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THE HONORARY SECRETARIES.

"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 at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease."

Sir Wm. Jones.

CALCUTTA:

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JOURNAL

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ASIATIC SOCIETY.

PART II.—PHYSICAL SCIENCE.

No. I.—1869.

NOTES TO ACCOMPANY A GEOLOGICAL MAP OF A PORTION OF THE KHASI HILLS NEAR LONGITUDE 91° *E.;—by Captain* H. H. GODWIN-AUSTEN, *F.R.G.S.*

[Received 28th January, 1868.]

In contributing this paper to the Journal of the Asiatic Society, it will be first necessary, as an introduction to those unacquainted with these hills, to commence with a brief account of the geology already published; this must form the base of all further inquiry extended into portions hitherto unvisited. I cannot, therefore, do better than briefly quote from the works of Thomas Oldham, Esq., Superintendent of the Geological Survey, and H. B. Medlicott, Esq., Deputy Superintendent in the same Department. These able surveyors, by their researches in the neighbourhood of Cherra Poonjee, have determined the superposition of the principal formations as displayed there, and though many minor sub-divisions have, no doubt, yet to be discovered and worked out, the main divisions on this longitude will most probably remain as the above geologists have laid them down. Mr. Medlicott in his report on the Coal of Assam, &c.* commencing at page 34, after mentioning the trap and metamorphic rocks north of Cherra, gives in detail an ascending series of the stratified rocks. These he divides *into three great Sections*, as follows:—

* Mem. Geol. Surv. of India, vol. IV. p. 387 etc.

Photozinco. at the Surveyor General's Office, Calcutta,
February 1868.

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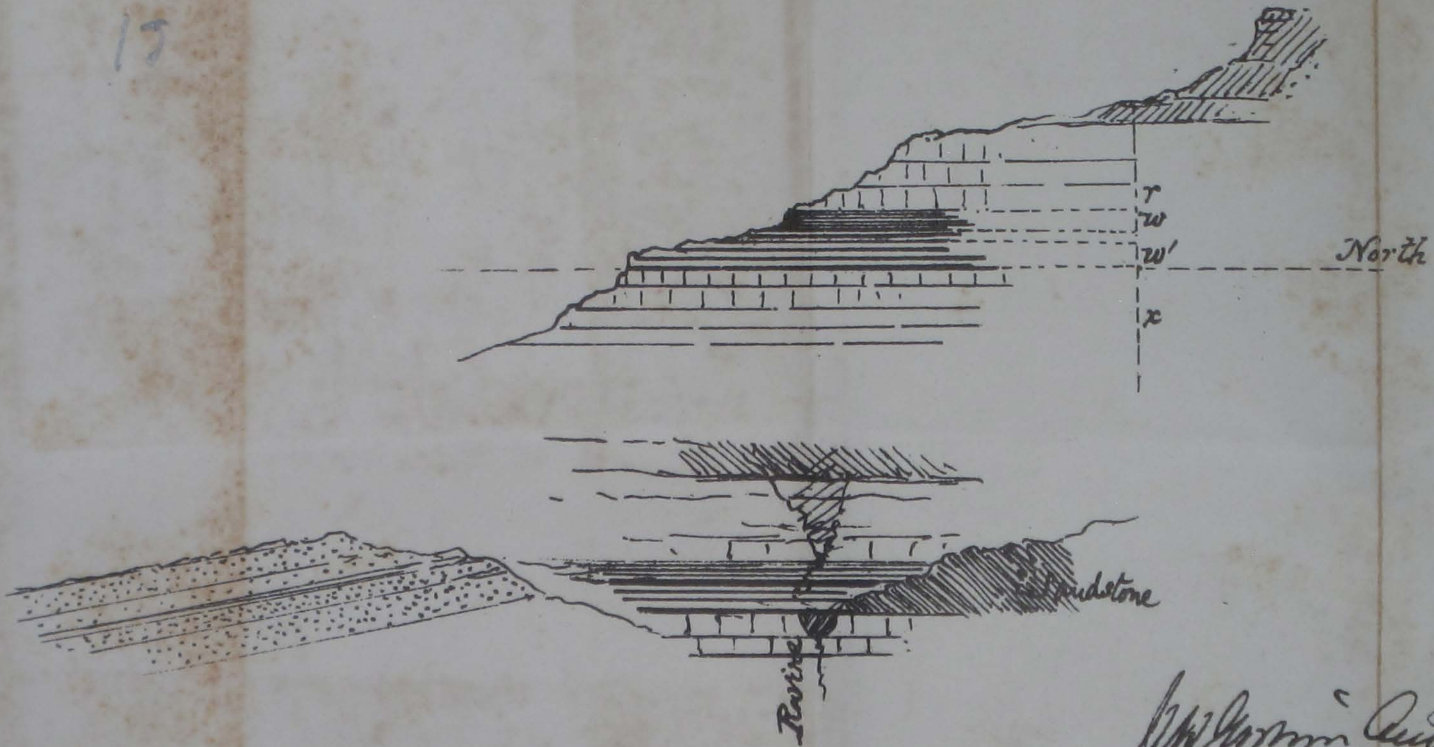

W. H. Godwin Austen Capt.
Surveyor

Photozinco. at the Surveyor General's Office, Calcutta,
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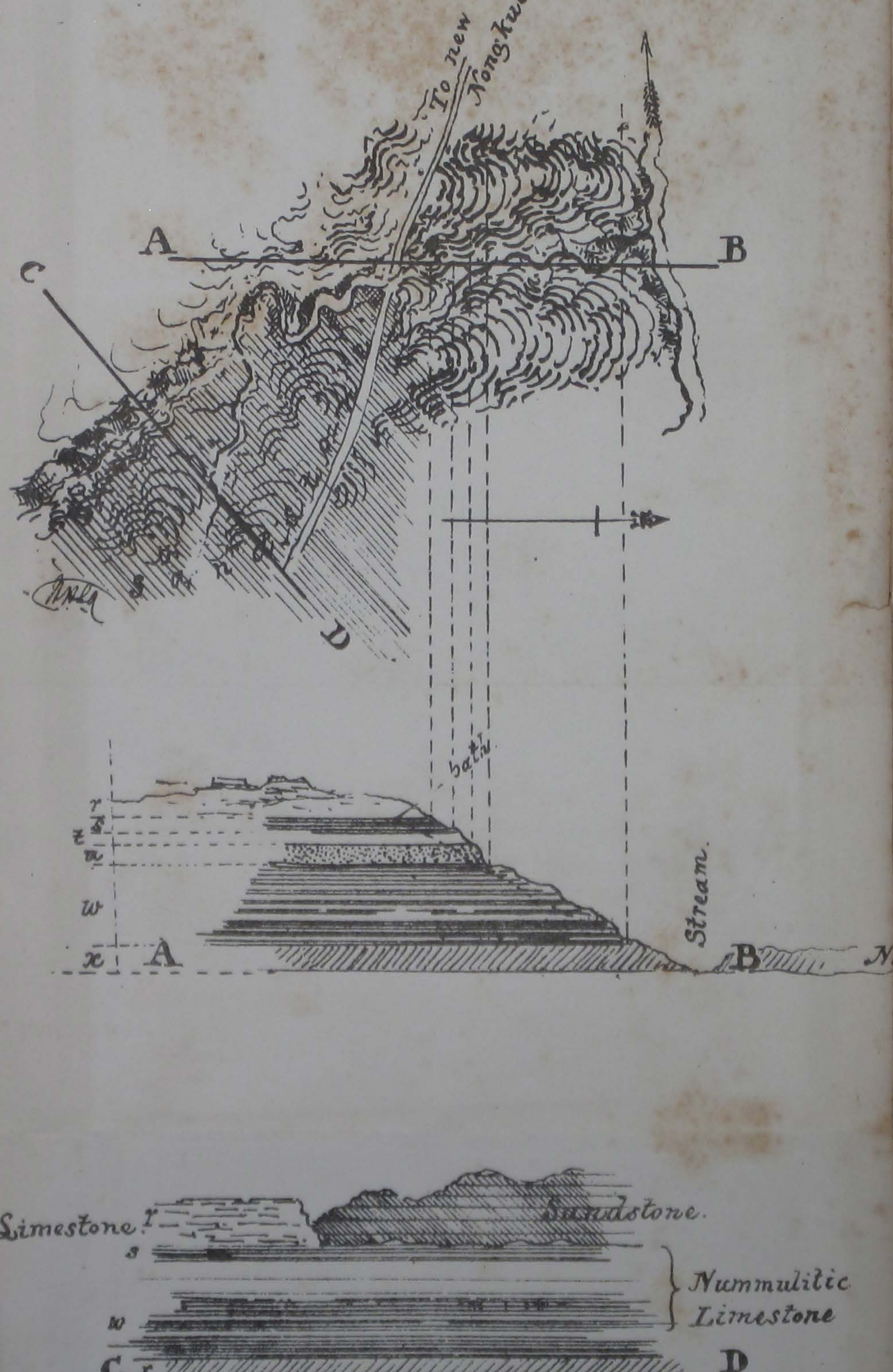
PLAN AND SECTIONS (d).



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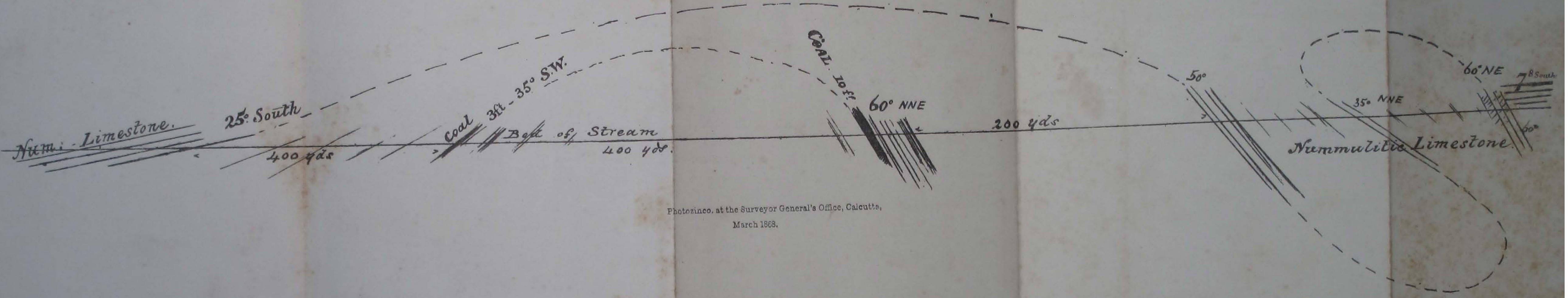
WEST KHASI HILLS.

SECTION IN THE UM-DURLIANG RIVER. (C).



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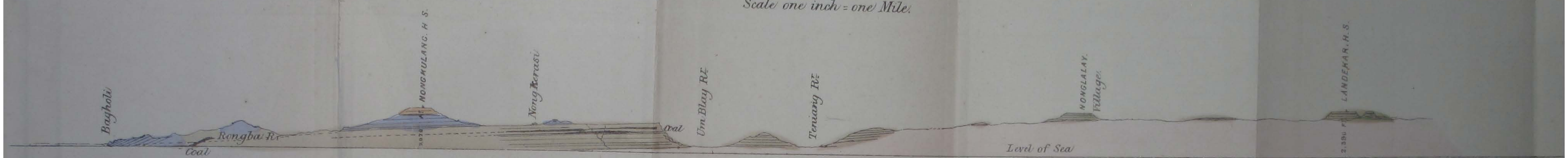
WEST KHASI HILLS

SECTION A. FROM LANDEKAR H.S. TO THE PLAINS AT BAGHOLI.

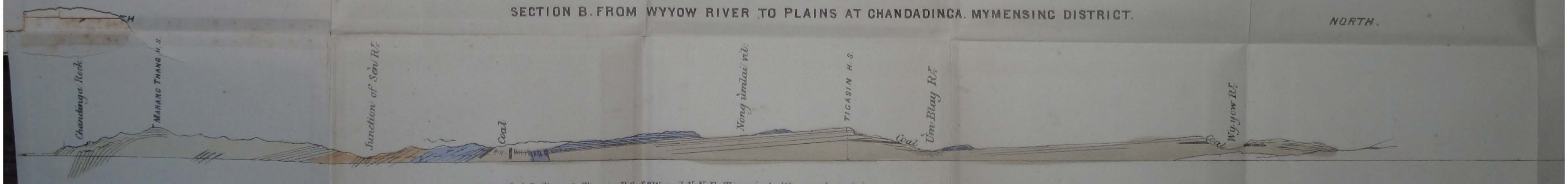
Scale one inch = one Mile.



Section nearly North & South looking West

- Granitoid Rocks.
- Infra Nummulitic.
- Nummulitic Limestone.
- Supra Nummulitic.
- Tertiary.

SECTION B. FROM WYYOW RIVER TO PLAINS AT CHANDADINGA. MYMENSING DISTRICT.



From Chandadinga to Tigasin H.S. SSW and N.N.E. Tigasin to Wyyow. N. and S.

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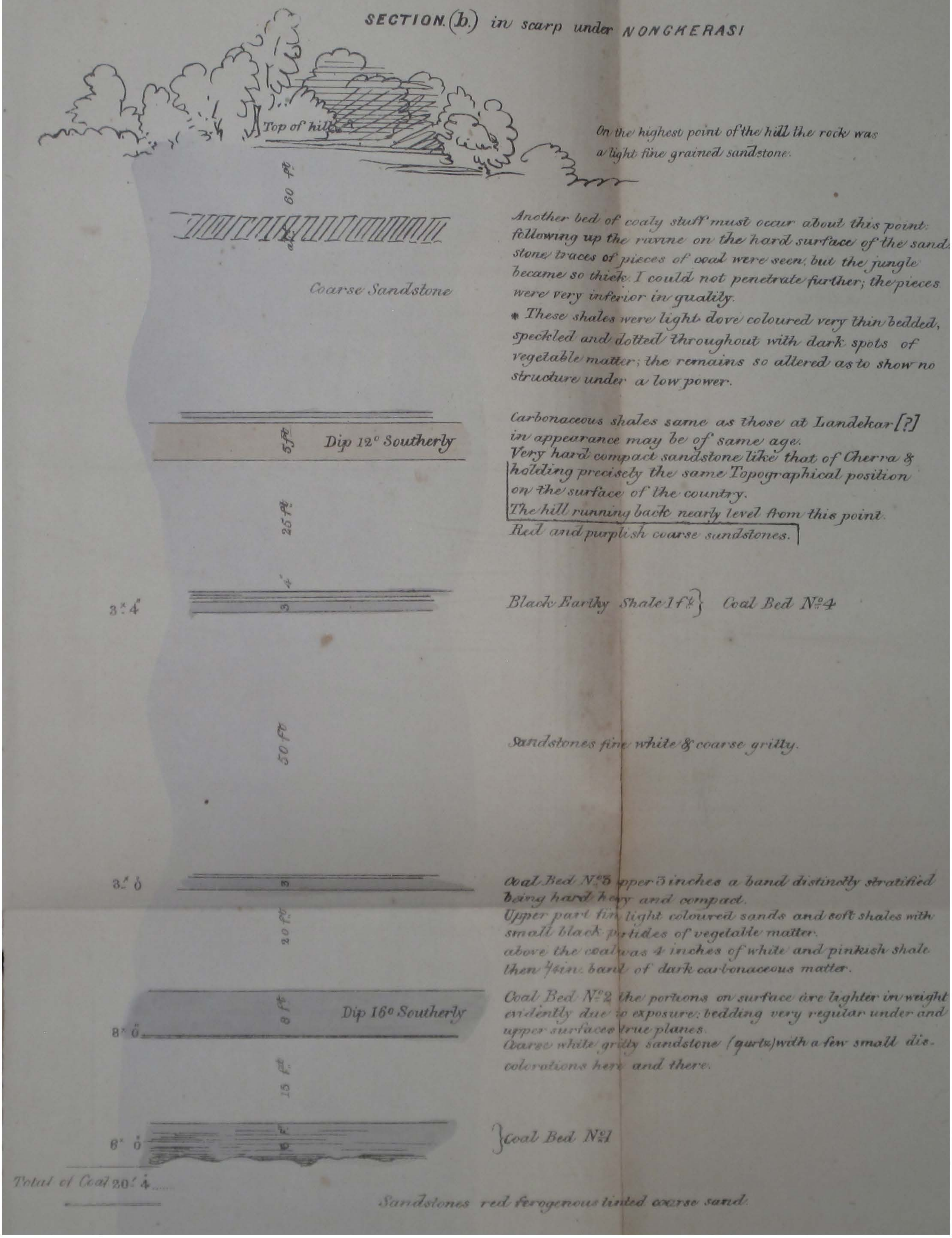
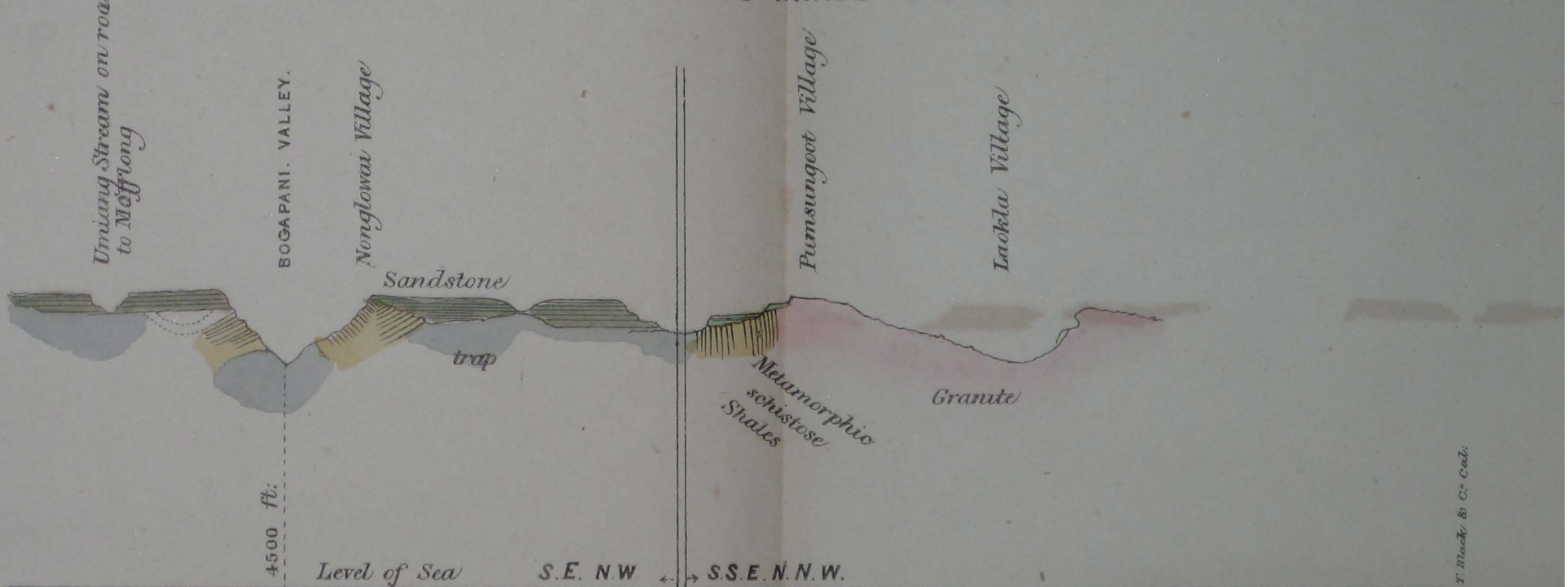
SECTION (b.) in scarp under NONGKERASI



SECTION a. NEAR BOCAPANI TO-WARDS LAOKLA.



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H.H. Godwin Austen Capt
Surveyor

First and lowest; the coarse sands and conglomerates, resting on the trap and metamorphic rocks.

Second; the rough tabular sandstone of the Cherra plateau, with all the beds between it and No. 1;—*Cretaceous.*

Third; the limestone, sand and shale with coal, that rise on the west of Cherra, forming what is locally known as the coal-mine hills;—*Nummulitic.*

Of the oldest rocks the trap, as one proceeds northwards, is the most conspicuous, and as shown in Mr. Oldham's geology of the Khasi Hills is in great force in the bed of the Kalapani, and Bog Pani rivers. It is seen for the last time beyond Mofflang on the road to Mairang, and in the bed of the stream from Mofflang near Langiong, on the road to Nongspoong. A rough section as observed on a march from the Boga Pani, in this latter direction, appears as given in section a, pl. I. The unaltered position of the sedimentary sandstones, and grits resting on the trap, and the great difference of level and exposed surface of the last, with the high dip of associated metamorphic shales and older sandstones, show a very decided unconformity and lapse of time between the two formations, as well as the prior contortion of the metamorphic shales on the first upheaval or depression with the trap.

The sudden and final termination of the nearly horizontal stratified rocks, is nowhere better seen, than on the road between Lookla and Langiong; this would strike the most unobservant traveller, more particularly if he were coming from the northward. From the great northern scarp to the Lookla valley all is metamorphic rock, gneiss or granitic formation; giving the usual peculiar features to the country of humrocky rounded hills, steep falls encumbered with enormous weather-worn masses of granitoid rocks, and many a grassy hill capped with a dark grey, single or double boss of the same. To the geologist the only sections exposed shew an interminable succession of coloured soft-bedded gneiss, always dipping at a very high angle, and of a regular strike which has given a like parallelism to the natural features of the country, its ridges and drainage lines.

