceeding 16,000 feet.* What makes this occurrence particularly interesting is, the fact of the limestone in which these ammonities are found occurring at no great distance from the boundary of a gneiss, which if it be not actually connected with, is not distinguishable in mineralogical character from that of the Himmalaya.

319. Ammonites, mineralised by clay slate, have been brought by natives, and as they aver, from no great distance from our frontier on the Neetee Pass. I have also seen specimens of belemnites mineralised by calcareous spar.† But neither these, or the preceding more authen-

* I have never had an opportunity of examining these fossils, but the identification of the species would throw no light on the question which is here being considered, as it is generally agreed by geologists, that however uniform the mineralogical character of rocks may be in the most distant localities, yet with regard to organic remains, no assistance can be derived from the *characters of species* in identifying formations, unless in a country of very limited extent. Even the hitherto generally received opinion of the universality of formations begins to be questioned, and a doubt entertained whether the granite of Cornwall, for instance, and of these mountains were formed or even assumed their present places at the same time.

† It has been made a question by a geologist of deservedly high reputation, whether the occurrence of organic remains (speaking generally) should be considered *ipso facto*, a decisive argument against the primary character of a rock, and though authority be against him, yet it is the authority of those who admit of a transition class into which they transfer these anomalous occurrences. Now, as no distinctive characters have

tic observation, where the locality and elevation are actually known, can be considered quite decisive of the fact of secondary formations being found at uncommon elevations. For the occurrence of ammonites and belemnites is by no means universally allowed to be characteristic of secondary rocks; and even by that school which asserts their presence to be destructive of the primary character of a rock, they are allowed to belong to the oldest of the secondary, or what they would call, the transition formation.

320. A more curious fact is that of the bones brought from the neighbourhood of the Neetee Pass, and which Mr. Buckland has recognised as belonging to the same era with those of the caves, the history of which he has so ably illustrated.* As this fact would establish the identity of the deposit in which they are found, with that which he has called diluvian, and which is the newest of all the formations, it would certainly be very interesting to settle accurately the locality from which they are derived. But nothing certain is known on this subject further than the negative fact, that they are not to be found south of the Neetee Pass. Hitherto, they have been collected only by natives, whose reports,—never very precise as to particulars the value of which they do not appreciate,—can scarcely be allowed to settle a point of this interest; even their account, however, places them a considerable distance northward of the limits of the zone, marked by the snowy summits of the Himmalaya.

321. Thus then it appears, that at present all we know of certain is, the occurrence of a limestone with ammonites at an elevation of 16,000 feet above the sea, and at no great distance from the boundary of the Himmalaya gneiss. As to the other organic remains, they are brought from beyond our frontier by natives, but neither the distance or the elevation are precisely known. But granting all that these may seem to prove, as to the great elevation to which secondary

ever been assigned to this class, as have been to the primary and secondary, it is not very unfair to consider this procedure as *something* similar to what is called a *petitio principii.*

* A collection of these bones belonging to Mr. Traill, which I had an opportunity of examining, appeared to me to be perfectly mineralised, judging from their high specific gravity. Now the peculiar character of the diluvium bones is stated to consist in their being not at all, or at least very imperfectly mineralised, differing in fact very little from grave bones of high antiquity, light, porous, and absorbent to the tongue.

formations attain beyond the limits of the tract which is the subject of this paper, it would still be true, that within this tract no such phenomena occur. The great extent covered by primary rocks, and the total deficiency of the trap or volcanic rocks may then serve to express the entire dissimilarity of geological structure between this tract and the Andes,* and I think it a point of considerable interest, and worth insisting on, that no traces of volcanic action,† whether recent or otherwise, has yet been observed in these mountains.

322. We have seen that these primary rocks are always stratified, and that the dip in a great majority of instances is N. E., the direction of the strata being consequently parallel to that of the zone of greatest elevation. The inclination also being small, we may perceive strong grounds for admitting the occurrence of comparatively recent formations at great heights in proceeding along the line of dip. Thus at no very great distance from the crest of the gneiss strata, we may fairly expect, as is the fact, a clay slate, and then a limestone with ammonites, and no doubt did our observations extend further to these, we should see succeeding secondary formations, tertiary, and lastly diluvian, so that upon the whole, there is nothing improbable in the accounts of those who assert the ammonites and belemnites to be found at no very great distance from our frontier.