On marching from north to south, and arriving at the village of Púmsúngút situated on the ridge, that bounds the valley of the Um Lookla, the change is most sudden; one walks off the dark grey granite on to a perfect shingle beach, and topping the ridge at the same time, the eye looks over a new land of high flat plateaus, showing at once their regular superposition, and notwithstanding the great elevation, their undisturbed state; even if the lines of bedding that show in the steep cliffs of the ravines were absent, to strengthen the impression. To the south-west rises the steep scarped hill of Maosinghi, an outlier of another long high plateau to the south; this is to a certain extent evidence of still newer deposits, mostly swept off by the all-powerful forces of denudation. The boundary of the beds first seen at Púmsúngút follows this ridge eastward towards Mofflang, these beds being at first very thin, from lying and abutting on the denuded southerly slope of the older rocks. The road towards the Bogapani, descends into the valley running towards Langiong, and the whole series is here well displayed, the most striking feature being its exceeding coarseness. Thick, irregularly bedded conglomerates of metamorphic rocks, are very equally associated with the very coarsest grits of quartzitic material. These are seen (Section A, pl. III. resting, first, on the granitoid rocks, and then on thin-bedded soft micaceous and pink-tinted schists, and in the bed of the stream below, on the dark green, or blue coloured trap, the extreme northern limit of a rock of which Mr. Medlicott in his report says:—"I have never seen, not even in Central India, such extensive phenomena of trappean intrusion."

From the great preponderance of shingle and water-worn stones in the beds around the valley of the Karamjoimai, the cliffs that were formerly cut away and bounded its sides, are now covered up for many yards in extent by a shingly gravelly talus; the old scarp only showing here and there at intervals. The quartzitic nature of the materials, as before mentioned, gives these slopes a very light colour, and to the country a very peculiar and uncommon appearance, the ground being so stony that hardly any grass grows on it.

The level of the opposite plateau, bounding the right bank of the Bogapani, is very nearly the same as that on the south of the deep gorge of that river. It is very noticeable, as one proceeds south, that the sandstones become finer, the bedding more regular, and thicker, until at last, the conglomerates are replaced by coarse grits, and the mass of the beds by hard and rather fine sands, some very white; even beds of a clayey nature are occasionally seen. North of the Boga Pani, I noticed no trace of any carbonaceous shales, which I had at first expected to see, the series appearing so continuous with the sandstones of Maobelurkur, where coal is found, and even worked, but I think now there is enough evidence to show that a line can be drawn between the lower and coarser beds, and the upper finer ones with coal. The manner in which the general denudation has acted, indirectly proves this; the lower, older and therefore harder beds remain, withstanding this force, while the higher and softer have disappeared fast and over a larger area. Extending through the whole mass of the beds, there is a very perceptible tendency to thin away at a very low angle towards the base of the main ranges, *i. e.* southward, and at the same time to thicken, I believe, quite as much in the lower series as in the upper. This, with irregular bedding, renders it very difficult, without the closest scrutiny, to be certain of the exact portions, as the conglomerates resting on the granite incline to the beds with coal at Maobelurkur. The coal itself is very local in its distribution. We see at Cherra how soon it fines out and almost dies away on the road towards Surarim.

The conglomerates in the valley near Langiong, bear in their composition a close resemblance to the great thickness of like rocks seen below the cretaceous beds above Nongphriam, in the deep valley, east of Cherra Poonjee; and I think they are, in both these positions, the lowest in the series. Should this view be correct, the greatly denuded patch of sandstones that form a higher plateau west of Púmsúngút, together with Mao Shinghi Hill, &c. are the representatives of the higher beds, forming a part of the nummultic series, the coarse grit and conglomerate being the very lowest of the cretaceous rocks; the well developed later beds containing fossils only come in with their increased thickness further south, but on this latitude they are absent.

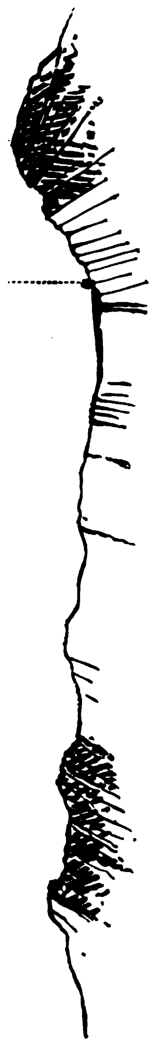
I have not had the leisure or opportunity of examining any of the country adjacent to Cherra Poonjee itself. It has been examined by far abler and professional geologists; I will therefore, make no further remarks in connection with this area into which I had begun to wander. In the section through the Bogapani, a series of schistose, yet sandy rocks is seen in close contiguity to the trap, and it occurs successively in two valleys. No like formation is to be found among the series of the sedimentary rocks, that have retained their almost normal position; they are quite distinct, and seem to form the oldest trace of a much earlier stratified formation, indurated, altered, and much disturbed by the trap. I think their extension east, and their counterpart is to be found in the quartzite sandstones of Mofflang and Shillong, associated with gneiss, and to all appearance merging into this rock, which is in all respects similar to that seen towards Nunklow, Kollong, &c.

Having endeavoured to give the reader an insight into the class of rocks and general characters of the country to the edge of the great granitoid centre of the Khasi Hills, I will, in proceeding to the portion in which my map (see pl. IX.) and sections were made, sketch the general topographical features adjacent to the route.

On this side of the Khasi Hills, the highest and most conspicuous feature is the Maotherichan ridge, the highest point of which, the trigonometrical station, is 6,297 feet above the sea. It is in fact the backbone of the range, throwing off its streams into the Brahmaputra on the north, and the vast jheels of Mymensing on the south. From the extreme northern point in section A (pl. III.), proceeding towards this central mass, the country is open and bleak, covered with grass, only some of the northern faces of the hill being sided and sheltered ravines, with a shrubby jungle. The Khasi Pine must have been once abundant, but has been so indiscriminately felled, that its southern limit is much contracted; it is fast disappearing along this line, and calls for Government interference and protection. The jungles are of sufficient extent near Nowgspoong, to supply the large quantity of charcoal, used by the iron smelters there. The whole process of extraction of the ore, found in the state of small grains of titaniferous iron, is fully described in Oldham's geology of the Khasi Hills; it gives employment to a large number of the inhabitants. The rivers Um Laokla and Um Nongspoong, are large broad streams, and shew that they are heavily swollen during the rainy months. Before reaching the southern foot of the Maotherichan ridge, a much larger river, the Um Kainchi is crossed, flowing through a broad flat valley, generally well cultivated with rice. These broad flat valleys are a very characteristic feature of the drainage lines in this portion of the hills, and some especially that of Mokasa, give the idea of a former lake system, before the sluggish rivers that flow through them, cut the present deeper channels. Under the ridge of Maotherichan, in the last named valley, the very regular strike and high dip of the gneiss is very marked, in a white coloured soft band that crops out at the very base of the hill, and is continued E. S. E. past the village of Laoburtun.

From all I could see of this formation here, the Mokasa valley, lies on a very sharp anticlinal bend of those gneisose rocks, the granite appearing to curve over the Maotherichan ridge.

Mokasa. Maotherichan, G. T. Stat:



Ideal Section looking West, near Mokasa.

The rock near the summit of Maotherichan is very porphyritic, containing large oblong crystals of felspar. In the valley it disappears, and coloured gneiss, soft and friable, comes in, to which is very probably due the present configuration of the valley. To the south near Mahaton, the porphyritic granite is again seen, with a corresponding rise in the hills. The above kind of granite is very common about here, forming as a rule the lines of the higher ground and elevated masses; it is of a very hard nature, often pink, and is generally used by the people for the monoliths set up beside the ashes of their dead.

On and about the summits of the low hills, south of Maotherichan, that rise some 150 feet above the present level of the rice cultivation, or what was originally the bed of a lake, I was surprised to find, scattered over the surface, a few well water-worn pebbles, mostly of a hard quartzitic rock. No beds exist anywhere near from which such well-rounded pebbles could have been washed, and I was quite unable to account for their appearance. They were not numerous, but sufficiently so to preclude the possibility of having been carried there by human agency, the nearest spot whence they could have been brought was the bed of the valley below. No well marked traces of any thing like glacial action are apparent. Equally puzzling in such valleys are two or three low mounds, all of transported material, that are to be seen at the eastern and upper limits of the Mokasa valley. I may ask, can even these hills have been affected by the glacial period in the Himalayas? On this supposition, long and deep snow beds extending down the flanks of this ridge, would be quite sufficient to account for the above appearance, without the intervention of true ice streams, but cold sufficient, to cover them deeply in snow, during the winter is by no means an improbable state for them to have passed through; and we have no reason to suppose, that their mean attitude has altered since the time when Himalayan glaciers extended down to 5,000 feet below their present limits. Such a physical change in a mountain range so close on the north, must have wrought a perceptible one on the highest parts of an outlier like the Khasi Hills.

Fifteen miles to the west of Maotherichan the higher general level of the hills, some 4,000 feet, comes to a rather sudden termination; and the central main water shed takes a bend to the N. W. Rising again, there in another higher portion called Laobersat 5,400, and Nongkana 3,726; overlooking the northern slopes that thence fall very rapidly towards the Assam valley. The watershed is thus brought very close to the northern face of the hills, almost the whole drainage being thrown to the south. The great depression west of Nongkana in the main axis of the range extends quite across them, the highest part the ridge near Nongkulang rises only 2,000 feet on the south, forming there a kind of natural wall, between the main drainage and the plains of India, the Um-Blay cutting through it near Púna Tith. The cause of this sudden fall in the levels of the country, I would suggest, is neither due to subsidence of the metamorphic rocks, or to their denudation, but that this portion has remained in a more tranquil state, and been less affected by the changes of level, on the west and east, particularly in the latter side, where the intrusion of the trap rocks alone has played so important a part in the present elevation of the whole series. As we shall see, this trap rock entirely disappears on this more western longitude, and in the sections (see pl. III.), I propose to explain, the stratified rocks are seen but little disturbed; whereas with the proportionate rise in the hills, on either side is to be seen an equal bending and displacement of the strata at their base.

Nongstoin, the residence of the Seem, or native chief of that name, is situated near the edge of the general fall, towards the west and south. A road leads out into the western part of the Nongstoin state, viâ Nongsingriang. Crossing the Kerkonshiongba river, 400 feet immediately below, its bed is seen cut through the metamorphic rocks; thence ascending to the plateau on the other side, the village of Nongrompoi is reached. This part loses fast the open bare featnres of the Khasi Hills, large timber trees come in, with densely wooded ravines, principally bamboo, until with the descent to the Umiam river and the village of the same name, this jungle growth becomes so dense, that nothing can be seen of the country on either side of the path. The scenery in the above valley is very lovely near the river, fine trees on every side overhang the still winding reaches of the Umiam. To the traveller it is both striking and novel scenery. It was only in the beds of streams that the rock *in situ* could be seen; this still continued to be of azoic age. Turning S. W. up, over and down low ridges covered with the same monotonous jungle of bamboo, grasses, and shrubs, Maomarin was reached, and a short distance to the west is Nongkúba built on a clearing at the south side of a hill, called Lamdekar in the map (properly Lúmdellor, Khasi) conspicuous even at Nongshingring from its sharply cut, though low scarp. On this hill is the site of one of the principal trigonometrical stations of the Khasi Hills Survey, and this led to my obtaining an insight into the formation. Nongkúba stands on a hard hornblendic gneiss, slightly pink in places, with a certain amount of bedding, the dip being very high to the north; it was of very compact grain and different to the same class of rocks hitherto seen in the East.

On leaving the base of Lamdekar Hill, at the very commencement of the ascent, is met a dark blue grey, and coarsish grit, having scattered water-worn pebbles of quartzitic rock in it. At the next portion of the ascent and the main one to the summit, these pebbles are not seen, but the same coloured grit, very conspicuous from its extreme neutral grey colour, occurs as a thick bed of quite 14 feet. This is succeeded by beds of a lighter colour, but still coarse texture. Higher again it changes to a bed of extremely coarse subangular quartzitic grit, set in a white sandy matrix. The whole thickness would be up to this point about 150 feet of horizontal bedding. Here a very fine grained series of beds comes in conformably. In this occurs a dark carbonaceous shale from two to three feet thick, shewing on fracture indistinct traces of carbonized wood and vegetable matter; it was very fine and soft, with few mica grains here and there. The colour is of a dark indigo, approaching to black in places; the little carbonized bits of wood still showed the fibre. The beds above this I could not see in section, but quite 30 feet or more, cap the hill. A great deal of loose stone lies about, and also shaly white fine clays and fine sands, more or less micaceous. The sands are thin-bedded, white and pink, some beds being composed of a finer material of a light blue colour, and full of minute bits of blackened vegetable matter. On splitting several of the slabs, I disclosed some very perfect impressions of large well developed leaves. The greater number of these were evidently of grasses, as large as bamboo, and interlaced over and under each other.

The Lumdekorh hill has no great area on the top, it is perfectly isolated, and another small hill of the same formation stands to the N. W., about 400 yards off. For 40 feet it falls in a cliff, and thence in steep latus the rest of the height; but owing to the dense jungle, it is almost impossible to examine the cliff. The Garrow hills rise rather abruptly on the S.W. into long flat-topped hills, having no conspicuous eminences, and are covered with forest; they so vary in height that no particular tree can be selected anywhere on their crests, that might serve, when observed from some other station, as a point for the detail Surveyor. Deep ravines proceed towards the plains, cut through horizontally stratified rocks. On the south rise two eminences of the same type as Lumdekorh, and in one and the same true line, due N. W.—S. E. It is curious to find these isolated masses, the last remnants of a higher level of the formation, still remaining, when all else has been removed. To the east of Nongkúba village, a hard hornblendic gneiss was seen, and the same rock extends towards Maomarin. A short distance before reaching this place, the path towards the south diverges, passing the site of the deserted village of Umlangyom.

Eight minutes walk along the ridge S. W. of this brings one upon a sheet of the coarse sandstones, resting on and capping the gneiss; not more than three feet of the sandstone remains visible; it is no doubt the same as the lowest beds seen at the base of Lumdekorh. Passing over this little outlier the ridge falls, and the metamorphic rocks are again traversed all the way to Nonglalay; the path crosses one large stream, and on the descent into this valley, much milky quartz is seen, evidently in thick veins. Close to Nonglalay, rises one of the eminences noticed at Lumdekorh. The lowest beds were precisely similar to those previously noticed. In the scarp, near the top, a few very dark beds gave indication of the presence of the carbonaceous and upper beds, which I have already described. Unfortunately dense jungle and want of time, prevented my paying a visit to the summit of the hill. From Nonglalay the country is seen to fall gradually towards a deep valley on the south. To the south-east again, the second isolated mass Katelao was seen, its scarped features are the same as the one we were under. This last also threw off spurs towards the deep valley of the Um Blay. Down towards this our path wended, following a long broad spur. About two miles down, I came on a thin capping of coarse sandstone, with sub-angular quartz pebbles, the position being due west of Katelao hill. The sandstone was evidently dipping away south together with the level surface of the metamorphic rocks. We thence rather more rapidly descended into a deep valley on the right, the Teniang, backed by a high wooded scarp, the stream flowing through beds of coarse sandstones and conglomerates, being nearly horizontally bedded. The forest is here very fine, the bamboos of enormous length, the tallest certainly I have ever seen. Crossing the Teniang, the path ascends steeply to the top of the plateau, and descends again a considerable distance, suddenly opening out of the forest upon the high bank of the broad fine river, the Um Blay. Sandstone is seen all the way to this. On both of the intervening ridges, or rather plateaus, one sandstone bed of a very blue colour was conspicuous, the tint generally was precisely the same as that of the beds noticed at Lumdekorh, but here the series had become of very considerable thickness, from 800 to about 1000 feet.

The way looking up and down the Um Blay, was very pretty, as regards its wooded character. The river was nowhere under 100 yards in breadth, flowing very sluggishly ; in its bed the sandstones had a south-easterly dip of about 5 degrees. A ford was formed about a quarter of a mile down, it was water knee-deep, but a very small fall of rain would have rendered it quite impassable. At the junction of a tributary from the south-west a short distance further down the right bank, the path leaves the Um Blay, and follows the new stream. In the bed I at once noticed rolled pieces of coal. Sandstone of the coarse purple kind was exposed in thick beds on the ravine side, dipping south with 7 degrees; and further up, the coal occurred in water-worn lumps quite 2 lbs. in weight,its fracture was bright. At half a mile the path leaves this ravine on its left bank, continuing steeply through a magnificent forest with very little undergrowth. As one ascends, the sandstones become finer and lighter, and at about 400 feet in a side ravine with water coal again was noticed in its bed, showing that it lay high in the series. Leaving the path, I struck up the steep ravine, which gave every promise of a good section being obtained, and it has well repaid the trouble of the climb, for at 50 feet of vertical height, coal was found. It rested on ferruginous coarse sands, and was overlain by a coarsish white quartz-grit, with a few little dark discolorations here and there. I am not over-estimating the thickness of this lowest bed of coal at six feet, and in places it was more ; the bedding was irregular. On a like surface of the strata below it I commenced here to take in the whole of the measurements with a 10 feet pole, well knowing how very wild some estimates have been, especially with regard to coal beds ; that at Cherra Poonjee, for instance, having been put down at as much as 17 feet by one officer. The results are given in section b, Plate II, shewing thus more clearly the succession of the beds and coal seams, which, good and bad, gave a total of 20 feet. The similarity of the upper fine beds was remarkable, as being very like those which were seen capping the Lúmdekorh Hill.

Leaving this section and continuing the march, we ascended along the face of the hill, the coal showing again on the path itself. On reaching the compact hard beds of sandstone (*vide* Section on Plate III.) the ascent ended, and the general level of the country dips away with the even slope of its dark brown weathered surface towards the south, and in many parts over several acres in extent is entirely bare, all earthy matter having been washed off it. A quarter of a mile further the village of Maokerasi, inhabited by a people of the Langam tribe, is built on a low knoll, rising above the plateau on the edge of the steep scarp that marks the sudden commencement of the gorge we had just come up. No streams find their way over this northern cliff, and the slope of the strata being south, the water issues from below and must have gradually caused the cliff and gorge to eat back far from the valley of the Um Blay.

From Maokerasi towards Nongkulang, is at first seen the tabular sandstone, which dips at a low angle from the edge of the northern scarp (*see* Sec. A, Plate III,) up to the stream that flows along the base of the Nongkulang ridge. This sheet of rock is so hard, that denudation appears to have made little or no impress on it, and the streams which cross its surface have scarcely cut into it at all, in fact, in many instances they flow irregularly and widely over its surface. At half a mile further on we crossed the main stream flowing westward, full of *Melaniæ* and *Paludomi;* the forest commenced immediately on the left bank and, I found, with it we had suddenly entered upon limestone rocks full of *Nummulites.* This was rather a surprise, as I had not expected to find them on the northern face of this ridge.*

We now began to ascend the Nongkulang hill through a very great thickness of the nummulitic limestone series, certainly 300 feet, if not more of it; this rock ended rather abruptly, and was succeeded by sandy ferruginous strata, some of the beds being very nodular, continuing to the crest of the ridge. Near the highest level of the limestone rocks occurred one very marked bed containing *Nummulites* (about five feet thick) of very large diameter and perfect form; the stratum was horizontal and curiously weathered by the action of damp and water. The upper sandstone series was found to be rich in fossils well preserved; there must be several beds of these parted by non-fossiliferous, light friable shales, and by less fossiliferous sandy beds. *Turritella, Neritina, Cyprea* and a *Trochus,* were common forms, besides a few *Echini* and numerous *Bivalves.* I made a good collection of these, a hazy day intervening when survey work was stopped; yet owing to

* I may here add, for the information of shell collectors, that this spot is a most productive one. Landshells were most plentiful, and in great variety. I added a large number to my collection in a few minutes, many of which have since turned out to be new species. It was just their favorite spot, a dense damp forest, black vegetable mould and limestone rock.

the sandstone being so friable and soft, it was very difficult to obtain perfect specimens.

From the top of the ridge, looking north and west, the view was a curious one, and showed the geological features very strikingly. This was principally due to the hard sandstone of the Maokerasi plateau which, I believe, to be exactly the same as that on which the station of Cherra Poonjee is built, and it occurs precisely on the same horizon as regards the nummulitic limestone. I give a panoramic sketch, taken from Nongkulang, which will give, I trust, an idea of this portion of the Khasi Hills, with those of the Garow hills in the extreme distance. (See Plate IV.)*

In such interminable forests, as here cover the country, it is not an easy task on first coming upon a new series of beds to make them out, and be quite certain of their relative position. I was inclined to think the fossils I had found, bore a cretaceous type, and again the perfect horizontality of the limestone did not appear conformable with the southerly inclination of the sandstone, which is about 5—7 degrees. We may account for this by the difference in their mode of deposit. The Molluscs in the upper beds point to a shallow sea with, in all probability, a sloping bottom. The limestone partakes in many places of a southerly incline, even very perceptible further west. To clear up this point, I made several excursions around this ridge, and was successful in finding several good sections. One of the best of these sections is to be seen on the path that leads from the old and deserted village of Nongkulang, to the new site of the same; it was at first a somewhat puzzling one. Leaving the trigonometrical station for some distance west, the main ridge on which it stands, is followed; it soon falls, the ferruginous sandy clays and shales continuing all the way to the first considerable ravine, and on the left bank of this, limestone comes suddenly in, but does not extend to the right bank. By following down this narrow ravine bed, the section d, represented on plate VI, with plan, in the nummulitic series was displayed. In this section *r* represents the hard white coloured limestone; *s*, where the path crossed the bed of the ravine, is a blue clay, four feet thick, resting

* There is one error I must point out, *i. e.* the peak of Wanrhy is too far to the north, its true position is immediately over Pudengrú scarp. This mistake originated by my putting in Wanrhy from another sketch, the peak at the time having been obscured by haze.

on light blue limestone and containing small *Nummulites;* its thickness is about 5 feet. This bed was succeeded in descending series, by 10 feet of sandy beds, *u*, the lowest being calcareous; then followed a massive bed of dark blue clay, *w*, quite 35 feet thick, in parts very nodular; these nodules were large and very hard, inside of a darker colour than the clay, and were not in the least calcareous. I found no fossil remains of any kind in this stratum. The lowest rock, *x*, seen at the junction with the last, and in the bed of a larger ravine with running water, shewed about 12 feet in the section. This limestone was full of large-sized *Nummulites*, and the base of the series was still many feet below. The hard blue clays were a new feature, as also the sandy beds; both were only locally developed. On the ascent to Nongkulang, I did not see them nor again do they appear further west; for proceeding towards new Nongkulang, the white hard nummulitic limestone is followed all the way from near section d, and is at last seen to rest on coarse and strong bedded sandstones, of the coal series (cretaceous ?). Approaching the village, the path ascends a low spur, and with it the limestone, contrary to expectation, is left, and sandstone is seen. In a cliff section, bordering a clearing here, a good view of these lower thick-bedded sandstones is to be got, the limestone forming another low scarp; on the south of the clearing scattered blocks of the same being still left on the intervening level ground. This marks the commencement of a great roll in the lower sandstones (coal series), its line of elevation running from east, and ascending to west, dipping low to north and south, taking the whole series some 1,000 feet in height up to the culminating cliff of Pundengroo. The amount of nummulitic limestone greatly decreases towards west; the thickest section being that under Nongkulang hill series up to and as far as section d; and I am even inclined to think that the beds were originally deposited on a very irregular surface of these underlying rocks. We cannot expect so sudden a change in their mineral composition to form a very conformable series.