323. An interesting question is here suggested by the view I have taken of the great central tract combined with this conclusion. We know from Patrin, that the great Altaian chain consists like the Himmalaya of primary formations. Are not these distant and opposite points

* For this reason I have been at a loss to understand, how analogy had taught us the primary nature of the Himmalaya formations. It certainly appears most natural to compare them with the Andes, in order to deduce analogical inferences. The Andes are not primary, the Himmalaya are so: analogical discoveries *a posteriori*, are always to be suspected.

† There is a foolish notion amongst some of the hill people, however, that the great peak, called Nunda Debee, the highest of the range, and consequently in the world, has been known to emit smoke. They suppose the smoke to be from the gods' Choola or kitchen. It is hardly necessary to add, that there is no real foundation for this opinion. The peak is within 60 miles of Almorah, distinctly visible at all seasons, and had any thing of the kind ever occurred, it must have been seen by some of the European residents at that station. It is, however, worthy of mention, that this peak is scarcely ever seen without a small light cloud resting obliquely upward from its summits; such an appearance might be converted by the crazy imagination of a devotee into smoke ascending from his gods' Choola.

connected on each side by rocks of the same character and eras, and is not the interior from which on one side at least these fossils of such different formations are brought, a huge basin or series of basins in which are arranged secondary, tertiary, and even diluvial deposits, surrounded and supported on every side by a gigantic zone of primary formations?

324. It has I know been disputed, whether the same mountain range or chain be, or be not marked by identity of geological structure. Like many other disputed questions, it is one of words, and the solution entirely depends upon the sense in which we use the word range or chain. If we mean continuous line of elevations, in other words a chain of water heads, such is certainly not marked by identity of geological formation. If again, the line of greatest elevation be understood, then we shall certainly find identity of geological structure, but nothing like continuity of surface. Analogy then adds all its weight to the opinion, that the series of primary formations continues quite round the central plateau.

325. It appears then, that the tract with which we are engaged, comprises a very small part of the outward declivity of a barrier of primary formations, the most extensive probably in the world; that these formations have in this particular quarter, a dip directed N. E. or at right angles to the direction of the tract, and that it is probable the dip continues all round to be also at right angles, that is, towards the centre of the great basin which they surround. The crest of these formations we see attains in more than one quarter to a height of 25,000 feet, rising from plains which have a level of 1,400 feet, and this in a distance of 90 miles. Here then, if any where, we may expect to find some clue to lead us out of the labyrinth of geological speculations and hypotheses; some key to the solution of the great problem concerning the origin of the present inequalities of the earth's surface. Could we but obtain access to all the particulars which are to be learned in these interesting countries, geology would very soon assume a different aspect from that which has as yet distinguished her. Perhaps even the small part of it to which we have access, may furnish particulars calculated to throw some light on the principles of a science as yet in its infancy.

326. Saussure has observed, that in mineralogical cabinets, we see every rock have a definite and easily recognised character. No anomalies

or irregularities occur to embarrass us; none of the transitions or mixtures which are found in nature, and which form the difficulties of the pursuit, "La on trouve tout disposé selon le systeme." The same may be said of our most approved geological systems. There we find every rock occupying its distinct quarter, and no hint of the great and perplexing irregularities with which the student of nature has to struggle at every step. We have granite occupying the lowest and the highest points, a covering of gneiss resting on the granite excepting at the very highest points, mica slate over the gneiss, clay slate over it again, and so on in regular array, and with the outgoings of the newer and newer strata. At lower and lower levels, such an account of things is no doubt very beautiful, very systematic, and indeed has but one fault, that it is not true. As countries have been examined more particularly, it is found, that excepting in a few grand points, not one country will serve for an exact type of another.

327. We have seen that in these mountains,* gneiss occupies the greatest part of the surface. Its thickness is considerable, if we adopt the commonly received opinions of stratification.† To this succeed various schists, the true relations and connections of which are very obscure; micaceous, talcose, chloritic and argillaceous in different places are conterminous with the gneiss. In the schists and in the zone of least elevation, we find a series of patches of granite disposed along a line parallel to that of the direction of the mountain band and strata. Beyond these again, we see an extensive zone of clay slate, in which occasional patches of gneiss also are found, and outside of the whole very limited examples of the secondary strata, which are finally lost in the plains.

328. Here then is a very different arrangement from that just

* Professor Jameson in one of his latest works mentions the Himmalaya as an example of a granitic chain. It would be interesting to know on what authority he founds his opinion. I have seen more of these mountains than any European, and the only granite within the above tract (beyond which we cannot without great violence apply the term Himmalaya) that I have ever seen consists of fragments in the beds of rivers. I have never had any doubts, and if I had, the occurrence of these fragments would remove them; but that there are occasionally veins and perhaps larger patches of granite as in other parts of these mountains, but I have never within this tract met with any rock, in situ, but gneiss and its contained beds.

† There are, however, some good reasons for rejecting this indefinite continuity of the strata underneath, at least in the direction in which they appear on the surface.

described. The great extent of gneiss, the limited occurrence of granite, its situation in the zone of least elevation, the want of a regular consecutive order in the super-position of the schists; these are sufficient to shew the total dissimilarity of nature and system. But we shall find much greater differences than these, as we descend to the details. It has been supposed, that in every chain of mountains, the strata dip outwards, that is, from the summit the dip on opposite sides is in an opposite direction, and it is obvious that such must be the state of things, supposing the origin of the stratified rocks to be as Werner has taught. But in these mountains this is by no means a description of the fact, for the strata, abstracting local exceptions, have but *one* dip, and that is, on one side towards the chain, on the other from it. The same arrangement obtains in the ghauts of Rewah and Bundlekhund, that is, their dip is only in one direction; and it is worthy of remark, that the precipitous side in that chain is also directed towards the great diluvial valley of the Ganges, which is thus bounded on opposite sides by the perpendicular faces of the strata.

329. Such being the arrangement which obtains, it becomes difficult to understand clearly the order of super-position of the rocks that are found south of the gneiss tract. It is no doubt a very singular feature in the structure of these mountains, and is the more interesting, as being apparently in direct opposition to opinions which have been so generally received. In the accompanying diagram,* it is evident that the gneiss strata at A. prolonged, would be over those at B., which succeed the gneiss in travelling southward, and this remark holds good throughout down to the plains, for the strata always dip conformably or sufficiently near, so as to establish this conclusion. Were the effect to stop with merely placing clay slate or mica slate superior to the Himalaya gneiss, there would not be the actual difficulty; for we know, that within certain limits, there is no exact and universally true order of super-position, though the contrary is stated by systematic writers, (Art. 12.) But in this particular case, the most generally received position in geology would be violated, for by supposing that no dislocation or separation of the strata has taken place, we should have clay slate,

* We trust, as before stated, that the figures and diagrams will be recovered with the geological map, when we shall not fail to give them to the public.—Ed.

primary limestone, mica slate, and lastly gneiss, all resting, and in this order, on a secondary conglomerate !

330. Are we then to say that this latter is really the case, and that even those facts most generally received, and as yet disputed by no school or sect however sceptical, are often all but partial and local occurrences, and not examples of a general law applicable to every country ? Or is there any way of viewing the subject by which we may escape from so startling a conclusion ? Will any dislocation, subsidence, or elevation of the strata explain the difficulty ? I think not ; for besides the enormous extent of the fault which we must suppose to account for the schistose strata, (at least eight miles in thickness and thirty in breadth,) appearing to dip beneath the gneiss strata, a fault which startles the imagination by its magnitude, we have also to believe, that at each junction of two different formations, a similar fault occurred. This is an assumption evidently gratuitous, and not having even a seeming of probability to recommend it. And in two instances, probably in many more, the appearances as described leave no doubt as to the fact of the newer rocks lying under the older ; that is, if we suppose the strata continuous underneath. In these instances, no dislocation whatever will explain the anomaly. The difficulty appears to me to be real, unless we give up those views of stratification which would identify them with the parallel and consecutive layers of mechanical deposition.