To return to section A, the lower portion of which I have only alluded to. Following up the same ravine from the path, the highly fossiliferous sandstone of the Nongkulang hill series is seen on the left hand, or the east bank, and nummulitic limestone on the right or west. In the sandstone I found an *Ovula* with

Echini. Keeping to the well defined boundary of the limestone, I met with a well marked unconformity of the two series running in a line, from south-east to north-west, and at a short distance further on, from north to south. The limestone terminated in a perfect cliff, and not a single particle was to be found on the sandstone side of the depression between the two. In these depressions blocks of the sandstone were found resting on the limestone irregular surface, and the former also rose in a rounded hill considerably above the general level of the latter. I give a sketch, (Plate VII) and a section (Plate VIII) of this upper junction. The local unconformity of the rocks clearly shews, that the sandstones have been here deposited around and against an old cliff of the limestone rocks. The section exposed in the same ravine, showed it was no result of local displacement.

In some new clearings, close under the trigonometrical station of Nongkulang, and on the north side some good sections are to be seen of the relative positions of the limestone and superincumbent sand. The first and highest bed of the nummulitic limestone series, is a peculiar dark burnt, umber-coloured calcareous rock, containing scattered very small *Nummulites.* In a ravine close by the light-coloured pure limestone was seen to pass horizontally into the hill. Great hollows occurred in the surface, where the limestone had evidently fallen in, and the ravine first mentioned entered into one that was of great depth.

Proceeding from Nongkulang south along the path to Shibak, one passes over a steep scarp of some 50 feet in the upper sandstones (fossils numerous), which extend some distance to the bed of the first considerable ravine. Nummulitic limestone occurs here again, and following it up in the section represented on plate VIII, it is seen close to the path, being a hard blue clay (*w*); it contains hard nodules of the same material, its thickness varrying from eight to ten feet. This accords, in its character, with Section d, see plate VI; above *r* is a great thickness of white pure nummulitic limestone, continuing up the face of the hill. Below the blue clay, following down the ravine, is a darkish purple earthy rock (three feet), it effervesces slightly with acid; then follows a bed of a dark brown rock, having minute white *Nummulites* scattered through the mass, and being interstratified with some light-coloured beds, the whole thickness amounting to about ten feet. The darker coloured beds are seldom more than one foot thick, and the whole rests on a hard thick bedded and light-coloured limestone (x), the thickness of which is unknown, although it must be considerable.

In this section again, the unconformity of the upper sandstone is apparent, masses of it are seen resting on all the above beds, in the position of outliers, and are the remains of the upper series, deposited against a high and irregularly scarped surface of the limestone series. The dark umber coloured bed, with small *Nummulites*, corresponds to the one mentioned, as seen on the north side of the ridge, being the highest of the limestone resting on the sand, but I am much inclined to think, that on that side (the north) much of the limestone was denuded, prior to the deposition of the fossiliferous sandstones and shales.

After leaving this section, one passes (on ascending to the crest of the ridge to the west) on to coarse sandstone of the lower group, *infra-Nummulitic.* There is no doubt of this, as on the south-west face, after crossing the crest, these same rocks dip into the valley at an angle of 10 degrees S. W. One again encounters the nummulitic limestone near Purjonkha, clearing the strata, seen in a ravine close to the field and belonging to the lower sandstones, on which the limestone rests horizontally. From the sudden appearance of these lower beds on the above ridge, close to the strata showing no sign of bending or contortion, I am inclined to think that even between these two last, a considerable unconformity exists, and that separation can be established. The surface of the lower beds must have been locally altered in level, before the nummulitic limestone commenced to be formed. Throughout the great thickness of the lower sandstone with coal, I have never found a single Mollusc or any remains, save those of indistinct vegetable matter. According to the sections, noticed by Messrs. Oldham and Medlicott, we should find, as at Cherra, the cretaceous rocks here; whether these sands with coal are their equivalents, or whether they will be eventually found below, or above them, and adjacent to the nummulitic formation, is an interesting point, yet to be discovered;—the probability is, that they are upper cretaceous.

From Nongkulang, direct to Maokerasi, a good section, displaying the conformity of the last named rocks, with the limestone, is met with. In the bed of the small stream with water, near where the paths to Maokerasi and old Nongkulang diverge, the sandstones are seen exposed; the limestone rests horizontally on it, and from this the path leads down the easy hill side, through a descending series of the limestone to the level of the main stream, in the valley, in which it terminates. The way in which the sandstone passed under the limestone was very striking, the former being the same kind of rock one had seen higher up on the Nongkulang main ridge, where there was apparent unconformity. At one spot where the main stream here entered the limestone rocks, for a short distance, the scenery was extraordinary, from the strange and grotesque way these had been eroded. No water was to be seen, as it soon disappeared among the blocks and masses of rocks that filled the bed. All the limestone was perfectly horizontal, the effects of denudation were most extraordinary and marvellous; huge masses formed columns and natural arches, or standing on three or four thin pedestals reared themselves amidst the forest trees, 15 to 20 feet in height. Sometimes such a mass was surmounted by a tall stately tree, whose roots ramified among the holes and crevices in the rock; huge cable-like creepers hung suspended from, or wound round them, while canes and ferns formed the under-wood, and flourished in the dark vegetable mould of this damp virgin forest.

After leaving New Nongkulang less limestone is encountered, though it occasionally is seen on the left hand side of the road, but is nowhere thick, and partakes more of the character of outliers that have stood out the forces of denudation. In all the numerous ravines that are crossed, up to the steep descent into the Riangwylam, the lower sandstone in thick beds is seen with a dip of from 10 to 12 degrees west, bending to south-west, in the direction of the main ridge. The descent into the Riangwylam valley was quite 300 feet; on reaching the river and looking up the gorge, a fine cascade is seen falling over a steer cliff of horizontal strata, the limestone at the top; the whole scene being most lovely and grand. In the bed of this stream, lay masses of limestone fallen from the cliff above, and a few pieces of coal soon led to my finding a thin seam of bad quality, and evidently the highest in the series. It was about one foot thick associated with coarse sandstone of light colour. A bed of carbonaceous shale above this contained a good deal of shining iron pyrites, and was very heavy. A steep ascent here commences, up a spur, bounded on the north by a lateral valley of the Riangwylam, we had just crossed. Beds now were seen, with the rise to have an easterly incline, or the commencement of another great roll in the sandstones. Near the top a trace of coal was found, but nowhere in the forest could I find a satisfactory section. The thick debris covered the ground too deeply, the associated beds being very fine sparkling, lilac coloured sandstones. At the top of the final ascent, where an open glade in the forest was entered, the surface sandstones were of a very gritty coarse description, with thin beds of water-worn quartz pebbles, and had more the look of the coarse beds seen near Maobelurkur, &c. After crossing a ravine where the dip is south, these beds are seen capped by the lowest strata of the nummulitic rocks, but it is a mere outlier and only some 20 feet thick. Several other isolated masses are contiguous. The sandstone, beyond this a short distance towards the village of Nongumlai, dip with the surface level of the ground, and is evidently of the same hard durable kind, that occurs near Nongkerasi, but here it is thrown up several hundred feet higher, falling towards the south-west to rise again in a higher roll, in the culminating scarp of Pundengroo.

The village of Nongumlai is a very good central point, whence the geology of this neighbourhood can be studied. It stands on an open bare slope of the hard sandstone that terminate a few hundred yards below, in the main stream, a source of the Um Durliang flowing to the south. Immediately beyond this stream a densely forest-clad hill rises rather abruptly, all of nummulitic limestone, the surface of the slope being as usual, most fantastically eaten away. Thence to the south a very large area covered with forest is also of this rock, in which all trace of drainage lines ceases, water finding its way down the innumerable crevices and holes, or rather wells in the rocks, for the word hole hardly expresses the deeply honey-combed state, it presents. Land shells literally strewed the ground, principally large *Cyclophoridæ*. The limestone here presents a thickness of some 250 to 300 feet, and is very similar in stucture, colour and hardness throughout, none of the blue and clayey bands being seen. Both in the stream and near the top of the ridges, transported small lumps of the fossiliferous upper beds were found, but nowhere did I see it *in situ*. The large quantity in the ravine points to its existence higher up the valley, but I had no time to penetrate in that direction.

To give some slight idea of the majesty of these forests, I may here give the dimensions of a tree on the top of this hill on which a *maichan* was erected by one of my assistants, ascended by a rough ladder lashed on with cane. After sketching the surrounding country on the plane table from it, on descending, I measured it down 92 feet. The upper branches before they were cut away to open out the view were probably 20 feet higher. The tree was without a branch for 50 feet from the ground, a clean straight trunk, but at that height forked into two contiguous stems, and continued thus for 30 feet higher. Its girth was small for size, being only some 14 feet near the ground. This tree was a very good average, few were shorter, and many exceeded it. With such associates, those who have never seen such tropical scenery, can hardly realize its features, and the feeling instilled by the antiquity of such vast growths of vegetable life, when passing through them for hours of the day. In such a country all its topographical features are lost, and to see them and sketch them in, the only plan for the surveyor is to erect platforms on trees, selected for the purpose, that they overtop and command the sea of waving foliage that stretches for miles around. Reaching the level of such a platform and emerging from the gloom and shade of the 80 feet below one into bright sun, with the far horizon of blue hill and mountain, and nearer valleys, is like entering another world. The highest level of these forests form a densely populated zone of insect life, among which the *Lepidoptera* seem to rule, and many a coveted form have I seen from these sites, flitting safe beyond the reach of net, much less of foot.

One of the most conspicuous hills in the neighbourhood of Nongumlai is Yindku, and as on its flanks some of the best sections are to be obtained forming a passage into still newer strata, I will describe them as they come in in turn along the ridge. This has a direction almost due south, to which the road keeps. The sandstone on which the nummulitic rocks in their outliers are seen, extend for some distance, the dip about 15° east; 1½ miles from where this path leaves that from Nongkulang to Nongumlai, at the foot of a rather steep ascent the limestone occurs in great thickness, the total being perhaps 250 feet. On this ascent I came on detached pieces of the fossiliferous iron-coloured clays. Next in order came the nodular ferruginous sandstones, noticed also below Nongkulang on the northern side, and then again some 40 feet of limestone. The topmost bed of this rock was of a brown umber colour, the *Nummulites* were small and much reduced in number, with here and there a faint trace of a shell; shales, and sandstones with precisely the same fossils as I had found on Nongkulang ridge, then succeeded. The base of Yindku was quite 1½ miles further along the ridge; where an ascending series of the beds is first noticed, they at once become much lighter in colour, and coarser in texture. With this change the fossils become scarce, at last only an occasional bivalve is to be found, and these soon disappear altogether, thin shalely beds intervene, and at the top of Yindku itself, the rock was soft, sandy, and friable. The thickness of these newer deposits is quite 200 feet, the dip now being very low to N.W. Yindku from its isolated position, and greater height than any of the hills around, formed an excellent point for observation, but being covered to the very top with large timber trees, would be of little use without a *maichan*. From the one built there, the view was most commanding, extending to the very foot of the hills in the Mymensing district.

On the spur thrown off from it, to the east, a like section to that first described, occurs again, and the best spot whence to visit it is Shibak, situated on the direct road from Nongumlai to Bagoli in the plains. After leaving the main ridge of Tigasin near Nongumlai, a quarter of a mile of descent brings one to the Laokla stream flowing north. Leaving this a ridge of the fossilferous beds is another stream, the Umpernon, is crossed where they dip S. W. at a low angle; on the descent, the unconformity was again noticeable, although the beds still retained their normal horizontality. After descending over a considerable thickness of the nummulitic limestone, it suddenly is replaced by the ochre-coloured sandstones, at the foot of an ascent extending to a height, considerably above the lowest limestone just left. At half a mile, limestones again dip north 5°, and at the bottom of the valley all was of this formation; near a huge overhanging mass of it, used as a temporary shelter, it was seen to rest on a light coloured fine sandstone (the cretaceous ?), the same sequence in every respect as is seen near

New-Nongkúlang. The Shibak stream was now quite close, flowing over the slightly sloping surface of the lower sands, and striking the edges and the termination of the limestone, which also marked that of the forest. This valley of the Shibak was for a long time a very great puzzle. In no direction could I see any likely depression in the forest-clad heights about, where the united streams of Shibak (the Wakit from under and north of Yindku, and the Umpernon and others) might find their way to the plains.

The conspicuous cliff of Kúta Bram, was the only open point in the neighbourhood, and it was by visiting this, I determined the existence of a very anomalous physical feature, on a really grand scale and one which, though familiar with the like topographical feature on a small scale, as seen near Cherra Poonjee, fairly surprised me. The cause is simple enough, the united streams all meet in the nummulitic limestone, that here extends quite across the main valley; the streams drain away under it, over the surface of the harder sandstone on which it rests. This water must percolate under the Kúta Bram ridge into the Rugsir, but the greater quantity evidently finds its way into the Gabir, at Bagholi, there a large stream without an equivalent drainage area. The ascent to Kúta Bram cliff is through a forest of enormous trees in the bottom of the valley, passing into bamboo near the crest of the ridge, that rises quite 350 feet on the south. The fossiliferous sands succeeded limestone as usual, and continued to a short distance within a few feet of the cliff; this consisted of fine thin-bedded sands, micaceous, of light ochre and gray colours; they dip about 10° south, but no fossils could I find in any of the debris at its foot, although about 100 feet of the beds were here exposed. This newer series covers all the spurs south of Yindkú, and is exposed again on a direct path leading from that peak into the Rugsir and on to Gillagora, a village of Habiang Garos. Some of the beds at this point were of a blue, crumbly clay, and all thin-bedded; the presence of springs causing land-slips, have formed this bare open spot, whence a fine view is obtained.

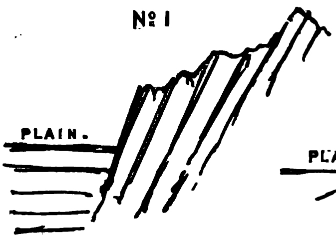
Passing on down this ridge, nummulitic limestone again makes its appearance on the right hand or the west, rising in a very steep cliff, the path is over the red sandy clay (fossils being numerous of Nongkulang forms) at its base. Descended at last rapidly into the bed of Rungsir, here hard massive fine sandstones passed under the limestone, which dipped far higher than yet seen in this area, being evidently on the south side of an anticlinal fold. The beds where first observed, dipped 12° south by west, then 15° to the south, increasing to 20° and 25° south. Although a deep gorge existed through the mass of the limestone (here very thickly bedded) no water is seen; at about 400 yards through the gorge, it terminated suddenly with its highest dip, succeeded immediately by highly fossiliferous beds, well developed under Rongsitilah, (the summit of which is of the higher series, of coarser sand and thin shales). In the first open clearing on the right bank I found my best specimens of fossils in a bed *in situ*, most of the Nongkulang forms turning up. These rich deposits of shells are immediately succeeded, as one travels down the bed of the Rugsir, by thin-bedded bluish clays, the sandstone shales becoming more sandy and compact, the dip increasing with every few 100 yards, until below the village at the debouchement of the stream into the plains, at the very last spur and section exposed, they are complete sandstones of very lower tertiary Siwalik type; their colour is brown, and their dip about 50 degrees to the south.

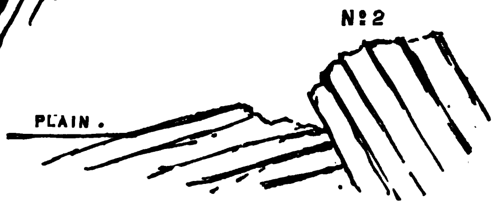
Emerging into the rice fields of the plains, and looking both to the east and west, it is very evident that the last and far newer beds, extend on both sides along the base of the hills. The dip of the beds is seen on the ridges of the spurs most markedly,—more marked is this on the west, at the base of the true Garo hills, and these, bending more to the south of the latitude, we are now standing on, bring in beds of again a later period. Save for the marshy plains, flat as an ocean and the greater exuberance of the forest on the hill slopes, one might be looking at an expanse of the Siwaliks of the Deyrah Dhoon, the same characteristic long slopes towards the plain terminating in a short steep fall on the north, whence rises another long slope of rather a less incline to the horizon.

I followed the foot of the hills, in both directions; 1st, on the east side to Bogali, where two streams the Gabir and Ronga unite, and form a large and navigable stream. Nothing new is observable thus far, the different "soras" or streams take their rise in the tertiary sandstones; in their beds, the same succession is seen, as in the Rugsir at Gilla Gora, and the usual fossils are also found as one gets deeper into the series. Crossing the Gabir into the village of Bagoli, the whole eastern side with the hill slopes, are of nummulitic limestone, which here abuts on the plains; the Ronga flows out through the mass of it, which dips 25° south, in hard thick beds, and is the first point on this side, where it is worked for the Calcutta lime trade. A limestone quarry, with a shallow canal approach for canoes, occurs about 1½ miles to the east of Bagoli, worked I believe by the Manager, C. K. Hudson, Esq. of the Inglis estates. The Ronga river takes its rise immediately under, and to the south of the Nongkúlang hill series, and has one point of interest, but I was unable, from want of leisure, to follow up and examine it. Much coal is to be seen in the bed of the stream brought down from above, and can be no other than an outcrop of that in the infra nummulitic beds seen and described at Nongkerasi; what its extent may be here in the Ronga, it is impossible to say, but it deserves examination. A subsequent attack of fever prevented my penetrating further to the east of this line, in the most interesting and promising part of this geological district, where the useful mineral beds approach so near the plains with the magnificent water carriage which the Um Blay must offer at this very point. I do not think it likely that the coal will be found again near the base of the hills, west of the Moishkulla or Rungsiang river, for a very considerable distance. The general strike has assumed too strong W. N. W. direction, towards the culminating point Wanrai, and the tertiary sandstones appear very persistent, and with greater breadth, west of Chanda Dinga, owing to the slight extension of the hills southward. Returning to Gilla Gora, I carried my survey along the base of the hills westward, crossing the Rongsiang, near longitude 91°, and on to Chanda Dinga, in order to ascend and observe angles at the fine elevated hill of Marang Thang.

All belongs to the older tertiary series here; the principal and most noticeable feature of the rock being, the great increase of dip in this direction, coming in with the newer beds of the series (this is shown in Section B, Plate III), until at Chanda Dinga, the beds are almost perpendicular into the plain, forming here a bare flat rock on the hill side, marked in the old revenue map, as Chanda Dinga stone. The beds here had assumed that coarse texture, with light brown, or gray tint, lithologically so exactly similar to rocks of the Siwaliks,—even to the scattered strings of water-worn small pebbles, met with in the great mass of the lower series, known better as the Nahun group or Lower Siwalik formation,—that I think they can be well placed on that horizon. Whether this will be proved still further west, by the presence of the later Mammaliferous sands and gravels of the higher, and again unconformable series of the Siwalik group, is to be seen, and it is a most interesting point; or may not these last beds still exist under the present plain of Sylhet and Mymensing, undisturbed, abutting like the present land surface against the lower series? The change is so sudden here, from dry sandy steep slopes to swamps, that within a few paces of the hill side, the ground is covered with the dead shells of *Paludina* and *Ampullaria;* the sections seen in the beds of the streams show an alternation of sands with dark clay, containing the same shells. I could point out a bed, under and to the south of Nahun, so precisely similar, with the above shells (particularly the more lasting *opercula* of the latter species) that no one who had wandered over both areas, examining them attentively, could fail to be struck with the great similarity of their deposition. The only difference rests in the present unconformity of the one, due to elevation; and in the still normal position of the other, slowly accumulating bed over bed, and perhaps in some future geological age, to pass through the same mighty changes. Medlicott's explanatory ideal section in the Markunda under Nahun, (where also lies the beds I have just referred to) is nowhere brought so forcibly to the imagination, as at the foot of these Hahiang Garo Hills.

The beds are actually at Chanda Dinga so near the perpendicular, that a transition from No. 1 to No. 2 (*vide* Ideal Sections below) is easily wrought, and this is what is actually seen at the junction near Nahun, if anything greatly exaggerated in nature, from the lateral force that has been introduced.