331. It is an opinion gaining ground every day amongst geologists, that the seams of stratification are not always what they have been supposed,—the effect or sign of mechanical subsidence ; and many other facts besides this, militate against the supposition we are considering. Were those layers really deposited from a fluid by the effect of gravity, how are we to explain the sudden changes which are often seen to take place in strata, not vertically, but horizontally, and this repeated often in a very limited space. ? That what is called concretionary structure may sometimes produce parallel seams, we see in the case of those clay slates in which what are supposed to be the planes of stratification, are not parallel with the schistose planes. And that parallel seams, not to be distinguished from those of stratification, may originate in some other cause, is also obvious from the fact so often observed of two, and even three sets of these seams occurring

in the same rock; thus creating a difficulty of saying which is or which is *not* the set indicative of the strata. If we admit then with some of our most celebrated geologists, that in the older rocks the planes of structure have been erroneously attributed to stratification, the difficulty with which we are contending will vanish.* In this case there will be no necessity for inferring a continuation of the strata underneath, and therefore no violation of generally received notions as to the super-position of rocks. The newer formations will rest on the older, and as in this case, the configuration of the surface could not have had any effect in giving the present dip and direction to the upper strata, (for it would have been the reverse,) it is quite clear that neither in these rocks are the seams significative of mechanical depositions.

332. It is at all events very certain that, in all primary countries, the stratification presents various anomalies not easy to be explained on the hypothesis of the formations being mechanical deposits. It is likewise not impossible, that a more particular examination of our mountain strata may suggest some other explanation, or at all events lead us to view it as less contrary to geological observation than I have stated.† With these considerations in view we may for the present consider the order of superposition as determined by the succession of rocks found in proceeding southward, or at right angles to their direction. We will therefore suppose the schists to be deposited on the gneiss, and the sandstones on the schists, notwithstanding the dip being towards the crest of the chain. We have seen, that the two zones into which, on a large view, the rocks may be divided, are parallel with the direction of the mountain land, and with that of the elevated zone, though not with that of the chains, which, as we have before shewn, have no connection whatever with the geological structure.

* If we could follow their limits with the eye we should probably find the fact to be as now stated, a view of the subject which may tend to explain the apparent inflections and contortions of rocks in general, and perhaps the stratified structure, in all its varieties, may ultimately be considered as resulting from concretion on the large scale.—*Geol. Trans. vol.* 5, *part* 1, *p.* 176.

† See Mr. Weaver's Paper on the Geology of Ireland in the 5th vol. Geol. Trans. part 1. Dr. Macculloch and Professor Jameson appear also to be of this opinion. The latter, however, combines with it a less tenable doctrine, that the Earth may be a large polyhedral crystal, and the planes of stratification its cleavages.

333. In the separation of these two facts,* continuity of elevated ground and identity of geological structure, and which is everywhere so strongly marked in these mountains, we may perceive proof incontrovertible, that the present hydrographical arrangement of the surface has been posterior to the original formation of these mountains; in other words, that their vallies or hollows are effects of denudation, and not of original structure. This conclusion could not be more firmly established, even if we saw the corresponding but disjoined ends of the strata on opposite sides of the valley; such an appearance, however, is by no means rare, as may be seen in the details given in the preceding section. But the proofs need not stop here. For if there be a truth more firmly established than another, by many and various circumstances, it is this of the extensive waste which this surface has undergone, and evidently from causes far exceeding in power any that are now in operation.

334. It is sufficiently obvious, however, that though the system of vallies or drainage, generally speaking, be the effect of denudation, yet we are not to attribute all the irregularities of the surface to this cause. Some it is certain originally existed; some may have been caused by a sinking in of the strata. In the first way, we may account for much of the great depth assigned to vallies in Art. 41. The excavation of a valley of 15,000 feet in depth, and having a slope of nearly 30°, would indeed be incredible whatever force of water we employ, or however long the period we have at our disposal. Even with this abatement, enough remains to stagger our belief. Our incredulity may, however, be softened by recollecting the continually recurring difficulty of accounting for so many openings in the line of the strata, without any marks of displacement or dislocation.