After visiting Marang Thang, whence the deep gorges with precipitous sides of a large river, draining from south-west of Pundengroo scarp, was seen, and presenting a complete section of the whole series I have been detailing, I retraced my steps into the interior of the hills once more, *viâ* Júgni, situated about four miles up the Rongsiang river. I give the reader some idea of this mountain stream, its features being so unlike what is generally seen, and nothing like it is met with at the base of the Himalayas. I proceeded the whole way, without much obstruction, in a canoe to Júgni, the water being so little deep in parts that save to a native who easily disencumbers himself of superfluous clothing, it would have been a most disagreeable route. It became still more difficult to navigate beyond the above village, shallows and rapids commencing; yet very deep long reaches still continued right up to the junction with the Sen river, where is a pool famous for the immense number of fish killed periodically by poisoning the water. With a stream navigable so far into the hills, one would expect the valley on either side to be broad and somewhat open, the contrary is however the case. For the whole distance the spurs approach, and end in high sheer cliffs, washed by the excessively deep water of the pools at their base; opposite Júgni itself these cliffs are at least 200 feet high.*

The whole valley is extremely malarious, close, and shut in from air, and we all suffered a few days after from passing up it; not a man with me or self escaped fever, the season was advancing, rain had begun to fall (March 1867), which may account in a measure for the suddenness of the attack. A short distance above the last deep pool, the river is seen gushing out, with a considerable body of water, from a small cavern in the limestone rocks. The valley still continues over these dipping at about 20° to 25° S. S. W., their strike being in the general direction of the valley. At about two miles further up the limestone comes to an end, and the lower sandstones become visible; they dip at 30 degrees. Pieces of coal had been common for some distance below, and here it was seen *in situ*, with an increasing

* They present excellent sections of the sandstone rocks: these gradually lower in dip, becoming very low and rise again towards the junction with the Sen river. There is nothing remarkable in their appearance, being thick-bedded, sometimes very soft light coloured and micaceous; their dip is always a southerly one.

dip in the coarse sandstones. About 400 yards on was another bed, of greater thickness and better quality, the remnants of which we had seen scattered all the way down the stream bed ; it passed quite across it, from bank to bank. For a better idea of this most interesting section see that marked C ; it will be there seen, that the coal is brought to the surface by the anticlinal in the whole set of these beds, which extend to the nummulitic limestone, being evidently much disturbed here, and seen to change suddenly from a dip of 60 degrees N. E. to perfect horizontality, and continuing thus with the slightest dip, about equal to the fall of the valley, all the way up to Nongumlai. This line of dislocation, it will be seen from a glance at the map, is curiously situated, in a direct line, with another evident great bending of the same strata in the Rugsir, where the limestone crosses that stream, and would extend to Bagoli, where the limestone is again seen bending over with an increased dip of 25 degrees to the south. Continued to the N. W. as a due straight line, it passes through a culminating point of the Garo hills, Wanrai Prak, which seen from a distance is doubtless of the newer stratified rocks, having there attained considerable elevation.

Not far above the last mentioned section the Sú Hileng tributary comes down to the N. West; and from under the eastern scarp of Pundengroo, much coal is washed down; but I had no opportunity of visiting the site.* To the north of Tigasin hill-station the coal is seen, with a dip north of about 8 degrees and a thickness of some 8 to 10 feet, in the infra nummulitic beds; this northerly dip brings in the limestone at the bottom of the valley, whence the beds rise again with a S. S. West incline, and a very low angle. At a distance of some six miles, the path descends into the Asbik river, close to which, the same coal is met with again, here almost in a horizontal position. It is again seen on the ascent of the left bank, but a good deal of it is covered up with debris. On descending to the Wy-yow river on the other side of the ridge, gneiss comes in, and I did not again observe any stratified rocks all the way to Nongtien Shiling, and thence *viâ* Nongkushba, until Landekar is again reached. The Um Blay at this part of its course, flowed through the mass of metamorphic rocks.

* Native information indicates that the coal here is in large quantity ; even should this be found the case, it is too far into hills to be worked profitably.

From the preceding notes and sections, it will be observed, that on this longitude we have no infra-nummulitic coal as at Cherra, that the seams here occur always below the last named formation, at a very regular depth below it, and that unlike the coal of Cherra, it is very persistent over a large area, and often to be found in a series of deposits one above the other. It is to be traced along the high long line of bluff that bounds the Um Blay on the south, in its south-east course to its debouchement near Puna Tith bazar. If this coal ever be utilized, it must be somewhere in this neighbourhood, or between longitude 91° 10′ and 91° 20′, and south of latitude 25° 26′. This small area would well deserve a close inspection, and the results would be extremely interesting, if continued to the east, the rocks be followed out into the Cherra sections. Until this be done, it would be premature to theorise, or draw comparisons, between different beds, one of which, the limestone, is identical, while the beds both immediately below and above differ very much. I have already stated my opinion that for a long distance, west of Chaudadinga, and the Rongsiang rivers, but little coal can be expected to be found, from the presence of tertiary sandstones on that side.

This paper has now reached a size I little contemplated, yet with its errors, with which no doubt it may abound, in bringing it to a close, I trust it may prove useful to those, who may at some future date visit, and plot out the same sections.

Camp, Cherra Poonjee, October, 1867.

On the anatomy of Sagartia Schilleriana *and* Membranipora Bengalensis, *a new Coral and a Bryozoon living in brackish water at Port Canning;—by* Ferd. Stoliczka, *Esq. Ph. D., F. G. S. Palæontologist of the Geol. Survey of India.*

[Received 3rd June, 1868.]

Special interest is always attached to the study of any organic forms, found living under unusual and sometimes anomalous conditions, inasmuch as these forms very often represent peculiar types of organisation, adapted to the peculiar circumstances under which they live.

In a theoretical point of view, there exist, we may say, in *each specific* organism a number of forces which, by their harmonious action, produce a certain stable equilibrium between the organisation of the animal, and the influences of the medium in which it lives. Should it now happen that the animal is, either voluntarily or accidentally, placed, under conditions *different* from those under which it formerly existed, and further, should the influence of these external agencies be so great as to overthrow, or be not sufficient to maintain this equilibrium, it devolves upon the organism to restore this balance, or to be dissolved into various other forces. The latter case need not occupy here our attention any further; but as to the former, we may observe in general that the amount of the changes in the organism, necessitated for the purpose of restoring the disturbed or unstable equilibrium, may in various cases be very different.

In some cases an alteration in the colour or in the viscosity of the animal may suffice; in others it requires a change in the digestive or the nervous system, and again in others it becomes necessary to change the existing, or to produce new and additional organs of locomotion, &c. Thus are clearly by *natural selection* produced new forms or types of organisms, designated by naturalist *varieties*, *species*, *genera*, &c.

Looking at the same time upon the numerously varied organisation of beings in general, it will readily be understood that the less different the organs of a species may be,—that is in other words, the lower its place is in the natural system,—in the same degree would probably decrease the necessit for a change in the organs. In any case, this change would not be so easily perceptible, as when the organs are numerous, various and more highly developed. Expressing, therefore, this idea in a more general way, we imply that, within certain limits,* forms of lower organisation possess a greater faculty of accommodating themselves to different conditions of life, than more highly organized beings.

In the present communication I shall record a very interesting case of the persistency of a form under different conditions, relating to a coralline species, a so-called sea-anemone, and to another species belonging to the Bryozoa, or the lowest organized Molluscs. With respect to the anatomy and physiology of these two species, I shall state all the data which I have obtained, for though some of them are not directly new discoveries, still detailed records of these animals are so rare, that I must treat the subject somewhat at length, in order to be intelligible; and this, I think, is very necessary as naturalists have become in late years rather sceptical regarding new species, only characterised by few high sounding,—occasionally unintelligible,—terms. Besides this, it would be impossible for me to give additional observations, without bringing them into a systematic connection with those which are already known on this subject.

Phylum, Cœlenterata.†

(Cnidozoa or Actinozoa.)

The name *Cnidozoa* is derived from the word *αἱ κνίδαι*, used by Aristotles for the designation of this group of animals; the same word is now retained for the name of special, defensive cells which characterize these animals, as will -be shown subsequently. For the extent of the various divisions of the Cœlenterata, Leukart and Kölliker's works have to be consulted.

* It is very often stated that the more highly organized forms possess a greater faculty of accommodation; this is, however, I think, a mistaken idea, originating partly in the comparison of the same external influences upon organisms of different kind and degree, partly in the difficulty of noticing any changes in the lower organisms. The comparison must always be a truly relative one; for in differently organized forms, there is a different amount of forces present to counteract the influence of external agencies.

† The first few principal divisions are noticed according to Hæckel's *Generale Morphologie*, 1866, vol. II. p. L.

Sub-phylum, PETRACALEPHÆ.*

(Polypi).

Class, ANTHOZOA.

(Zoophyta.†)

Body fleshy, attached with one end; on the other provided with a mouth usually surrounded by hollow and perforated tentacles; internal cavity divided by septa.

Sub-class, HEXACORALLIA.

The original number of septa and tentacles are *six*.

Order, HALIRHODA.‡

(Zoantheria malacodermata, sea-roses, sea-flowers, or sea-anemones.)

Body soft, septa not forming an external hard skeleton, into which the animal can retract.

Sub-order, ACTINIACEA.

Body very rarely containing loose, scleroid particles; base adherent at pleasure, not adapted to form a swimming sac; internal cavity instructed with very long, not emissible thread-like organs *(craspeda)*,§ containing the so called nettle-cells, or *cnidæ*.

Family, SAGARTIIDÆ.||

Body pierced with loop-holes *(cinclides)* for the purpose of emitting long, retractile threads *(acontia)* containing *cnidæ*, being the defensive organs of the animal.

This family may be separated into two divisions, the *Sagartiinæ* and the *Bunodinæ*, the latter of which have the column instructed with tubercles.

* From being usually adherent to *rocks*, the other sub-phylum is called *Nectacalephæ*, including the swimming or oceanic forms.

† This name is inconsistent with the usual nomenclature, and could only be used by reversing it into *Phytozoa*, but to this the name *Anthozoa* is preferable.

‡ This name only can imply that the animals live in water, which contains a proportion of salt, &c. it must not be understood as pure sea-water, for there are numerous brackish species belonging to this order.

§ To avoid numerous repetitions, I must direct any one, not acquainted with the terminology of the anotomy of corals, and especially of that of the HALIRHODA, to the subsequent detailed description of the various organs. Most of the terms will be found fully explained in Gosse's admirable History of British Sea-anemones. London, 1866.

|| The true *Actiniidæ*, and several other allied families, do not possess emissible threads, or *acontia*, and are therefore destitute of loop-holes, or *cinclides*.

Sub-family, Sagartiinæ.

(Sagartiadæ, Gosse.)

The body is, according to Gosse, generally remarkably soft, more or less pulpy, lubricated on the surface with copious mucus, exteriorly mostly studded with *sucking cavities*, which, by forming a vacuum have the power of adhering to foreign bodies, but the margins of these cavities *do not rise into conspicuous warts;* the base is usually broad, the column moderately high, furrowed longitudinally; the tentacles are smooth, simple, generally arranged in uninterrupted circles at the margin of the disk; the *cnidæ* of the tissue are usually of the stilet kind, being long cells, with a short in itself retractile flagellum, called by Gosse the *ecthoræum.*

Gosse distinguishes the following divisions, from the relation of which the generic classification of our species will become apparent.

A; Tentacles moderately long, slender,
  a; disk perfectly retractile,
    α; column soft, destitute of suckers ... *Actinoloba,*
    β; „ „ with suckers .... *Sagartia,*
    γ; „ partly provided with a rough epidermis .... *Phellia*
  b; disk imperfectly retractile, . *Adamsia et Gregoria*
B; Tentacles represented by mere warts .. *Discosoma.*

Genus, Sagartia, Gosse, 1855.

All the species of *Sagartia* are characterized by a thick, fleshy, contractile body, adherent by a *base* which is under ordinary circumstances *wider than the height of the column;* the surface is studded with numerous small suckers, not forming permanent warts, and with many comparatively large *cinclides;* the peripherical margin of the disk is distinct, *but not separately thickened;* the tentacles are simple, placed near the outer periphery of the disk; they are generally very numerous, but variable in length and arrangement; the mouth is somewhat elevated, provided with two *gonidial* grooves, each having a pair of tubercles on either side; the *acontia are numerous, and are emitted freely.*

The *presence of solid scleroid particles* of two kinds, as they will be described in the present species, may likely be added to the generic characters of this genus, but this has to be proved by the examination of other species.

Species. Sagartia Schilleriana, *Stoliczka*, 1868.
Plates X and XI.

Char. *Sagartia corpore pulposo, transparente, virescente pallido, basi lata, sæpissime rotundata adherente; columna cylindracea, in altitudine diamatro basis fere æquante, longitudinaliter angustatim sulcata, transversaliter minutissime corrugata; septis ad peripheriam plerumque* 48, *distinctis, æqidistantibus, alternatim virescentibus; tentaculis numerosis, prope peripheriam disci sitis, exterioribus brevissimis, interioribus gradatim longioribus, omninis ad basin inflatis, versus apicem attenuatis, terminationibus subtruncatis et perforatis instructis; tentaculis seriem primam formantibus senis ceteris conspicue crassioribus, ad basin sæpissime rubescentibus, ad terminationes albidis; apertura transversaliter ovata, angusta; labio plus minusve prominente, ad marginem undulato, sub-reflexo, tuberculis duodenis instructo; lentiginibus bipartitis, ad utrumque angulum gonidialem sitis, tuberculis ceteris minoribus; canalibus gonidialibus parvis, orificiis rotundatis, vix prominulis, albide marginatis notatis; radiis gonidialibus vix dignoscendis; gula sulcis virescentibus furcata.*

Ovariis duodenis, bipartitis, folliculis in utroque latere septorum sitis, cæruleo-purpurescentibus; craspedis numerosis, sordide luteolis, interne suprâ ovaria suspensis; acontiis albis, perlongis; cinclidibus subrotundatis, numerosis, paululum impressis, in tegumine irregulariter dispersis, nonnullis prope marginem superiorem columnæ positis latissimis, semper apertis, ceteris minoribus aliquantisper obscuris; cnidis ovato-elongatis, stiliformibus, ecthoræis brevibus prope rectis instructis; septis mesenterialibus intus ad basin solidulis, albis; tegumine corporibus minutis tabulatis siliceis, ac alteris subcylindraceis et varie dentatis calcareis instructis.*

* Gosse in his above quoted Treatise on the British Sea-Anemones distinguishes four kinds of *cnidæ*, all of which have rather long, spirally coiled *ecthoræa*, except one globular kind, in which no ecthoræum was observable. The *cnidæ* of the present species of *Sagartia* are mostly, short, straight, or very rarely slightly bent. I shall term this kind of *cnidæ* which were also observed formerly by Blainville, Leukart, and others, *stiliform*. Gosse says that the chambered form is the usual one in the *Actiniidæ*, though the present variation seems quite as common.

The principal and characteristic distinctions of this species are, the very great softness and transparency of the body, having a very slight greenish tinge, mingled with somewhat of a pale fleshy colour, a distinct layer of a dark green pigment being deposited near the external surface, below the outer muscular layer of each alternate septum, and thus producing greenish, longitudinal bands of about equal width; further, the prominent lips of the aperture, the great thickness of the primary tentacles, the blueish purple colouring of the ovaria, the yellowish craspeda, the purely white acontia, and their great length.

I shall at first speak of the various normal *forms* of this species, than of the *anatomy of the different organs* and of their signification, and last of the *physiology, the habits and modes of life.*

a. *Form.*

The general form of the body of *Sag. Schilleriana* is common to that of other truly marine species of the same genus, the column being, however, when the animal is expanded in a normal condition, a little shorter than the diameter of the basis (see pl. X. fig. 1). In consequence of the softness of the fleshy substance, the base, (which is comparatively more solid than any other part), always adapts itself entirely to the object on which the animal is sessile. On a smooth surface, the circumference of the base is almost circular, only on account of the projecting septa slightly undulating at the margin; on a rough surface all cavities* are filled up with the fleshy mass, securing at the same time the attachment of the body, but also altering the original roundish form into an oval or irregularly polygonal one. The septa are distinctly traceable by the alternate greenish bands.

There are three principal forms to be observed, which may be called the *normal* ones, being successively adopted by every animal in a healthy condition. The first is the expanded form (pl. X. fig. 1) from which these animals derived their name of *sea-flowers.* The frequent bright colouring of the disc, as a rule, increases their resemblance to

* I have seen portions of the body filling such cavities of about half an inch in depth, and one-fifth of an inch broad. When the animal was carefully detached, it lasted for several days, till all the protuberances disappeared, but they were at last assimilated to the regular form of the body.

an open flower of one of the *Compositæ.* The tentacles reach far beyond the diameter of the column, of which only the lower portion is visible; the body is perfectly transparent, allowing all the internal organs to be traced without difficulty, the lips of the mouth are slightly prominent; the water is seen moving up and down in the hollow tentacles, which play about actively in all directions, being strongly inflated at their roots, and gradually becoming thinner towards their tips.

None of the *Actinozoa* possess special organs of sensation, though they are highly sensitive to the touch of any solid body, and even to the influence of radiating heat, or to the light. The fact is that their entire body, when soft, and not covered by a thickened epidermis, is almost throughout equally sensitive and, therefore, makes special organs of sensation superfluous. Still, I should think, there must be an intimate connection of some kind of nervous system through the entire organism, inasmuch as the slightest touch of the tip of a tentacle is sometimes momentarily communicated to the whole body, its effect being exhibited by a change of the whole form of the body.

Thus a slight unusual movement of the surrounding water, or the coming into contact with a solid object, causes the *Sagartia*, when expanded partially, to contract, by which a quantity of the water contained, is always ejected through the existing openings, *(cinclides)*. In this position, (pl. X. fig. 3) the animal forms a short column, with the upper margin [of which I shall speak as the *collar*] somewhat thickened, the aperture hidden, and the tentacles protruding about one-forth of their length; the transparency of the body slightly diminishes; a few *acontia* are usually seen to rise from the central portion of the base, being then forcibly ejected through the *cinclides*, at or near the *collar*. Sometimes the tentacles are laid down, very slightly protruding, forming a sort of a broad cone; and then viewed from above, they are seen arranged most regularly: those, belonging to the different circles, being easily traceable from their thickness, (see pl. X. fig. 2). Any further disturbance generally induces the *Sagartia* entirely to contract, its form resembling in this position a short, depressed conical heap, (see pl. X. fig 4), leaving only a small opening in the upper centre, from which usually the white tips of the primary tentacles slightly project. In consequence of the contraction of the outer muscular layer,-chiefly consisting of concentric fibres, - the transverse plication becomes somewhat more distinct than it was before, and the immediate neighbourhood of the suckers slightly rises to short, transverse prominences. The greater contraction of the pigment layer also makes the greenish bands of the septa more distinct, though the entire body possesses a slight tinge of the same colour. The *cinclides*, especially those placed near or on the collar, become rather widely open, and others are distinctly traceable; the *acontia* are numerously ejected on different places of the body, and the general transparency has again diminished as compared with the former position.

Besides these three, so called normal, positions* of a *Sagartia*, there are others which the animal assumes under certain abnormal conditions, generally resulting from ill health, and being produced, either by excessive heat or light, or by a change in the saline constituents of the water, &c. Some of the principal forms, as observed on one and the same specimen, are represented in figures 6 to 9, on plate X; but I will defer the remarks upon these, until I come to speak of the physiology and the habits of the animal.

b. *Anatomical Structure.*

In order more easily to understand the general anatomical structure of the animal, I must direct the reader to the vertical section, as represented in figure 3 on plate XI. This section is taken only in half of the diametral length, being sufficient for our purposes, and the different letters, noted in this figure, have the following significations :— a, base; b, column; c, collar; d, disc; e, tentacles; g, throat; h, larynx; i, stomach, or internal cavity; k, *craspeda*; l, *acontia*; m, ovaria, or the reproductive organs; n, *cinclides*, or pores in the integument for the purpose of emitting the *acontia*. I shall now briefly describe these parts as much as possible in the same order, in which I have just mentioned them.

The entire body of the *Sagartia* is surrounded by an external, mucous layer, which chiefly consists of numerous, oval *cnidæ*, and sparingly dispersed green pigment cells.

a. The base is, as already stated, a more or less round disk; on which the septa are distinctly traceable (pl. X. fig. 5), being of con-

* Being observable in most other HALIRHODA.

siderable thickness, according to the different series to which they belong. The twelve ovarian strings, or reproductive organs, can be seen through the transparent skin; and equally easily traceable are the six bundles of the craspeda, in position nearer to the centre of the axial cavity than are the former.

b. The column represents the peripherical portions of the mesenterial folds, grown together, and it will, therefore, be sufficient to give a detailed statement of the structure of one of the septa. The original number of these, as represented in the view of the basis (pl. X. fig. 5), is six, radiating from the centre. The second cicle is again six, the third, fourth, and fifth are each twelve, one septum first appearing next adjoining the primary septa, then one next to the secondary ones, than again one between the two last ones. This is a common law in all HEXACORALLIA, and I only notice it here, because I will subsequently draw the attention to the difference, apparently existing between the increase of the septa and that of the tentacles. The septa of the first, and usually also of the second, cicle are distinctly traceable almost up to the centre, those of the 3rd and 4th nearly so, both being about equal in strength, but those of the 5th are considerably shorter. I have not observed in any of the numerous specimens which I have examined, a larger number of cicles than five, or 48 septa altogether; small specimens often had only three or four cicles developed. The various cicles are shematically represented in figure 2 of plate XI.