335. There are some facts which, though they throw no light on the manner in which this great change of the surface has been effected, yet are sufficient to shew, that such a conclusion is not to be rejected, even though there may occur a difficulty in explaining all the details. The beds of some of the rivers are, for a part of their course, in the solid

* One of the first impressions made on the mind in examining the Tortworth district is, that the existing form of the surface appears to a certain extent to be unconnected with the nature of the rocky formations that compose its base, an observation indeed that may admit of almost universal application, and be deemed a maxim in Geology.—*Mr. Weaver Geol. Trans. vol.* 1, *p.* 319.

rock. In these cases, the depth is often considerable, while the appearance is such, as leaves not a doubt in the spectator's mind, but that the present channel was once filled up with solid rock. This is a conclusion we cannot escape from, however difficult it may be to understand the removal of so many thousand cubic feet of solid rock by the agency of water.

336. In all the river beds too we see that there are accumulations of gravel and boulder stones, all perfectly rounded, and consequently all of them such as have been subject to the action of water. These collections, it appears from the details I have given, are in many cases of very great extent, and frequently occur at a height of even 300 feet above the present bed of the river. That these collections should ever have been formed by such bodies of water as are found at present in their vicinity, is altogether inadmissible. Their extent, the size of the fragments, the distance from which they are derived; above all, their great depth, and the height at which they are found above the present bed of the river, all forbid so incredible a supposition.

337. Even if we could get over these difficulties, and really believe that rivers, which in their greatest power at the present day cannot move one of these fragments a few feet, did yet in former ages, transport for many miles, several thousands, nay millions of them, and accumulated them in heaps many times exceeding in height the greatest depth of the said rivers; even if we could get over the difficulties, yet others greater remain. The tract defined in Art. 71, called the Bhabur, we have seen equally consists to a vast depth of these water-worn fragments, evidently of the same era, derived from the same rocks, and transported by the same causes; so also the several plains or vallies described in Art. 57, *et seq.* contain immense beds, the same in every respect with those found in the river vallies. These it is evident, could never have owed their disposition to the power of rivers, whatever may be said of the former comparatively limited accumulations; because they are found where at present no rivers flow.

338. That there is some connection, however, between the disposition of these beds of gravel and formation of the river vallies, appears evident from the following fact:—In establishing a series of bores along the terrace, I found that the distance from the common boundary of plain and mountain land at which gravel was found, was greater in the beds

of rivers, or in their banks, than on the intermediate ground. Whatever therefore the cause which accumulated these beds of water-worn fragments, we see that it acted with greatest force in the direction of the river vallies.

339. There is another very striking fact which enables us to limit still more precisely the direction in which these fragments travelled. At Hurdwar, it terminates rather suddenly in the low range of hills, which bound the Dehra Doon to the southward. These hills, as I stated in Art. 61, form an uninterrupted chain or line of water-heads, on each side of which they are intersected with deep gorges now the beds of torrents. Those which open to the Doon, it appears, are strewed with fragments of the same kind as those which cover the valley itself; but those which open plainward, contain no fragments but of the rocks in situ, which it also appears are of an entirely different character, and not possible to be confounded. The deposit seems, however, to have continued along the foot of those hills, and even to have left fragments at the mouths of the gorges; but in no case do they extend to any distance upwards.

340. These deposits have been observed in every country in which as yet geological investigation has been carried on, lying at the foot of mountains, and often covering extensive plains, or scattered over the bottom of vallies. Perhaps in no country can they be seen on so large a scale as in these districts. The enormous extent of the bed comprising the Bhabur, and filling up the several vallies, is alone enough to excite all our wonder. They have everywhere been recognised as witnesses of the progressive nature of the changes that have affected the surface of the earth. They have established the fact of at least two eras, that of the original formation of these mountains, and the subsequent extensive denudation of the surface forming the present system of vallies. But from considering all the circumstances of the case a still greater discrimination may be made. It is almost certain, that they owe their present arrangement to some sudden and violent catastrophe. Now, it is not likely that their rounded form, being as they are amongst the hardest of stones, was given them by any other than a cause operating through a considerable period of time. Here then we have proof of a series of actions, which must have been posterior to the formation of the original strata, and which carries up the latter to a still higher antiquity.

341. Nor is this question affected by the doubt as to the origin of these boulders; that is, whether they have proceeded immediately from the debris of the primary strata, or immediately been formed into secondary conglomerates. It is remarkable, that the nature of the stones is the same in both deposits, the secondary rocks and the diluvium; the only difference being in arrangement, the former being distinctly stratified, and passing into well-defined micaceous sandstone, while the latter forms a confused heap of gravel, in which stones of all sizes and even angular fragments sometimes are found. That they have originated in the breaking up of secondary strata, is I think, the most probable, although we shall then be puzzled to account for the deposits in the beds of rivers where now no secondary rocks are to be seen. However this may be, it is still worthy of remark that the greatest accumulations are found where the secondary formations still exist.

342. Granting that some such catastrophe in these mountains as a mighty *debacle*, or rush of waters, must have given these beds of diluvium their present place, we shall see strong reasons for supposing, that for a time these waters have been pent up in the Doons or vallies, which extend along the frontier. Have they subsequently broke through this range by their own accumulated pressure, or has any other cause of change assisted in finding an outlet for this series of lakes? The reversal of the dip on the opposite sides of the river at Hurdwar, is a curious anomaly occurring in such a place, and must, I think, strike every one. Till all the circumstances be known, it is vain to speculate. Whether such fact or any disturbance of the strata is to be observed at the other *debouches*, will be interesting to determine.

343. The theory which has identified this rush of water, traces of which have been found in every part of the globe, with the deluge, as described to us in the Scripture, and which has derived its chief illustrations from the labors of Cuvier and Buckland, has been strongly opposed by the geologists of Scotland. In particular, Dr. Fleming has stated some difficulties with regard to the subject, not easily got rid of. He has shewn, that the silent and quiet rising of the waters, and their equally gradual subsidence, as deducible from the account of Moses, cannot be confounded with a cause which has evidently been sudden, vast, and overpowering. The former we see did not even abrade the surface, for vegetation, and trees even, still remained, whereas

the latter has torn up a vast mass of consolidated strata, scattering their ruins over an extent of many hundred square miles.

344. Granting, however, that these attempts to find a geological theory in the sacred records have been as hasty as ill-judged, we shall not find Dr. Fleming more successful than those whose labors he has overturned, in explaining the phenomena in these mountains. With him it is merely the bursting of a series of lakes, and the diluvium is in his nomenclature, lacustrine silt. The mere alteration of the name is of little signification, nor does it lead us a step further in our search after truth. But here is no series of lakes, no vallies that might conveniently be supposed beds of lakes. The only vallies in the several Doons are beyond the limits of many of the phenomena which their bursting is to explain. Were our geologists always satisfied with shewing what is *not* the cause, the science might make more progress than it has done, but one theory is no sooner laid than another rises to supply its place.

345. In reality, our chief object should be in the first instance to collect facts from every quarter. If the explanation is to be general the induction should be equally so, as well as the data on which it is founded. Our limited acquaintance with the surface of the earth will not allow of our generalising as yet with safety, and it will be constantly found, that the hypothesis invented to explain the phenomena in one country, will be overturned by facts observed in another. Dr. Fleming, in his hurry to establish his own view of the subject, has certainly confounded two distinct, and in many cases, easily recognised classes of appearances; and in truth, the whole of what Professor Buckland has advanced in his Reliquiæ Diluvianæ remains untouched, (because it is observation,) excepting his notion of the identity of the cause, the effect of which he has so ably traced to the deluge of Scripture. I need hardly add, that the phenomena in these mountains have a most striking analogy with those detailed in the above work.