Each septum is composed of five distinct layers, as represented in the enlarged section, plate XI, figure 3-α β, γ, δ, ϵ. The outermost α is, as formerly noticed, almost only a mucous fluid, composed of a loose cellular substance, and a very large number of elongated nettle cells, or *cnidæ*, and a few dispersed cells of greenish pigment. The *cnidæ* of this mucous layer are, compared with others, the shortest, being ovately elongated, slightly curved or kidney-shaped, having, as a rule, an ecthoræum, shorter than their own length; they also appear to be nearly smooth.—Figure 4 of plate XI represents the appearance of the mucous layer under the microscope, and 4*a* three-isolated *cnidæ* still more enlarged.—The next layer (β) is strongly muscular, chiefly consisting of concentric or cross fibres, forming at intervals slightly elevated ridges which contain the so-called suckers; these becoming more distinctly apparent in the contracted position of the animal, (see fig. 4, pl. X). These suckers, however, are not essentially characteristic, and appear to vary greatly with the age. Along the dorsal edges of the septa, there seem to be also some longitudinal fibres present. This second layer is the same which, in several ACTINIACEA, becomes *coriaceous*, taking a principal part in the formation of the *exotheca* of other corals. The third layer (γ) only consists of thick, transverse fibres, containing large, dark green pigment cells. Below this follows a tough muscular tissue (δ) consisting of thin longitudinal and much stronger concentric fibres, gradually passing into a regular cartilagenous skeleton (ϵ), composed of an intercellular substance, and a large number of various scleroid particles; the figures 5, 5*a*, 5*b* and 5*c*, on plate XI will illustrate this. Figure 5 represents a small portion of the fourth layer, the three upper ones having previously been removed by maceration. The muscular fibres are especially strong on a portion of the septum; the cinclides are spacious. Fig. 5a represents the reverse or internal side of the same portion of the integument, and shews on the surface an irregular distribution of the scleroids.

The two last layers (δ and ϵ) chiefly compose the mesenterial septa, extending above to the mouth and at the base up to the centre, but being on the internal edge along the central axial cavity deeply insinuated. The hardest portions of the septa are those round the larynx and at the base, evidently on the two places where the strongest muscular actions are required. In figure 3, pl. XI the most cartilaginous portions are indicated by cross lines.

It is usually stated that the HALIRHODA, and especially the ACTINIACEA have neither an internal, nor an external solid skeleton, and this notion gave rise to the name *Hexacorallia malacodermata.* There can be, however, no doubt that in the present case the two internal layers, as represented on plate XI, figures 3 and 5, correspond to those which - in the ASTRÆACEA for instance - secrete the enthotheca. The scleroid particles are of two kinds; some of them are long, with slight lateral appendages, and others simple, sharply angular flat bodies, as shewn in figures 5b and 5c on plate XI. These scleroid particles are only visible when enlarged to about 500 diameters; and some of them are still extremely minute. In the fourth muscular layer, which chiefly consists of cross fibres, there are at distances small round holes to be observed, which evidently lead to the cinclides of the outer integument; these holes are often rather indistinctly traceable in the scleroid parenchym.

My observation as to the presence of solid scleroid particles in the internal tissue of the *Sagartia* has, in the first instance, been made in consequence of a simple process of maceration in water, and weak acid. It became, however, important to test further the true nature of these different scleroids. I consequently exposed a specimen, placed in a platina crucible, to a heat sufficient to remove every trace of organic matter, and was satisfied to find in it the residue of a perfect, solid skeleton of the *Sagartia*, on which were seen externally the holes for the cinclides, and, in being broken up, internally the septa. The external portions appeared more fibrous, the internal more broadly cellular or reticular. The character of the substance perfectly resembled the spongy and irregularly cellular structure of the corallum of other reef-forming *Anthozoa* (see fig. 6, plate XI). A portion of this skeleton was then placed in hydrochloric acid; this operation shewing that the solid skeleton mostly consisted of carbonate of lime, which is present in the form of the long scleroids (pl. XI. fig. 5*b*); the flat angular particles, being of silica, remained unaltered (fig. 5*c*.). The latter formed a dark, very thin, irregular network, though most of them were loose, and apparently irregularly distributed among the calcareous scleroids. Besides the two kinds of scleroids, I observed a large number of extremely fine, often branching threads; but whether these belong to the tissue of the coral, or to some species of *sponges*, I was unable to ascertain. The proportion of siliceous scleroids to those consisting of lime is not probably more than one to twenty.

This direct proof of the secretion of solid scleroid particles in the internal tissue of the *Sagartia* is very important, inasmuch as it will in time, when more observations of this kind have been made, necessitate a change in the characteristics of the so-called *Anthozoa malacodermata*. It would be premature and unjustifiable to state that all the *Sagartiidæ*, or other Actiniacea, possess an internal skeleton, as no other observations have been yet made on this point. It is, however, to be hoped that the present statement will induce stricter and more accurate inquiry, especially as Mil. Edward, Blainville, and others, many years ago directed attention to the existence of those solid bodies in the internal tissue of some of the species of *Zoanthus*, *Actineria*, and others. In spite of the solid skeleton which I have described, I must, however, remark that the softness of the body is unusually great in the present species, and nobody in observing the pulpy appearance of the same would suspect solid scleroids in it.

c. The *collar*, or the upper margin of the column, is generally slightly marked, though always indicated by a slight contraction below the upper edge. In the abnormal positions of the species, it becomes occasionally much more prominent, (see figs. 6, 7, 8, and 9 in pl. X); the muscular tissue is also much stronger on it, than on the other parts of the column, and sometimes nearly hardend. The cinclides on the collar are generally the largest, often forming a continuous series at its outer edge, while other loop-holes are irregularly dispersed over the entire column.

d. The *disc*, forming the upper part of the body, is very soft and transparent; it is only marked by radiating furrows which, strictly speaking, are in the present case an essential part of the tentacles. It probably consists like these only of four layers, the innermost, containing the scleroids, being wanting, or at least so much reduced, as to be hardly traceable.

e. The *tentacles* partially originate, according to the above statement, at the mouth, becoming isolated some distance from it; towards the periphery they are separated from the collar by a broad groove.

In the expanded animal, they are roundish, or slightly compressed from front to back, strongly inflated in the middle and at their roots, becoming after the first half length rapidly thinner. Their tips are slightly swollen or obtuse, and perforated. Externally the surface of the tentacles is smooth; but under the glass fine whitish spots, indicating the presence of *cnidæ*, may be observed (pl. X. fig. 1*a*). In the primary tentacles of older specimens the whitish specks are visible to the naked eye (see pl. X, fig. 1*b*). The anatomical structure (see pl. X, fig. 1*d*) of each of the tentacles is similar to that of the septa, except that they appear to want the scleroid layer. They are enveloped in a soft and usually very thick, mucous outer layer, being a little more consistent only at their bases. The *cnidæ* of the outer layer are of the same shape as those of the column, but slightly longer; the ecthoræum being about the same length as the cell, or a little shorter and distinctly turned inside; the largest *cnidæ* are not more than $\frac{1}{800}$th of an inch in length (pl. XI, fig. 7).

Below the mucous layer, there is a thin muscular, then a pigment, and below this again a muscular layer (pl. X, fig 1*d*). When the tentacles shrink in a sickly or a dead specimen, they have the appearance of thin, undulating threads, with a dark green centre, surrounded by a transparent viscous layer; the former representing the three inner, the latter the mucous layer, with a large number of *cnidæ*, (pl. XI, fig. 1*a*).

In a full grown specimen there can usually be counted about 160 tentacles, sometimes more; but I have not been able to trace in a perpendicular section more than five series of them. To illustrate the difference in the increase of the septa, and in that of the tentacles, as I presume it to be the case, I must direct attention to pl. XI, fig. 2, in which, on the right half, the disposition of the former, on the left that of the latter is shewn. The six primary septa meet, as I have formerly stated, in the centre of the base, but are not traceable on the disc. The six primary tentacles are seen to originate from each two tubercles of the lip, they are distinguished from others by their great thickness, though in length usually exceeded by the secondary ones. In the healthy animal they often are of a light fleshy colour, especially at their bases, and snow-white towards the tips; they are carried in a simple outward curve, generally with their tips, leisurely moving about between the other tentacles, which are more actively employed, as already stated. Observed with a moderately magnifying glass, the greenish and reddish pigment cells can easily be traced out. The white tint of the tips is, I believe, only due to a very large accumulation of *cnidæ*, which appear to be arranged in spiral rows, and become very distinct, when their inter-cellular substance is removed by its more rapid decomposition. On pl. X, fig. 1*c*, a representation is given of the tip of a primary tentacle, largely magnified. The *cnidæ* of this portion of the tentacles differ little in form from others of the integument, except in their larger size, having at the same time a proportionately thicker ecthoræum. Their fluid contents is homogeneous, perfectly transparent, and the cell-membrane is rather more tough, than in other *cnidæ*.

In very young specimens, the white tips at first appear on the three alternate primaries, subsequently and gradually on all six. In very old specimens, the tips of the next, and even partially of the third series, become white. Wherever there is a large accumulation of *cnidæ* on the column, or where the *cnidæ* are of a larger size, the white specks in the integument are readily recognised, even with the naked eye.

To return to our former statement regarding the position of the tentacles; the next, or second series of them, consists of twelve,* being distinctly traceable by a bipartition of the primary tentacles, with which they are connected on one side, while on the other, they extend to the lip. Thus, in position, the secondary tentacles originate more peripherically, and in pairs alternate with the primary ones; they often are the longest of all, being in large specimens about 1¾—2 inches in length, and most of them indicate by their whitish tips the presence of numerous *cnidæ*. This statement, relative to the position of the two first series of tentacles, is in the present species, based upon direct observation, but it was impossible to do the same with the other series; though in the next at least, or the third cicle, a more or less regular bi-division partially appeared observable. Sometimes I could notice three tentacles of a next series springing up from one of the former series; but this certainly is not the rule. Moreover, judging from the total number of the tentacles, which appears to be rather constant in specimens of equal size, and allowing for accidental irregularities, we cannot be far from the truth, when we also accept a regular bipartition for the third and fourth series, as partially represented in fig. 2 of pl. XI. By this bi-division we obtain very closely the total number observed in live specimens, being about 160. In the specimen figured on pl. X, the tentacles of the first series had a length of 1¼ inches, those of the second 1¾, of the third 1¼, of the fourth ¾, and of the fifth ½ of an inch.

f. The *mouth* is a transversally oval, or more or less linear opening, surrounded by prominent lips, which consist of twelve, elongated, inflated tubercles, between each pair of which originates one primary tentacle. On the two opposite ends of the longitudinal axis, terminate the *gonidial canals* with small roundish openings, (see *c*

* The second series of the septa is only six, like the first; thus tentacles and septa do not, as already stated, take equal steps in their development.

in fig. 2, pl. XI). The functions of these internal canals have not as yet been traced out; I even failed to observe their extensions into the internal space. *Gosse*, and others, suppose that the eggs and spermatozoa are ejected through them, though I usually observed these conveyed through the mouth. The tubercles placed on either side of the gonidial canals, have been called *lentigines*, they are smaller than the others, and bipartite, (see *l* in fig. 2 of pl. XI). There also often extends a groove from the gonidial canal towards the periphery, which has been termed *gonidial radius*, but this is hardly traceable in our species. The greenish or pale fleshy colours are occasionally very distinct on the lips, and the internal muscular tissue of the latter is stronger, than that of the disk and of the tentacles.

g. The *throat* is the immediate continuation of the lips into the interior; it is longitudinally sulcated, the furrows being marked by greenish lines, produced by the contraction of the pigment layer. The length of the throat from the lip to the *larynx*, is about half an inch; towards the base it is slightly enlarged, and then forms a strong projection (the *larynx*) into the inner space.

h. All along the throat the inner muscular layer, with the scleroids, is rather consistent, and especially so at the *larynx*, where it is very tough and nearly cartilaginous, often more so than at the bases of the septa themselves. This muscular strength of the lips, of the throat, and especially of the larynx, is of course indispensable for the existence of the animal, being not only required for the seizure of the prey, intended for food in the stomach, but also for its retention.

i. The *stomach*, the internal axial cavity, is produced by an insinuation of the inner margins of the septa, these projecting to a greater or lesser extent into its space. The stomach extends from the larynx, which guards its entrance, to the base of the column. When the animal is expanded, the height of the stomach measures about $\frac{2}{3}$ of the total height of the column. *Gosse* states that in some species, he observed internally on the septa thin, coloured layers, and is inclined to explain them as a sort of a substitute for the liver. Nothing of these layers was observable in any of the specimens of the present species examined. The stomachial cavity is the receptaculum of the food, and contains besides several other organs which are placed peripherically.

k. On the internal side of the larynx, and next to the entrance of the stomach, are suspended the mesenterial-threads, or *craspeda*. These are, in the present species, flat bands of one, or one and a half inch in length, being of a pale greyish yellow colour, and with the lateral margins partially rolled in, so as to have the appearance of nearly cylindrical tubes. They hang down loosely, and the greater portion of them lies in small heaps round the centre of the base. Their more central position as regards the reproductive organs, is clearly visible in the view of the base, (pl. X, fig. 5). There are always numerous threads together, but they cannot be easily distinguished through the integument of the base.

In figure 1, pl. XI, is given a representation of a specimen, which had itself turned inside out. In the centre the thickness of the primary *mesenterial* septa is clearly traceable, then the pairs of the ovaria, partly attached to the septa, and beyond those towards the periphery, the very numerous *craspeda*, and then follow the *tentacles*, with their shrunken tips ;—two of the threads extending beyond the periphery representing the *acontia*. The *craspeda* are seen constantly winding up and down, like worms, contracting and expanding, and thus shewing great vitality, but I have not observed in them any rapid motions; they are never ejected through the cinclides. Examined under the microscope (see figs. 8 and 8a, pl. XI) their *cnidæ* are seen to be arranged in two marginal rows, lying with their longer diameter perpendicularly to the length of the craspedum, and leaving in the middle a sort of a canal or a string, which is filled with a cellular substance and a very large number of pigment cells; no larger *cnidæ* being visible in the centre. The cellular substance probably assists in effecting the muscular motions. The *cnidæ* are distinguished by a considerable length, (the longest about $\frac{1}{500}$th of an inch), being rather straight, generally attenuated at one end, and usually shewing in a slight curve an indistinct central line, indicating a moderately long but very thin ecthoræum; this latter is rarely seen ejected, but if it is it appears to be about one-third longer than the nettle-cell itself. The thinner ends of the *cnidæ* slightly project on the lateral marginal surface of the craspedal bands, giving them a very fine ciliated appearance. Numerous pigment cells and others are also observable between the marginal *cnidæ*.

The true nature of the craspeda in the physiological economy of the animal is not known, and various suggestions have been made as to their signification. It appears to me that most probably they represent some organs of secretion. It is, however, likely that they also serve other purposes at the same time. I shall subsequently relate a case which tends to prove that they are especially active when the *Sagartia* takes some food into its stomach, thus, by their natural central position, they not only guard the reproductive organs against any injury from hard particles which are received as food into the internal cavity, but they most probably also facilitate the maceration and digestion of the food. The ready nutriment, or chilus, must be absorbed by the entire inner surface of the body, for no special organs are observable for its distribution.

1. Next in importance, for the existence of the animal, appear to be the *acontia*, which are also flat bands consisting of *cnidæ;* these being likewise arranged transversally in two rows on either side, leaving a narrow space in the centre which is, however, in the present case occupied by large transparent cells, a very small quantity of a fine granular substance, and by *cnidæ* of different size (see figs. 9, 9a, 9b, pl. XI). The marginal *cnidæ* are projecting at the edges about one-fourth or one-fifth of their length, and not unusually have their *ecthoræa* ejected. The *cnidæ* of the *acontia* are distinguished by their great length (some of them being above $\frac{1}{400}$th of an inch); they are either straight, or more often slightly curved, and almost equally attenuated on both ends. The *ecthoræa*, when ejected, often exceed the *cnidæ* by one half of their length, and are sometimes doubly as long; their thickness is about $\frac{1}{15}$th of that of the *cnidæ*, being hollow and provided nearly to the tip with short, reversed cilia (fig. 9a, pl. XI). It is not improbable that the *ecthoræa* of all the other kind of *cnidæ* are also bearded, but I have not been able to observe their minute cilia. The cellular substance in the centre of the acontia is transparent, but the large number of the marginal *cnidæ* produces a milky white colour, which strongly contrasts with the purple colour of the *ovaria* and the yellowish *craspeda*, and thus makes the *acontia* readily discernible.

The *acontia* are in constant motion, expanding and contracting, and winding up and down in different directions; their movements being much quicker, than those of the *craspeda*. Their length generally amounts to three or four inches, probably sometimes more. I have seen them ejected on every part of the column, even at the base, when the animal is forcibly removed from its place of attachment, in which case the large number of the *acontia* forms a regular net work round the animal. It is, I believe, principally due to the bearded ecthoræa of the *cnidæ*, that the acontia stick firmly to every thing which they meet, until the hooks are forcibly removed, or until the organs themselves relax. For small animals the acontia are, therefore, formidable weapons, and there can be little doubt that the fluid of the *cnidæ* acts as a kind of poison, in the same way as it does in the *Acalephæ*.

The different modes of emitting the acontia from the body will be mentioned subsequently, but I must make here some observations regarding their internal attachment, although it is very difficult to pronounce a conclusive opinion on this point. I have dissected several specimens for the sole purpose of obtaining a clear idea as to the places where the acontia originate,* and it always appeared to me that some of them are attached at the larynx, between the ovaria and the craspeda, but at the same time there seem to be some of them fixed below, near the centre of the base, between the muscular thickenings of the mesenterial folds. I am not aware whether any thing about the attachment of the *acontia* has been previously observed, and it is possible that the basal attachment is only auxiliary to the one at the larynx, so as to support the muscular power required for their emission.

m. Each *ovarium* consists of two parts, one placed on either side of the primary septa. The *ovaria* are long undulating strings, which are firmly attached with one end on the internal side of the larynx, then partially all along the internal cavity between the mesenterial folds, and loosely by some threads to the base. The halves of each pair are perfectly symmetrical, they run in a slight curve, generally parallel to the convexity of the column. The colour is a bluish purple, slightly varying in tint in different specimens.

* This operation is indeed not so simple, as it would appear, judging from the transparency of the animal. As soon as a portion of the *Sagartia* is cut off, it immediately contracts to such a degree that it is almost impossible to observe separately any of the internal parts.

Blainville was one of the first who pointed out different sexes in the *Actiniacca*, and since then, it has been repeatedly stated, that some of the species are hermaphrodites, while others appear to be sexually distinct. I have examined a large number of specimens of the present species, and always found the ovarian strings consisting of *ova* only, being connected by thin threads, attached to a conspicuous median string, and enveloped in a pale purplish coloured mucous substance, (see pl. XI. figs. 10, 10a, 10b). The eggs usually were of various sizes, some of them small, evidently in a young stage, others much larger, those of largest size measuring about $\frac{1}{48}$ of an inch in diameter, so as to be distinctly visible even without a glass, (see fig. 10a, pl. XI). The apparantly ripe eggs were perfectly globular, each attached to the ovarium by a thin string, it possessed a markedly thickened epidermis, surrounding a finely granular dark substance, and having a large, usually eccentric transparent spot, with a minute opaque centre, (see fig. 10b, pl. XI). Besides these eggs there were always smaller and larger globular masses of irregular shape visible; they were in a constant rotating motion, and probably represented earlier stages of ova, or others in a state of furcation. Boiled in hydrochloric acid, the ova remained almost unchanged, from which it would seem that their epidermis partially consists of *chitin*, which I have reason to believe is also represented in the integument. In the mucous substance of the ovaria *cnidæ* are sometimes observed of an elongated oval shape, having a thin remarkably long and strongly bearded *ecthoræum*, as represented in fig. 10*c* on pl. XI.

With respect to the sexual difference of our *Sagartia*, I have to record the following observations which, when confirmed, may throw some light upon the generative system of the *Actiniacea*. After having kept the specimen, figured on pl. X, and the history of which I shall relate subsequently, for about 18 days in my aquarium, it began in small quantities to issue from its mouth a milky white, viscous substance which, upon examination under a very high power of the microscope, appeared to consist of small round globules of different sizes, not however exhibiting any motion. There were only a few *cnidæ* interspersed in that mass. Sickly *Actiniæ* are said often to issue a similar white substance, but in the present case I could not see the slightest distinction between the character and form of those granules (pl. XI, fig. 11) and early stage of eggs, attached to the ovaria themselves, except that the former were deprived of the purple coloured coating, which always surrounded the latter, when connected with the folicles of the ovaria. In connection with the white viscous mass, there were occasionally issued pale yellowish, contorted bands. Each of these consisted of a thin but tough, almost leathery skin, with numerous irregular partitions (pl. XI, fig. 12) filled with extremely minute spermatozoa; on one side the edge of the band was considerably thickened. The spermatozoa appeared as round globules, each with a very thin and short tail (pl. XI, fig. 13); their motions were extremely rapid in all directions, and whenever a few eggs were introduced into the mass, the spermatzoa were seen collecting round each (pl. XI, fig. 14), until they formed a regular coating to it. Eggs observed a few hours afterwards, distinctly exhibited a motion of their fluid contents, but I have not been able to trace their further changes and development. It is not at all improbable that the spermatozoa, and in fact the whole of the male folicles, are developed, as in many other corals, either at a certain season of the year, or at a certain age of the animals. The act of fructification may result in the death of the animal, but this is not at all likely to be always the case. I shall subsequently again recur to this subject in somewhat more detail, as connected with the existence of the animal.

c. Physiology.

In tracing out the principal physiological phænomena of the present *Sagartia*, I may best attain my object by briefly relating the history of the specimen figured on pl. X.