346. The hasty generalisation which produced the Wernerian system of geognosy has long been acknowledged, and the fact established that few countries, even belonging to the same formation, present exactly the same arrangement and succession of rocks. The opinions of some geologists have even taken the other extreme, and it has been questioned whether there be any such thing as a general formation quite round

the globe; a continuous one there probably is not, but when we view amidst all the differences that undoubtedly do occur in the super-position and connections of rocks, the many and wonderful coincidences that still remain, not confined to a spot of limited extent, but *clearly* belonging to the whole *tract*, we shall be satisfied that the contemporaneous formation cannot be predicted of these masses in which such resemblances are found; at least they must be attributed to a common origin. When we read in Humboldt, that while in different countries, different plants and animals present themselves to the observation of the naturalist, the rocks are the same in every zone; in every climate we appear to be engaged * * * * * * * * known list of minerals might be formed, we have so small a catalogue of compound rocks, and these always the same wherever occurring, why should granite always contain quartz, mica, and felspar, and always nearly in the same proportions, however distant the localities? mica slate, mica and quartz, and so on of others. These are questions difficult to answer, but which none can avoid asking themselves who have ever reflected on the subject.

347. In all the grand features of geological character * * * * * * * * * * * Himmalaya does not [*coincide*] it is true with that [*of the*] Andes. But it bears a [*very*] close resemblance in general features to the description given us by Dr. Macculloch, of the Western Isles. As on those Islands, so here we recognise the great extent of gneiss occupying in each system the middle and highest tract. In the great deficiency of granite, we see another resemblance and a common difference from the dogmas of the schools, that the highest part of every system of mountain * * * * * * * * impossibility of discriminating in this point between the primary and secondary rocks. But the most interesting coincidence, at least to me, is in the arrangement of the schists, and their connections with the other rocks. In his chapter on the chlorite series, he has almost completely anticipated every thing I had to say on the chlorite schists of the Himmalaya.

* A quarter of a page, or more is wanting, where this and the following lacunæ occur, and there is no clue by which even to guess at the writer's views.—Ed.

348. The existence of coal all over the world, and always in the same geological situation, is another proof that even in * * * * * * * * condition or state of things, which must have been common to every country of the globe. Pursuing the analogy taught by the facts learned in the coal fields of England, that valuable mineral has been brought to light in almost every part of the world, it may not therefore be uninteresting to enter into some little explanation on this subject, in order to judge whether the deposit may be expected in this quarter, as in any way connected with the series of facts described.

349. The coal formation though, as has been observed, owing its origin most probably in every country to the action of some general cause, may yet be considered, as far as appearances are concerned, to be a local deposit, inasmuch as it is always of limited extent compared with the other strata. Its place in the system is well marked, nor has any bed of coal worth mention ever been found out of that place. It is known to overlie a limestone, which from its relation to the coal, has been called carboniferous, and which itself lies upon the rock called the old red sandstone, the lowest of the secondary strata. Above the coal measures is found the newer red or saliferous sandstone. Between these two members of the series, it has always been observed to hold its place; subordinate strata occasionally intervening, occasionally being wanting, but the coal never occurring, that is, in any quantity above the latter, or below the former rock.

350. This would seem to be a sufficiently definite arrangement to enable us always to pronounce on the greater or less probability of finding this useful mineral in any tract in which the succession of rocks has been accurately traced. Applying the principle to the present survey, it will be found that limiting facts are wanting, although the general presumption is strongly in favor of the existence of a coal formation. Thus we have the saliferous or newer red sandstone on the border of the mountain tract, dipping N. E., giving the promise of older or inferior deposits to the Southward; and again at Dehli, we have the old red sandstone, leaving it a natural inference, that in the intermediate space, intervening formations will be found.

351. The great coal field of Northumberland and Durham is situated in millstone grit and limestone shale (the upper anomalous beds of the

old red sandstone,) on the outside of which small patches occur of the newer red, and beyond that, a country of schistose formation. On one side it has the mountain or carboniferous limestone, and outside of it, a large band of the red sandstone, part of a mass which occupies the centre of England. The coal field of Wales is separated from the old red sandstone by a narrow strip of the carboniferous limestone. Those of Staffordshire are similarly situated with those of Northumberland. The coal field near Burdwan is covered by the newer red sandstone; all these facts, I think, give a strong probability to the opinion, that coal will be found in the Dooab. The facts that are wanting are such as would limit its position, and consequently give a well-grounded prospect of discovery, before commencing any thing like an expensive search. These facts will be furnished by the prosecution of the survey.

The concluding section of this Report is that upon the Mineral Productions of the Himalaya, which will be found in Vol. XVIII, Part I. p. 227 of the Trans. As. Society.—Ed.