The specimen was obtained, on the 22nd March, 1868, in a tank close to the railway station of Port Canning. I filled my aquarium with a quantity of the same brackish water, and placed the specimen with several others of smaller size in it. During the first ten days, the large specimen exhibited great activity, usually having its tentacles spread out, attacking every small animal that came in contact with them. The six primary tentacles, being considerably thicker than the rest, were bent out in a curve, usually leisurely moving about between the bases of the other tentacles. The least touch with a solid object of any part of the body, or even an unusual movement of the water, or the sudden direction of the sun's rays against the animal instantly effected its sensitiveness, the effect being a total or partial contraction of the body. At this act a quantity of water was emitted, and generally a few *acontia* were ejected from the cinclides of the collar, this being done with such a force, as to make the *acontia* rise nearly two inches in a perpendicular direction. They usually remained for a few moments in the extended position, and were then gradually rolled up in a closely coiled spiral line and retracted. Seldom were there any *acontia* seen to issue from any other part of the column. According to the magnitude of the disturbance, from one to about five minutes elapsed before the animal, when it had once entirely closed the disk, expanded again.

After the first ten days, the specimen gradually lost somewhat of its high sensitiveness; it almost constantly remained expanded, but the tentacles were much less active than before, and it required a rather forcible touch to induce the animal to retract them. In a similar manner, the expansion of the body, or the unfolding of the tentacles was remarkably slow, though the animal would not voluntarily remain closed longer than five or six minutes. Other specimens, however, which also partially lost their original sensitiveness, would remain closed for several hours; some of them did not expand their tentacles, even for many days, at least not in the day time.

The *acontia* were always first discernible to begin their movements near the centre of the base, proceeding towards the periphery, then rising along the wall of the column, till they met a *cinclis*, through which they were ejected; they did not, however always rise as high as the collar. When they came in contact with a foreign object, they attached themselves so firmly, that they had to be removed with force. This attachment is, as I have already stated, undoubtedly due to the serrated or bearded *ecthorœa* of their *cnidœ* which are of considerable length. The ejection of the *acontia* is almost momentanous, but the retraction sometimes extends over 8 or 10 minutes, or even longer;-in a perfectly healthy animal for about three minutes. When the *acontium* is retracted within the body, it again usually remains lying for sometime along the wall of the column, or is coiled up at the periphery of the base, till it wholly disappears towards the centre. I have never seen any acontia issuing from the tentacles, or any part of the disc; as a rule they are emitted only from the sides of the column, but when the animal has been removed from the place of its attachment, I have seen them as already stated, to be emitted from the base near its periphery.

Gosse says that each *cinclis* is not assigned to a special *acontium*, but that at the contraction of the animal, a quantity of water is thrown out, carrying the *acontia* with it, and issuing them through any cinclis which happens to lie nearest. This appears in general to be correct; but at the same time it can, I believe, hardly be questioned that some muscular power is connected with the issue of the *acontia*, and perhaps the motion of the water only supports the former principal action, and directs the *acontium* towards a cinclis. It would be, for instance, impossible to understand why in the fresh and healthy animal, nearly all *acontia* issue at the collar; and besides that some of them are under circumstances issued with great force in a contracted state of the animal, where extremely little water is given out. Moreover it is very probable that the same muscular power which retracts the *acontia*, after they were ejected, is also in operation at the act of their emission.

Regarding the digestive system of which I have previously treated, I must here record a very interesting observation, inasmuch as it supports the suggestions previously made. I fed a large specimen with a small Crustacean,-after it had been slightly pressed, so as to reduce its active motions, and prevent its escaping from the mouth of the animal. The *Sagartia* kept the Crustacean for about five minutes between the lips, and then by almost insensibly slow movements of the labial muscles gradually swallowed it down. When this had been done, it remained in a half contracted position for more than an hour. During this whole time the craspeda were seen much more actively moving about, than either before or after that. The Crustacean was actually so thoroughly enveloped in the net of the craspeda, that I could not trace its form; even the next day the craspeda were seen more approximate and arranged round the central space, than they were on former occasions. This observation appears to be in favour of my previous statement, that the physiological signification of the *craspeda* is to some extent that of secretive organs, as liver, gall, panacreas &c., being essential for the digestion of the food. It would be probably going too far in stating that the ready chylus is also conveyed through the *craspeda* to the body, though the anatomical structure of their central portion is not directly opposed to this opinion. There can be however, little doubt that by the numerous marginal *cnidæ*, the *craspeda* have among others the object of protecting the generative organs from any injury which could be produced by the objects taken internally as food. The *acontia* evidently only serve for external defence, they do not seem to have any other physiological duties to perform.

Passing these remarks, I may return to the history of our specimen. It remained in the less active state, as previously described, for about 8 or 10 days. After this time it generally somewhat retracted the tentacles raised the disk and the lips (pl. X, fig. 7), and began to emit from the mouth a granular substance, the granules appearing, as I have already noticed, to be eggs in very early stages of development. The white substance was extremely viscous, and in irregular masses more or less resembling contorted strings. The next day I observed that, besides the white substance, there also were pale yellowish strings issued, containing the very minutest spermatozoa, as above described (p. 47). This issue of white substance, with eggs (?) and spermatozoen follicles lasted in intervals for two days, after which the specimen began to expand and contract its body in various ways. The tentacles were reduced to about half their usual length, the lips were projecting, the disc was occasionally produced, then again retracted, the collar more or less inflated, and at the same time, either the upper or the lower part of the body attenuated and extended, sometimes to more than double the usual length, (see pl. X, figs. 6, 8, 9). These various transformations of the body were observed for about 8 hours, during which time the *Sagartia* left its former place of attachment, (being a small piece of wood) and was seated at the bottom of the aquarium, on a horizontal ground. The next morning the specimen was found flat, perfectly turned inside out, exhibiting all the internal organs, (pl. XI, fig. 1). The *acontia*, *craspeda*, and even the tentacles shewed subsequently signs of vitality for more than 24 hours. Upon examining the figured, and another specimen which died under similar conditions, I found that the eggs on the ovaria were rather larger than usually in other live specimens, and the spermatozoa were accumulated in large numbers between all the mesenterial folds, and some of the pale strings which contained them, appeared to be attached irregularly between the ovaria. In a third instance they almost seemed to me that they have taken the place of some of the craspeda.

The important question resulting from this observation is, whether the death of the specimen was an accidental, or a natural one. I would not in the least deny, that the somewhat different conditions under which the animals were placed, accelerated the death of two of the specimens, but it would be strange to affirm that their death was caused merely by these different conditions,* inasmuch as they had hardly any influence upon other specimens, living in the same aquarium, and remaining healthy for a long time. Before those observations were made and afterwards, I had at different times dissected several specimens, but I never found a trace of any spermatozoen follicles, or any spermatozoa between the ovaria, though the ova were sometimes of large size and highly developed. I have, never observed internally any young *Sagartiæ*. Still it appears very probable that the present species is like many other *Actiniacea* viviparous, this being the ordinary course of propagation. I have likewise not observed any buds or stolones, or a natural division of any of the specimens. However, either at certain times of the year or, more likely, at a certain age the male follicles may be formed and spermatozoa developed in large numbers. The death of a specimen after the act of fructification may be only an accidental one, but this has still to be confirmed by other observations. In the specimen of which I have given the history, the eggs remained after its death perfect, only loosened from the ovarian strings, while the other animal substance quickly decomposed. Gosse says that he once observed an *Actinia* issuing spermatozoa, but he does not state whether the act resulted in the death of the specimen or not. Blainville's observations, if I remember rightly, gave a distinct proof that in some species ovaria and spermatozoa are developed in one and the same specimen.

* Being probably a slight alteration of the percentage of the saline constituents of the water, caused by evaporation, (though this percentage was maintained as much as possible), greater exposure to light and increased temperature, want of sufficient motion in the water, etc.

It is usually stated that, when an *Actinia* is cut into a number of pieces, each restores itself to a perfect animal. Though this kind of propagation no doubt has its limit, I may, record, that experiments made on some specimens of this species in general confirm the great vitality and reproductive power of the *Actiniacea.*

With the object of observing some of the ovaria, I once cut a specimen in two halves, and left one part of it in water attached to a piece of wood. In about 24 hours I found the half *Sagartia* closed again and after a few days the animal was perfectly restored, only counting a smaller number of septa, but even these were in time partially replaced. The specimen, however did not grow larger, although I fed it with mosquitoes and various larvæ for about six months. The other half which was removed from its place of attachment died shortly afterwards.

d. Habitat.

It is generally stated that all the *Actiniacea* are truly marine animals, and there are indeed very few instances known where species have for a time been kept in aquaria in which the saline constituents of the water were in proportion considerably less, than represented in pure sea-water. *Actiniæ*, and others, are sometimes found attached to rocks above the low-water mark, or living in small pools of sea-water, but I am not acquainted with any record of a species having been observed living permanently in brackish water.

The present species was found, as I have already stated, in one of the tanks close to the railway station of Port Canning. It lives here attached to old trunks of trees.* I have not observed it in any of the other tanks, partially on account of a difference in the water, partially on account of the want of any fit places of attachment. The specimens which I collected were of different size, the smallest about one quarter of an inch in the basal diameter, and the largest measuring about 1½ inches in the same diameter. They usually were seen 8 or 10 inches below the surface of the water but sometimes at the surface itself; sometimes even a part of the animal was above it, and while the exposed portion became perfectfy dried up under the direct influence of the sun, the other half remained as usually vital.

Slight progressive movements have often been observed in *Actiniæ*

* Hæckel's name *Petracalephæ* would on this account not suit this species, we had to create a name something like *Lignacalephæ*.

and I may mention, that one of my specimens moved in 24 hours by gradually contracting and expanding its base* four inches on a level horizontal bottom, and three inches on the perpendicular side of the glass, so as to reach the surface of the water; in all therefore seven inches. All the specimens shewed a particular liking to move nearer to the surface of the water. The above shews that the *Sagartia* has the power to move progressively at about the rate of 0.26 of an inch in one hour, which is comparatively a very quick motion for these usually sessile animals.

The species is also common all along the banks of the Mutlah river. During low water the specimens often remain for hours exposed to the direct influence of the sun, attached to wooden pillars, stems of trees, &c. Each specimen always retains a large quantity of water during the time of exposure, and gives a portion of it up when disturbed.

In conclusion I have only to mention a few words regarding the chemical constituents of the brackish water, in which the animals were found living, as compared with those of sea water. Mr. D. Waldie, who very kindly undertook to make an analysis of the water, tells me that 1000 grs. contain a total quantity of solids of 12.87 grs., of which are 0.78 sulphuric acid (anhydrous), 0.78 magnesia and 0.23 lime. Mr. Waldie further observes, "the arrangement of the constituents is arbitrary; supposing the acids and bases are combined in accordance with the analyses usually given of sea-water, it will stand as follows :—

Chloride of Sodium (including potassium),	9.81
„ „ Calcium,	0.46
„ „ Magnesium,	0.93
Sulphate of Magnesia,	1.17
Carbonic acid, &c.,	0.50
	12.87

This will be found very nearly the composition of sea-water as to its principal constituents, but in quantity amounting only to very nearly one-third of sea-water for the same volume of water." Dana in his Manuel of Mineralogy also states that the amount of solid substances in sea-water changes between 32 and 37 parts in 1000 pts. of water.

* Measuring about one inch in diameter.

We may, therefore, say that the brackish water from Port Canning is composed of very nearly *one part of sea, and two parts of river-water.*

The occurrence of a species of *Sagartia* in brackish water, resembling in nearly all respects of its organisation marine species, is one additional fact how often an animal has it in its power to select or change the conditions of its life. It does not apparently depend so much on the quantity of certain solid constituents, composing sea-water, as it does on their presence in general; smaller quantities of them may occasionally have no effect upon the animal life, but the absence of one or the other of them could likely produce a thorough change in the fauna.

Considering the great disturbances of the atmosphere which have taken place towards the close of the last year (1867), we could suppose that these corals may have been transferred from the sea coast in the tank accidentally. This however is not the case. Although the water of the river is subject to constant changes of flood and tide, and contains a large proportion of fine mud and silt, which undoubtedly would greatly interfere with the existence of most other corals, the *Sagartiæ* live in it in large numbers. I also found them several miles north of Canning, in the tributaries of the Mutlah river, where the water is often much less brackish than further south. Besides the *Sagartiæ* there are in the same tanks at Port Canning, and in the neighbourhood, a large number of most interesting species of Mollusca living which mostly belong to marine types. Many of the animals may die or otherwise become less active, when during the monsoons the water of the tanks is nearly quite fresh, but some of them certainly must survive. Pure fresh water, or even that of the Hooghly obtained at the height of the flood, acted injuriously on the *Sagartia.* The animals, when placed in it were momentarily paralysed, though exhibiting vitality for some time afterwards, but they died in about 24 hours; still I think it very probable that the specimens would gradually and in time get accustomed to the Hooghly water also and they probably also occur in this river further south, and nearer the sea.

I have associated with this extremely interesting species, which gave me the opportunity of observing so many new points regarding the anatomy of the *Actiniacea*, the name of my friend, *Ferdinand Schiller*, who has been so actively engaged in the improvements of the locality where the species was discovered.

Phylum, MOLLUSCA.

Sub-phylum, HIMATEGA.*

These animals are also called *Moluscoidea*,—they are without a complete nervous system, the heart is wanting and if present it is without an auricle.

Class, BRYOZOA or CILIIPODA (*Polyzoa*, auctorum).

Heart and special organs of sensation wanting.

Sub-class, GYMNOLÆMA.†

With a simple row of tentacles.

Order, CHILOSTOMATA.‡—(*Cellulinea* d'Orb.)

Cells more or less ovate, aperture not produced, closed by an operculum or a muscular lappet.

Sub-order, INCRUSTATA.

Cells more or less attached by the entire, or a portion of their base.

Tribe, MEMBRANACEA.

Cells above wholly or partially membranaceous, the aperture being situated in that membrane.

Family, FLUSTRELLARIIDÆ.

Cells without special pores.

Genus. MEMBRANIPORA, *Blainville*.

Cells large, depressed, their single layers generally incrusting different objects; upper portion mostly membraneous; aperture with simple, entire margins, situated at the anterior end.

Species. Membranipora Bengalensis, *Stoliczka*, 1868.

Pl. XII.

Memb. polyzoario semi-calcareo, simplici, incrustante seu varie torto; cellulis depressis, sexangularibus, longioribus quam latis, in seriebus alternantibus positis, supra membranaceis, minutissime porosis, infra ac lateraliter calcareis, in adultis ad marginem superiorem nonnullis spinis solidulis paulum elevatis instructis; apertura in adultis speciminibus sub-rotundata, antice ad terminationem sita, marginibus integris aliquantum prominentibus circumdata; margine posteriori paulo producto atque sæpius quatuor spinis postice prolongatibus instructo:

* Hæckel, *Generelle Morphologie*, Berlin, 1866, Vol. II. p. cv.

† The other sub-class form the PHYLACTOLÆMA.

‡ The other orders are *Cyclostomata, Ctenostomata, Paludicellea* and *Urnatellea.*

spinis inæqualibus, exterioribus brevioribus quam interioribus. Animal virescente album, tentaculis longis, 14-18 *instructum.*

a. Form of cells.

The polyzoarium of this species is extremely variable, its form being altogether dependent upon that of the object to which it is attached. It is either found incrusting stones or wood, or it grows on different water-plants, being then variously contorted and apparently partially free. According to this the cells undergo many variations, often so much so that it is extremely difficult to determine the characters of the species.

As a rule they are hexagonal, slightly elevated, about twice as long than broad and posteriorly emarginated (pl. XII, fig. 1, f). The base and the sides are in full grown cells always solid, the upper portion more or less membranaceous, representing a usually slightly convex, very thin covering. The upper margins of the solid portion of the cell,—where the thin membrane is attached—are somewhat raised, and each cell is separated from the next by a slight furrow. The aperture lies at the anterior end, being roundish and provided with somewhat thickened, elevated and solid lips. The anterior portion of each cell with its margin extends into the basal indendation of the previous one, while the posterior margin of the aperture is much more prominent, possessing a small thickened projection which is posteriorly often prolonged into four, radiating spines, the outer pair of these being much shorter than the inner one (see pl. XII, fig. 2).

In consequence of the greater elevation of the posterior margin the aperture, when viewed perpendicularly from above, appears almost semicircular, but viewed at about an angle of 45 degrees from the front its round shape* is distinctly perceptible. The posterior upper portion of the cell is always convex, thin, finely perforated, and according to the different stages more or less solid. The radii or ribs originate at the upper lateral solid edges and extend in a more or less regular way from both sides toward the centre. Sometimes, but not usually, they unite in the median line and form solid cross bars. The length of the radii also varies with the age of the cells, but their number appears entirely to depend upon the length of the cells, (see figs. 3, 4, pl. XII).

* I mention this point here particularly, because the same *roundish* form of the aperture also occurs in many marine *Cellporæ* and *Lepraliæ*, and is usually stated to be semilunar, though in reality it is not so.

In live specimens, the cells are so thoroughly transparent, that their detailed structure is very difficultly noticed; but in dead cells the membranaceous covering generally disappears, and the solid radii or spines are seen to project towards the median line. It is, however, not always the case that they can be observed, even when the cells appear well preserved. On account of their great tenderness, they not only become in dried specimens variously contorted, but are often very easily broken off; such is the case in almost all the fossil *Membraniporæ.* In some, even very old cells however, they remain rudimentary, or do not develop at all, with the exception of one posterior, median spine which is always present. Again other very old cells become entirely incrusted, even at the aperture. All these variations of the form of the cells and the differences in the arrangement of the marginal spines are amply exhibited in figures 1-4 of plate XII, and these will give a better idea of those changes than any lengthened description.

I hardly need to notice the great importance of the study of those structural differences of the cells in one and the same species. In the present case, I find that the cells which spread over a large flat surface usually are short and broad (fig. 3), those which incrust small, thin stems of water plants, and the like, are much elongated and narrower (fig. 4). Were these forms not passing one into the other, and had the animals not in each case been observed, one would certainly may think to have a good reason for acknowledging these forms as distinct *species.* How different would this be in the case of their being fossil *Lepraliæ* or *Membraniporæ!* It is certainly true that we often describe merely fossil forms, and not species.

Only the sides and the base of the cells are, as I have previously stated, solid; they are chiefly composed of carbonate of lime, forming a thin porous layer. Each cell communicates through a large pore with each of the six adjoining cells. Two of those larger pores are found on each side and one in front and one behind. Sometimes, however, in younger cells the number of large pores is greater. When the polyzoarium is partially free, for instance in growing round a quantity of algæ, each cell usually has at the base a long membranaceous tube, through which a muscle, originating at the lower side of the mantle, is protruded, attaching the cell to the plants, (figs. 7 and 8). The round opening of this tube brocken off, with a slightly raised margin, is generally visible near the centre of the base of each dead cell, when carefully removed from its place of attachment; it is rarely wanting except in very old cells (see pl. XII, figs. 5 and 6). When, however, the cells are firmly attached with their entire base the opening often becomes closed up, and in time disappears altogether. Viewing the basal portion of a polyzoarium each cell appears separated from the others by a raised margin, while their median portions usually are slightly excavated. The surface is finely porous. The usual colour of the cell is pure white, occasionally slightly opac or brownish.

b. Animal.

There is little of special interest that I can mention with reference to the animal of this species. It is enveloped in a perfectly transparent mantle, which lines the internal, slightly rugous surface of the cell, and appears to be firmly attached to it posteriorly and at the margins of the aperture (see fig. 1, *f*, pl. XII). When the cell is broken and the animal taken out, the mantle generally remains with the cell; it is therefore very difficult to trace out the connection of the animal to its mantle. I have only observed a few very thin muscles posteriorly, but none anteriorly, though they also may exist. Equally difficult is it to observe the animal expanded, because the slightest motion of the water compels it to remain closed for a long time. When it protrudes out of its cell, the total length of the tentacles and a portion of the collar is visible. In the retracted position the *V-form* twisted viscera can be clearly traced through the cell-membrane. In the animal, taken out (fig. 1, *h*) of its cell, the length of the retracted tentacles (*t*) measures nearly one fourth of that of the entire body; they are separated by a groove from the muscular larynx, in the centre of which lies the mouth; then follow the viscera, usually somewhat contorted, being thickest in the middle, and by a sharp twist joining the membrane which surrounds the tentacles at about one-third distance from their base. At the end of the visceral cavity, there is usually seen one, seldom two or three oval, dark bodies,—probably *statoblasts*. These viewed under the microscope, seemed to be filled with a rather homogenous, granular mass, but sometimes there was a contorted, dark string visible, and the rest was filled with a clear fluid (fig. 1 *i*). Whether this difference is due to different stages of growth I am not in a position to say. I have not observed their development in the present species, but I hope to recur to this subject at some future occasion, when treating of the development of some of our freshwater Bryozoa.

The microscopical structure of the animal is a granular, or cellular substance in which numerous greenish pigment cells are interspersed. There is no trace of *cnidæ*, such as described in the *Actiniacea* and *Acalephæ*. The tentacles generally are moved about slowly, not being usually widely separated from each other, and the movements of each are independent from those of the other, they also often have the tips bent outward, (see fig. 1, *g*, pl. XII). It is generally stated that the tentacles of all the Bryozoa are tubular, but in the present species it always appeared to me, that they are flat bands with the lateral edges folded in, so as to leave a broad furrow in the middle. They consist of about six or seven rows of large angular cells, being finely ciliated on either side. The cellular structure is perfectly different from that of the tentacles of the corals, but remarkably resembling, for instance, that of the tentacles or eye-pedicles of small Gastropoda (see pl. XII. fig. 1, *k*).

c. *Growth of the polyzoarium.*

The progressive growth of the polyzoarium of the present species deserves a short notice, inasmuch as the observations on this point are as yet rather imperfect.

The terminal end of each fresh polyzoarium (see fig. 1*a*) is very thin and membranaceous, being wholly composed of young cells, in different stages of development. It is in all the incrusting species of this group of Bryozoa free, becoming attached only in an advanced age. The first stage (1*b*) appears to be that of a small, flat and homogenous cell, filled with a quantity of a dark granular substance. This cell is produced in the form of a knosp from the previous cell of the same row. Young cells, especially seem to have the power of propagating themselves by buds, but in the old cells this mode is replaced by the formation of statoblasts.

In a next stage, subsequent to that above mentioned, cells are observable in which the granular substance is a little reduoed, but generally in the right basal corner a dark spot becomes visible with a translucent centre. This is the first distinct embroyonal form (fig. 1*c*). Subsequent to this the upper edges of the sides of the cell and the base become more solid, (fig. 1*d*), then a small spine appears posteriorly, but no aperture as yet in the upper membrane, though it seems to be indicated by an opac-line (fig. 1 *e*). In the transparent centre of the embryo there are furrows to be observed, radiating from the centre and indicating the formation of the tentacles; a few thin muscles are also seen attaching the young animal to the posterior end of the cell. After this, the development appears to make more rapid progress; the body extends, the twisted viscera become perceptible, the membrane covering the aperture is absorbed and the basal string which gives the cell a fixed position developed (fig. 1 *f*). Thus the animal is seen perfect, lying in the cavity of the cell, and the mantle becomes attached all round the margins of the aperture. At a progressive age, the statobasts appear in the posterior portion of the visceral cavity, and the upper membrane of the cell gradually attains a greater solidity by a number of thickened radii or spines. All these stages of cells may often be observed on only a small terminal portion of a large polyzoarium (fig. 1). The basal string is very strong in the young cells, but becomes obsolete in advanced age, as I have previously mentioned, it is therefore only a temporary organ, and not essential to the existence of the animal.

I also may notice at this opportunity that I observed on one of the polyzoria, small membranaceous tubes attached between each two cells, near their apertural margins. Out of these tubes an organ was voluntarily, and independent of the animals in the cells, projected and retracted. It simply consisted of two fleshy *flagellæ;* these were probably the so called *avicularia* the true nature of which,—as apprehensive organs,—is as yet little known, but the surface was so much covered with different *Spongillæ*, that I was unable to trace the immediate condition of these supposed *avicularia* with the cells themselves. When the polyzoarium was dried, the membranaceons tubes and naturally also their contents disappeared.

d. Chemical composition of the polyzoarium.

When boiled in hydrochloric acid, the polyzoarium left as residue a very thin membranaceous skeleton; it was complete as regards form of the cells. This membranaceous skeleton could hardly be anything else, than chitin, as distinguished from the common horny substance by being insoluble in hydrochloric acid.* Subsequently I burned several portions of the polyzoria in a platina crucible, until every trace of organic matter disappeared. The cells were by this operation not materially affected, but placed in hydrochloric acid, they were almost perfectly dissolved, they seem therefore to a very large proportion to consist of carbonate of lime. There was a small residue of siliceous spiculæ and scleroid particles left, but these were most probably derived from the numerous *Spongillæ* adhering to the cells.

e. Habitat.

Membranipora Bengalensis was found at Port Canning with *Sagartia Schilleriana* in the same tank of brackish water; it is, however, much more widely distributed as the last. It also occurs in tanks, the water of which contains only about one fifth of sea-water. I found the species incrusting old trunks of wood on several places along the Mutlah river, on many points in the salt-lakes and in other places of the Sanderban. The present species does not, however, occur in fresh water, where it appears to be replaced by *Hislopia*, evidently belonging to the same family of *Chilostomata.* There are a large number of similar forms found on various places of the coast of the Bengal Bay. One of these, with smaller cells, is often seen on shells and fragments of wood coming from the lower portions of the Sanderban, but it is difficult to obtain it in good preservation.

A marine species which I lately collected at Ceylon and at Aden is very like the one here described but it has the cells much more solid.

* The plates at the entrance of the œsophagus, or the so-called thoeth, have been found also to consist of chitin.

Explanation of Plates.

Plate X, (p. 33).

Fig. 1. Unfolded specimen of *Sagartia Schilleriana*, in natural size (see p. 33); 1 *a*, a portion of a tentacle of the second series; 1 *b*, a portion of a tentacle of the first series, both enlarged twice the natural size; 1 *c*, termination of a primary tentacle, with the *cnidæ* arranged in spiral rows, six times the natural size; 1 *d*, longitudinal section of one tentacle, shewing the different layers of which it is composed, (p. 39).

Fig. 2. Top-view of the specimen represented in fig. 1, when in a half contracted position, (p. 34).

Fig. 3. Side-view of the same, with the ovaria visible through the transparent body, the tentacles half protruding, and several *acontia* ejected.

Fig. 4. Side-view of the same specimen in a fully contracted position, the transverse rugations being more distinct than in the former positions, (p. 34).

Fig. 5. View of the basis; numbers 1-5 shewing the 5 series of the septa; the dark spots, each situated on either side of the primary septa, represent the *ovaria*, and the striped marks, more centrally situated, the bundles of the *craspeda*, (p. 35.)

Figs. 6—9. Side-views of the various abnormal forms of the same specimen, (p. 50).

Plate XI, (p. 35).

Fig. 1. View of a specimen turned inside out, the primary septa and the ovaria accompaning them being prominent, (p. 50); 1 *a*, represent three shrunken tentacles, enlarged.

Fig. 2. Ideal representation of the distribution of the septa and tentacles according to the different circles (p. 40).

Fig. 3. Ideal perpendicular section of a *Sagartia*, in half of its basal diameter, (see explanation of the various letters on p. 35).

Fig. 4. Appearance of the mucous layer, enlarged 200 diameters; 4 *a*, a few isolated *cnidæ*, enlarged 500 diameters (see p. 36).

Fig. 5. Upper or outer view of the scleroid tissue; 5 *a*, the internal view of the same; 5 *b*, calcareous scleroids; 5 *c*, siliceous scleroids, very much enlarged, (p. 37).

Fig. 6. A portion of the scleroid skeleton, after the specimen was burnt in a crucible (see p. 38).

Fig. 7. *Cnidæ* of the tentacles (p. 40).

Fig. 8. Longitudinal section of a portion of a *craspedum*, and 8 *a*, its *cnidæ*, more enlarged (p. 43).

Fig. 9. Longitudinal section of a portion of an *acontium;* 9 *a* and 9 *b*, its *cnidæ* (p. 44).

Fig. 10. A portion of an *ovarium,* 10 *a*, shewing the distribution of the eggs in the mass; 10 *b*, eggs much enlarged; 10 *c*, one *cnida* from the ovaria (p. 46).

Fig. 11. Appearance of the spermatozoa slightly enlarged.

Fig. 12. Male follicle, (see p. 50).

Fig. 13. Spermatozoa, very much enlarged.

Fig. 14. Eggs surrounded by spermatozoa, (p. 47).

Plate XII, (p. 55).

Fig. 1. Natural size, of a portion of the polyzoarium of *Membranipora Bengalensis;* 1 *a*, enlarged, with two supposed *avicularia* on the left corner; 1 *b*,—1 *f*, various stages in the development of one cell (see p. 59); 1 *g*, a full grown cell with the animal partially protruding, the body seen through the transparent cell; 1 *h*, the animal taken out (p. 58); 1 *i*, a statoblast; 1 *k*, internal view of the terminal portion of a tentacle (p. 59).

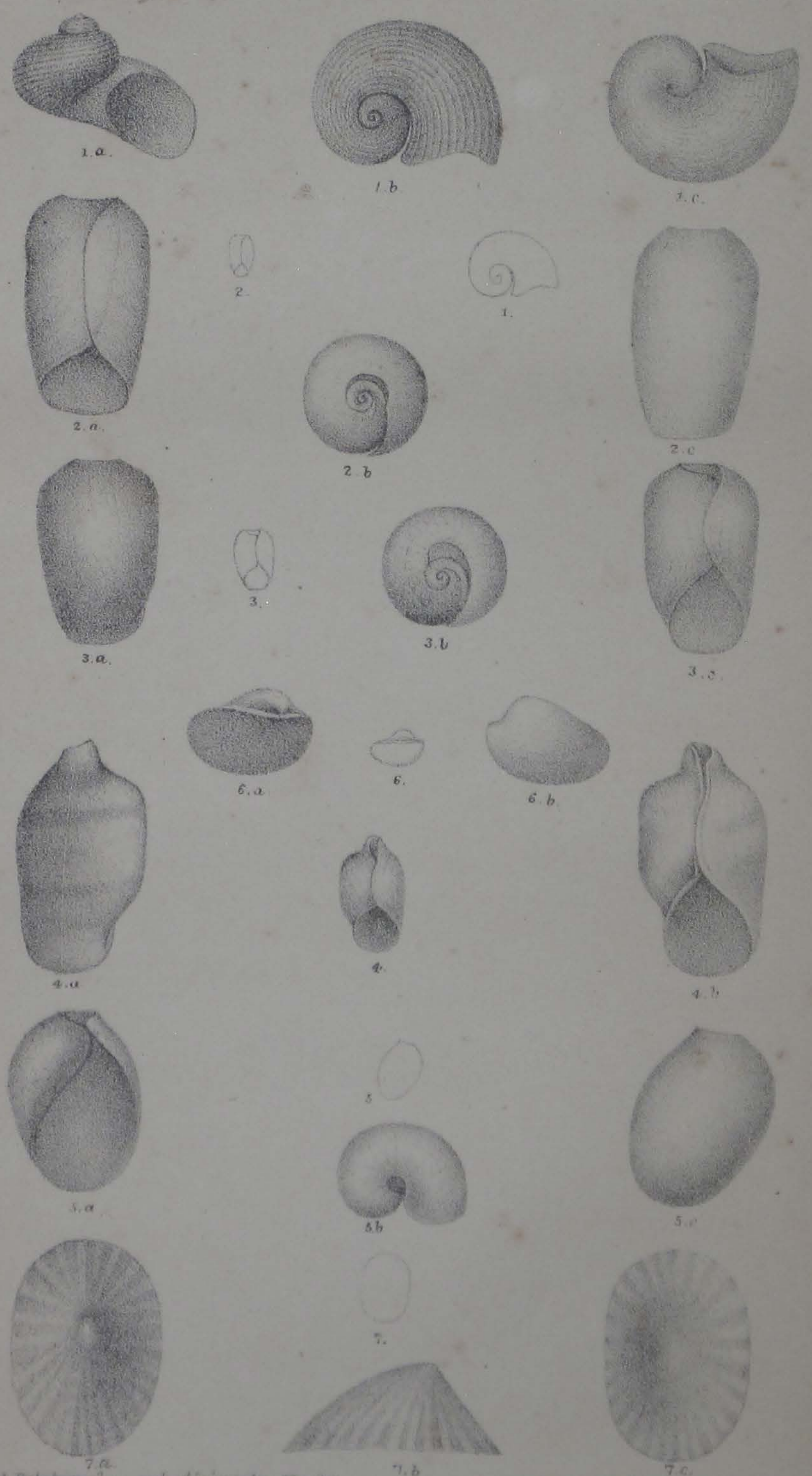
Fig. 2. Front view of a few cells, greatly enlarged, also shewing the spines attached to the lower lip (p. 57).

Fig. 3. Front view of a number of cells of an oval shape; 3 *a*, much enlarged portion of the upper surface, with two transverse, solid radii.

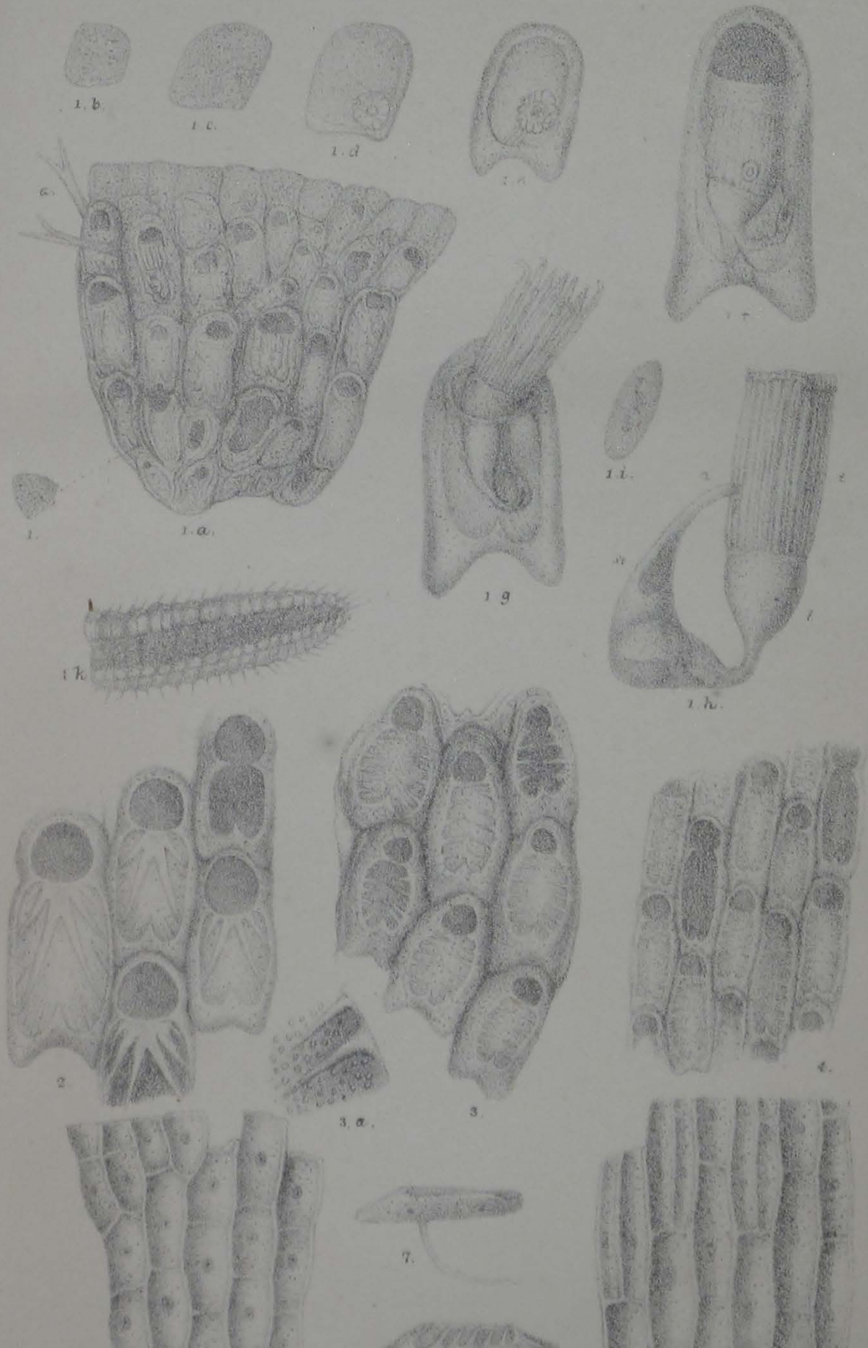
Fig. 4. Much elongated cells which were attached to a stem of a plant.

Figs. 5-6. Back-views of two kinds of cells, corresponding to figures 3 and 4.

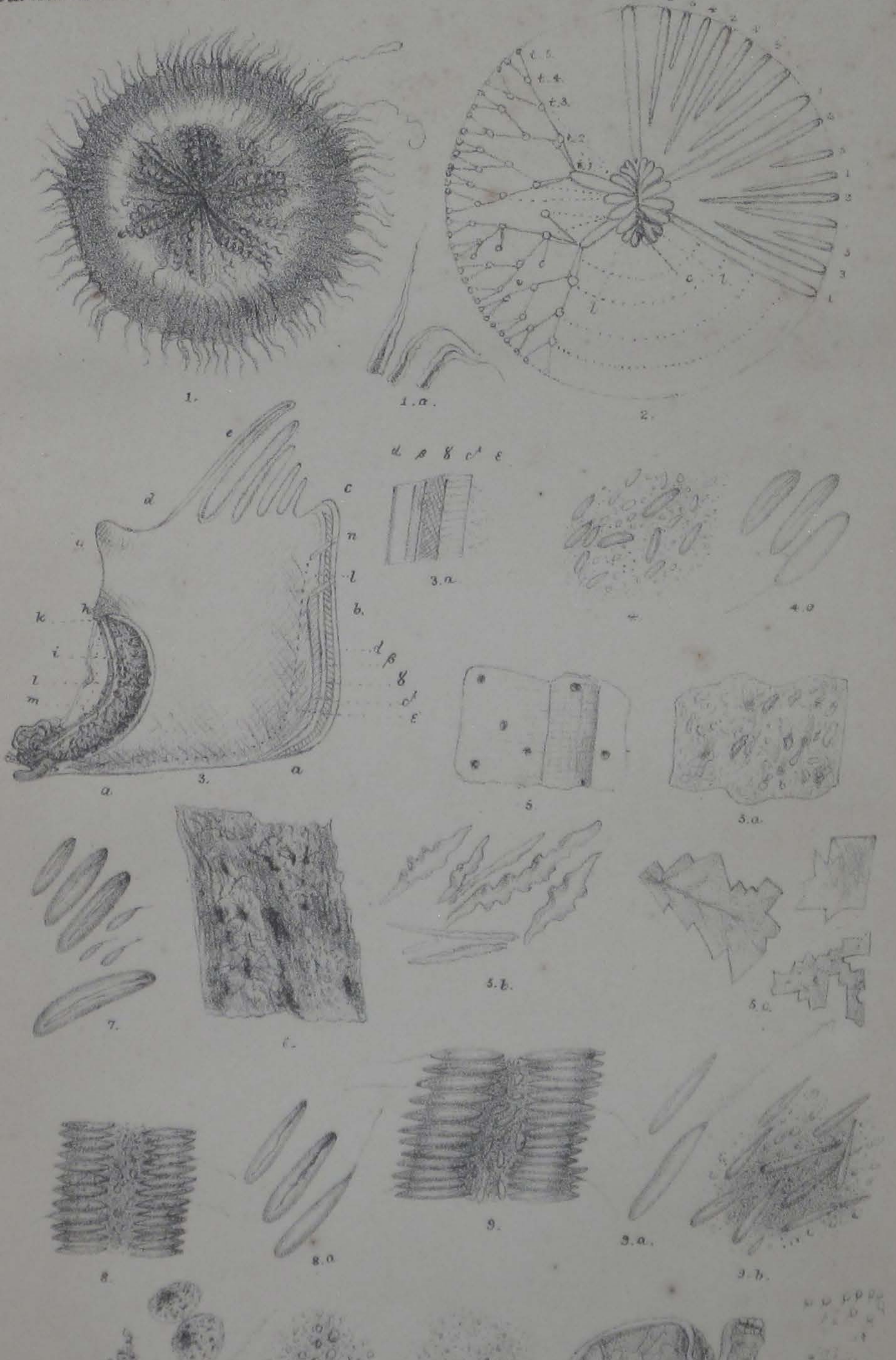
Figs. 7-8. Side-views two cells, shewing the lateral pores by which they communicate with the adjoining cells, and also shewing the lower string which is well developed in young cells.



1 Delphinula sub-disjuncta, H. Ad.
2. Cylindrobulla pucilla, Nev
3. " sculpta, "
4. Oxynoe cincta, Nev.
5. " delicatula, "
6. Lobiger viridis, "
7. Broderipia eximia Nev.

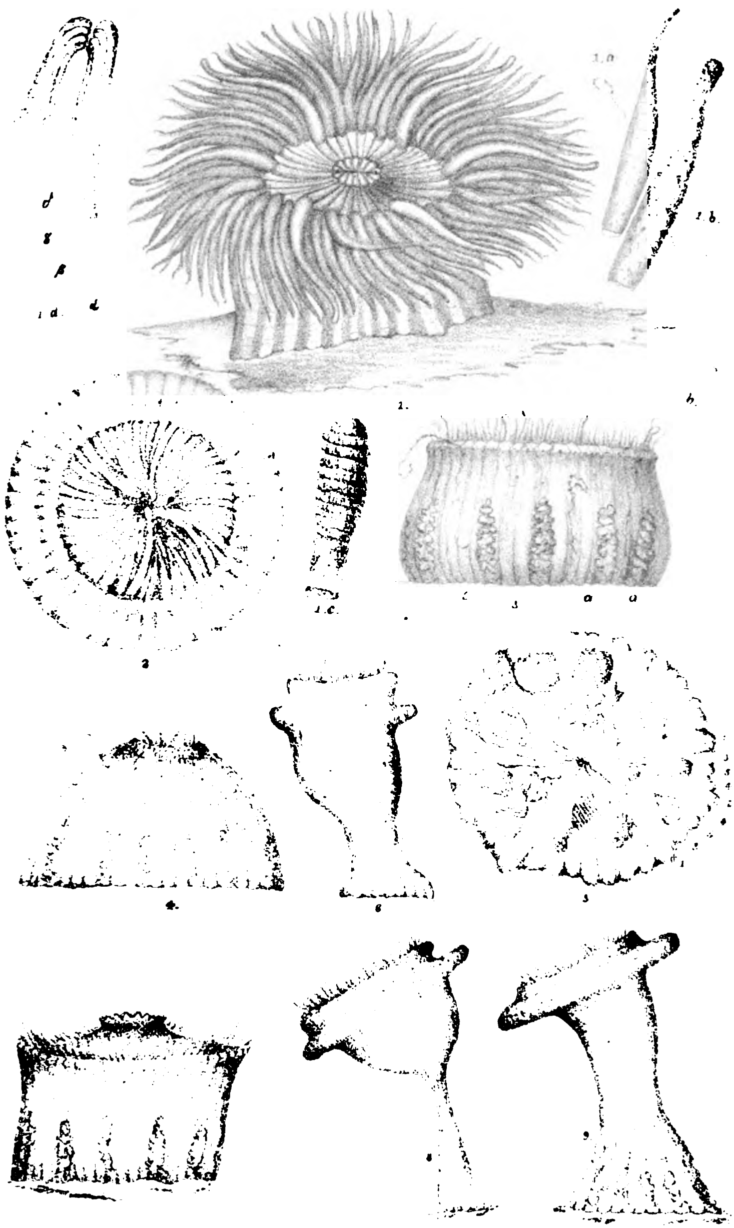


Membranipora Bengalensis, Stol.

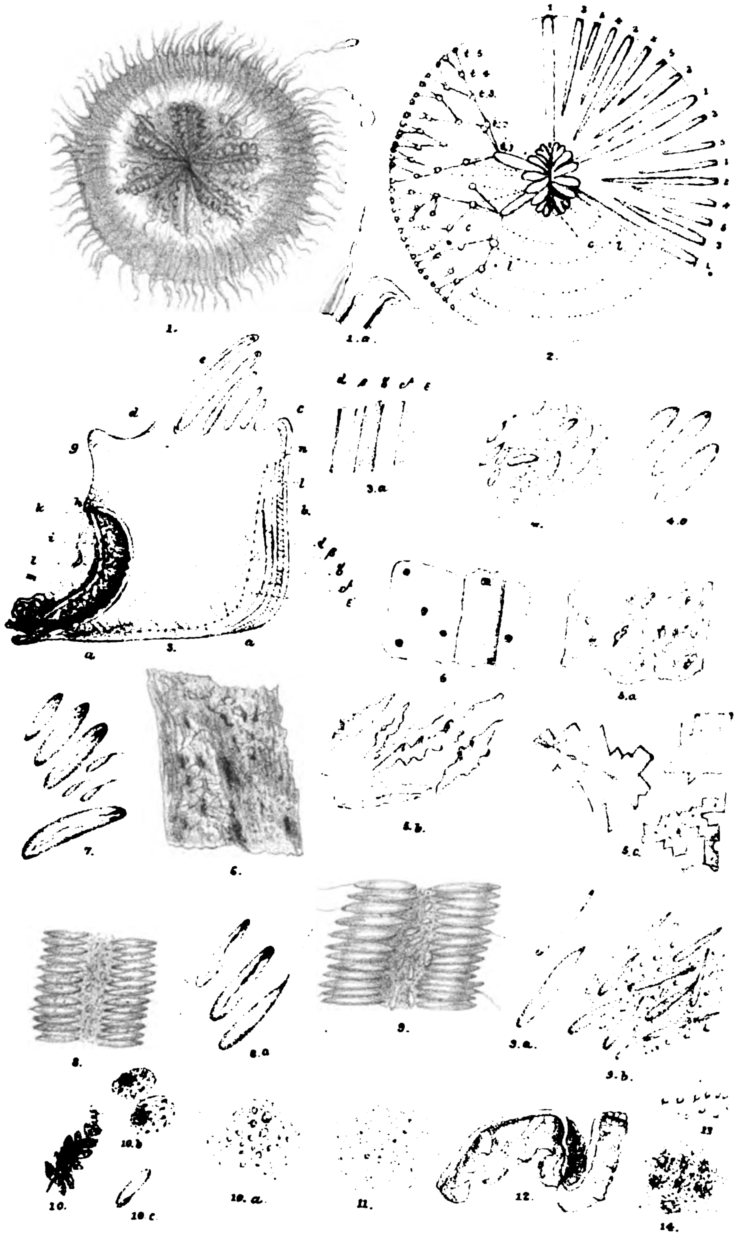


Sagartia Schilleriana Stol.

Sagartia Schilleriana, Stol.



Sagartia Schilleriana, Stol.



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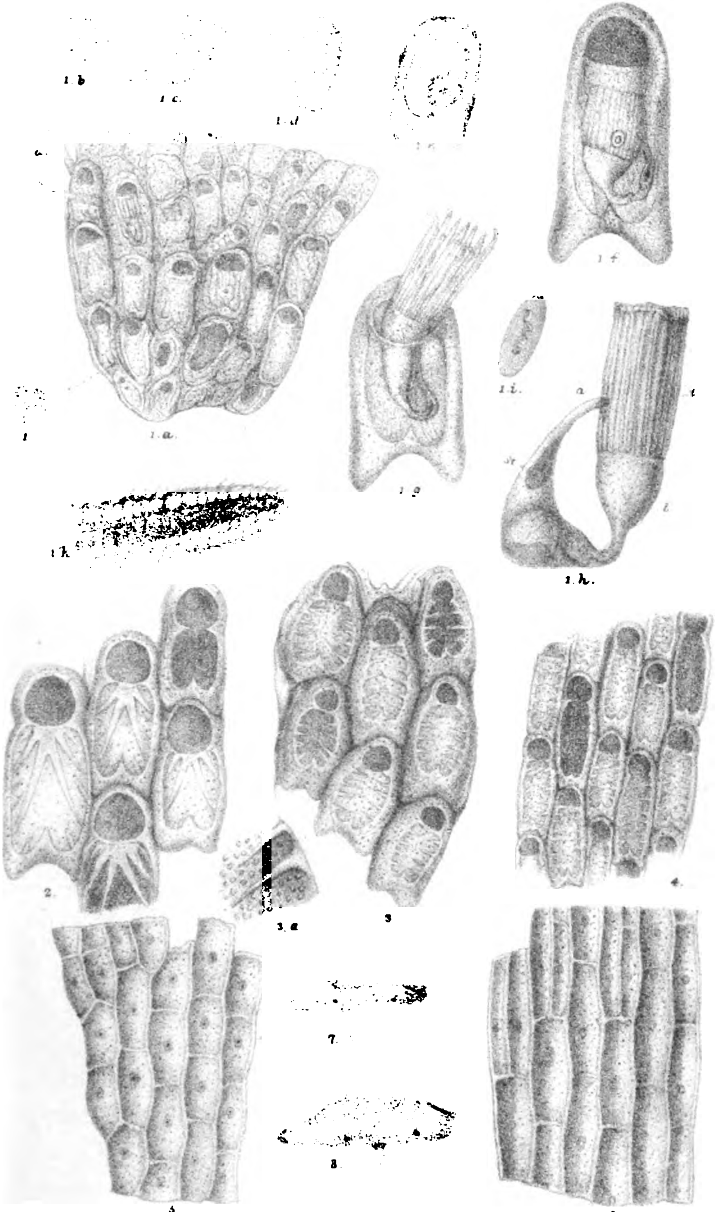

Membranipora Bengalensis, Stol.

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Part II.—PHYSICAL SCIENCE.

No. II.—1869.

On some new marine Gastropoda from the Southern Province of Ceylon;—by Messrs. G. & H. Nevill.

(With plate XIII.)

[Received and read 5th August, 1868.]

The seven new species described in this paper, are the first of a considerable number of new shells, found by ourselves in Ceylon. Up to the present, we have succeeded in identifying over 1,000 species, and are still obtaining many fresh additions, some of which are very interesting forms, and of which we trust, before very long, to publish as complete a list as possible. Ceylon has been much neglected in this respect, as regards marine Mollusca, nothing having been published about them, except the list in Sir E. Tennant's admirable work which, however, only mentions some of the well-known and characteristic Trincomalee species.

Of the shells here described, two belong to the genus *Oxynoe*, proposed by Rafinesque in the "Journal de Physic" of 1819, for a shell from the Mediterranean, *O. olivacea;* the description is a very good one. Mörch in the "Journal de Conchyliologie" for 1863, Vol. XI, mentions nine species as belonging to this genus, namely—

1. *O. olivacea*, Raf., Malta.
2. ,, *Sieboldii*, Krohn, Sicily.

3. *O. brachycephalus*, Mörch, Loc.? This species would seem to require confirmation, Mörch having merely described it from H. & A. Adams' figure, intended for *O. Sieboldii*, from which, however, he states it differs too much to be possibly the same species.

4. „ *Krohnii*, A. Ad., Sandwich I.
5. „ *pellucidus*, „ Loc.?
6. „ *Antillarum*, Orst and Mörch, St. Thomas.
7. „ *viridis*, Pease, Sandwich I.
8. „ *Cumingii*, A. Ad., W. Columbia.
9. „ *Vigourouxii* Montr. and Souv., N. Caledonia.

There can be no doubt, the two last named species, must be removed to the genus *Volvatella*, Pease, (see Amer. Journ of Conch., 1868, Pt. 2).

We have also here described two species of the rare genus *Cylindrobulla*, formed by Fischer in the Journ. de Conch. of 1857, for a species from Guadaloupe, *C. Beauii*; the only other species, as yet described, is from South Australia, *C. Fischeri*, Ad. and Ang.

Of Krohn's genus *Lobiger*, two species have been described from the Mediterranean, *L. Philipii*, Krohn, and *L. corneus*, Mörch; a third named is from Guadaloupe, *L. Souverbii*, *Fisch.*, and a fourth from Polynesia, by H. Pease, *L. pecta*. (Amer. Journ. of Conch. 1868, Pt. 2).

Three species of *Broderipia* are known from the Philippines, *B. iridescens*, Brod., *B. rosea*, Brod., and *B. Cumingii*, A. Ad. A fourth was described from Bourbon by Deshayes, *B. nitidissima*, the same writer records *B. iridescens*, as occurring at the same locality; we have also ourselves found at Ceylon, the rare and pretty species *B. rosea* and add a new species under the name of *B. eximia*.

The only species of the *Delphinulinæ* at all closely allied to the shell here described, *Cyclostrema sub-disjuncta*, H. Ad., is *Delphinula nivea*, Chemn. Indeed we do not feel quite sure, but that the present is the species originally described under that name, and that the shell described and figured for it by Kiener and Reeve, may prove to be a different one, certainly the two figures in Küster's Conchylien-Cabinet, one after Chemnitz, the other after Kiener, belong to perfectly distinct species; the present shell, if not the same, is very close to the former, but differs essentially from the latter.

Fam. PHILINEIDÆ.

VOLVATELLA, *Pease*, 1860.

Volvatella cincta, n. sp. (Plate XIII, Fgs. 4. 4a 4b.)

T. ovato-cylindracea, membranacea, involuta, in medio paululum constricta, utrinque producta; postice abrupte contracta, antice lente rotundata atque subdilatata; apertura postice angustissima, in medio clausa, antice subrotundata, labio paulo reflexo; labro tenui, postice oblique desinente, in medio sinuoso; epidermide cornea, pallide fusca, cingulis latis rufescentibus instructa; striis incrementi minutis, regulariter flexuosis.

Long. 11½ Mil.—Diam. 6½ Mil.

Differing from its nearest ally, *V. Vigourouxii*, in the peculiarity of the epidermis and in the anterior part of its aperture being more rounded and not nearly so dilated; there is also no callosity near the margin of the inner lip, the difference in size is equally very great, *V. Vigourouxii* being 24 Mil. in length and 14½ in breadth.

The animal resembles that of *V. fragilis*, Pease, (Am. Journ. of Conch. Pt. 2. 1868), the colour being bright orange with bands of red aggregrated corpuscles; it lives in shallow water on reefs among corallines &c.; when molested, exudes a milky fluid.

Fam. OXYNOEIDÆ.

OXYNOE, *Raf.*, 1819.

(Syn. *Icarus*, Forb. 1844. *Lophocercus*, Krohn, 1847.)

Oxynoe delicatula, n. sp. (Plate XIII, Fgs. 5. 5a. 5b. 5c.)

T. ovata, involuta, postice paulo contracta ac truncata, antice rotundata, albida, tenuis; apertura postice subcircularis, antice ovata, elongata, dilatata, marginibus prope terminationem posticam approximatis instructa, labio levi, tenui, labro postice paulo inflexo, ad marginem acuto.

Long. 6 Mil.—Diam. 3½ Mil.—Rare.

The much smaller expansion of the outer lip, &c., at once distinguish this species from *O. Sieboldii*, which it most resembles.

The animal of this species proves it to be a true *Oxynoe*, it is of a pale sea green colour spotted with round turquoise blue spots, it is found on reefs in very shallow water.

Cylindrobulla, *Fisch.*, 1857.

Cylindrobulla sculpta, n. sp. (Plate XIII, Fgs. 3. 3a. 3b. 3c.)

T. cylindracea, tenui, alba, medio angustata, postice sub-gibbosa; sutura postice profunde incisa et ad terminationem truncata; labio incrassato, labro sinuose inflexo; apertura antice subdilatata ac rotundata; superficie striis incrementi minutis, flexuosis, postice crassioribus, prope rectis notata.

Long. 6 Mil.—Diam. 4 Mil.—Very rare.

Cylindrobulla pusilla, n. sp. (Plate XIII, Fgs. 2. 2a. 2b. 2c.)

T. elongato-cylindracea, postice sub-gibbosa, truncatim desinente, alba, nitida, pellucida, tenuissima; sutura postica angusta; labro inflexo; apertura antice transversaliter subdilatata, marginibus tenuibus instructa; superficie striis minutis, postice approximatis notata.

Long. 4 Mil.—Diam. 2 Mil.—Very rare.

Rather closely allied to *C. Beauii*, but differing in the overlapping of the outer lip, &c. There also appears to be considerable resemblance to a shell described by H. Peace as *Volvatella candida*, (Amer. Journ. of Conch. 1868).

Lobiger, *Krohn*, 1847.

Lobiger viridis, n. sp. (Plate XIII, Fgs. 6. 6a. 6b.)

T. ovata, involuta, tenuis, virescens, ultimo anfractu postice valde inflata; apertura oblonga, antice attenuata et rotundata, postice breviter producta, sub-angustata; labio tenui, prope recto, levi, lente elevato; labro arcuate expanso, ad marginem tenui.

Long. 3½ Mil.—Diam. 5½ Mil.—Very rare.

L. viridis differs from the other species of the same genus in being anteriorly much more gradually rounded, as also by its greater tumidity near the spire, &c.

Fam. TROCHIDÆ.

Cyclostrema (Tubiola) sub-disjuncta. H. Ad.

(Plate XIII, Fgs. 1. 1a. 1b. 1c.)

Delphinula tubulosa, n. sp. Proceedings Asiatic Society Bengal, August, 1868.

T. tenuis, subturbinata, moderate umbilicata, spira paulo elevata, anfractibus quinis, fere tubulosis, rapide crescentibus instructa, ultimo prope terminationem dissoluto; superficie striis numerosis spiralibus ornata; apertura transversaliter sub-rotundata, marginibus tenuibus conjunctis; labro supra atque ad basin insinuato.

Long. 6½ Mil.—Diam. 9 Mil.—Rare.

Since the publication of the Abstract of this paper, where this shell is noticed as new, we find Mr. H. Adams has described it under the above name in the Proc. Zool. Soc. (1868, p. 293) from a specimen we sent to him some little time ago.

Fam. STOMATIIDÆ.

Broderipia eximia, n. sp. (Plate XIII, Fgs. 7. 7a. 7b, 7c.)

T. regulariter oblonga, patelliformis; apice excentrice sub-postico, paululum incurvo, antice sub-applanato, postice lente convexo; superficie costulis radiantibus, longioribus ac brevioribus alternantibus, prope apicem obsoletis, interstiis fere æquidistantibus separatis ornata; striis incrementi concentricis, minutis; costulis albescentibus, sulcis fusco-rubidis; testa interna margaritacea, in medio callositate tumescente, incrassata.

Long. 10 Mil.—Diam. 7 Mil.—Alt. 4½ Mil.—

Somewhat close to *B. nitidissima*, Desh., from Bourbon, though distinguishable at the first glance.

On Pandanophyllum and allied genera, especially those occurring in the Indian Archipelago; by S. Kurz, Esq., *Curator of the Calcutta Herbarium.*

[Received and read 7th October, 1868.]

The genus *Pandanophyllum*, established in 1844, by Dr. Hasskarl in his catalogue of the plants, cultivated in the Botanic gardens at Buitenzorg (p. 297) remained for a long time but imperfectly known, until Dr. Thwaites in his Ceylon plants, and Professor Oudemans in von Mohl and Schlechtendal's "Botanische Zeitung" directed the attention of botanists to this interesting genus of tropical plants.

Some time ago I noticed, in Professor Miquel's supplement to the flora of Sumatra, several species which that author had placed in the genus *Lepironia*, but which doubtless are congeners of *Pandanophyllum*. This circumstance has induced me to examine all the Indian species belonging to *Pandanophyllum* and its allies, and at the same time to describe those species, which occur in the Indian Archipelago, as far as the materials at my disposal allow it. In the present communication, I shall briefly state the results which I have thus obtained, trusting that they will be acceptable to Indian botanists. The new genus, *Thoracostachyum*, of which I shall give a detailed characteristic in the course of this paper, forms to a certain extent a connecting link between *Hypolytrum* and *Lepironia*, but it is sufficiently distinct from both of them, and deserves to be treated as an independent genus of Cyperaceæ.

Scirpodendron, established by the late Zippelius in the Herbarium of the Botanic gardens at Buitenzorg, is the most gigantic of all the Cyperaceæ I am acquainted with and, when destitute of flowers, it is hardly to be distinguished from stemless screw-pines.

HYPOLYTREÆ, *N. E.*

Spicae compositae squamis undiquê imbricatis sqamulis squamae ut plurimum contrarie instructis; spiculae solitariae, rarius ternae, squamâ oppositâ obtectae, compressae, 1—multiflorae, diclines v. raro hermaphroditae; flosculi masculi monandri, uni-squamulati, saepius ad squamulam solam reducti; flosculus femineus centralis v. excentricus, nudus v. rarius squamulatus; stylus 2-3—fidus; achenium v. achenium drupaceum.

I shall at first give a short review of the genera belonging to this tribe of the natural order CYPERACEÆ, and then enter in detail upon the description of the species, as far as this appears necessary.

Conspectus generum.

A. Pauciflorae. Spiculae 1-3—florae; flosculi hermaphroditi v. diclines.

1. HYPOLYTRUM: Spicae corymbosae; spiculae 3—florae; fl. masc. 2-3; flosc. femin. nudus, centralis; stylus bifidus; achenia ossea.

B. Multiflorae. Spiculae 6—multiflorae; flosculi diclines.

* Achenia ossea.

2. THORACOSTACHYUM: Spicae corymbosae; spiculae circiter 6-florae; flosc. exteriores masculi, sequentes ad squamulas reducti; flosculus centralis femineus, nudus; stylus trifidus.

3. LEPIRONIA: Spica solitaria, sub apice culmi lateralis; spiculae multiflorae; flosc. masc. 1—6, vario modo inter squamulas vacuas dispositi; flosc. centralis nudus; stylus bifidus.

* * *Achenia drupacea.*

4. PANDANOPHYLLUM: Spicae capitatae, v. rarius solitariae, terminales; spiculae 6-8—florae; flosc. 3 exteriores masculi, sequentes ad squamulas reducti; flosc. femineus excentricus, squamulatus; stylus 2-3—fidus; achenia acuminata, non stipitata.

5. CEPHALOSCIRPUS: Spicae capitatae; spiculae circiter 7-10—florae; flosculi 3 exteriores saepius masculi, sequentes ad squamulas reducti; flosc. femineus excentricus squamulatus et squamulam vacuam amplectens; achenia longe rostrata et longiuscule stipitata.

6. SCIRPODENDRON: Spicae compacto-paniculatae; spiculae 8-10—florae; floscul. centralis femineus nudus; fl. reliqui omnes masculi; stylus bi—(v. tri ?) fidus; achenium majusculum, sulcato—6 costatum.

I.—HYPOLYTRUM, *Rich.*

Spicae laxe vel compacto-corymbosae, teretes. Squamae arcte imbricatae, dein deciduae, inferiorum nonnullae vacuae, reliquae triflorae, androgynae. Flosc. masc. 2—3, monandri, uni-squamulati; squamulae squamâ oppositâ breviores, carinato-compressae; flosc. femin. nudus, centralis; ovarium oblongum v. sublagenaeforme; stylus bifidus. Achenium styli basi conicâ spongiosâ rostratum, compressiuscule ovatum.—*Herbae perennes, rhizomate obliquo ramoso lignescente, foliis trifarie equitantibus, frequentius trinerviis, basi complicatis, culmis trigonis paucifoliatis, foliis culmeis ochreaeforme vaginantibus, corymbis squamosis, spicis parvis v. pusillis.*

1. **H. latifolium,** *L. C. Rich. in Pers. Syn.* I. 70; *Kth. Enum,* II. *Fl.* 1; *Steud., Cyper.* 132; *Miq. Fl. Ind. Bat.* III. 333; *Bth. Fl. Hongk.* 389; *Kurz in Tydsch. Nat. Vereen. Ned. Ind. deel* XVIII. 164; *ejusd. in Bot. Ztg.* 1865. 204.—Folia lato-linearia v. linearia, sursum margine costâque apicem versus serrulato-scabra, trinervia, nervis lateralibus 2 crassis in pagina superiore obtuse prominentibus; culmi paucifoliati; corymbus amplus, intricato-ramosus, v. (in var.) simpliciuscule ramosus, contractus; achenia vix nitentia, in sicco lacunoso-rugosa v. sublaevia.

Rhizoma crassum, ramosum. Folia subcoriacea v. chartacea, trifarie equitantia, lato-linearia v. linearia, flaccida, basin versus parum angustata, complicata, superne explanata, plicato-trinervia, margine a medio costâque subtus apicem versus serrulato-scabra, 2—2½ ped. longa, 1½—½ poll. lata. Culmi penn. gallin. crassi v. graciles, strictiusculi v. debiles, trigoni, laeves, glaucescentes, pauci—1—2 foliati. Folia culmea basi ochreaeforme invaginantia, fol. superius corymbo saepe valde approximatum et potius involucro adnumerandum. Corymbus confertiusculus v. divaricatus, nunc simpliciuscule nunc intricate ramosus, squarrosus, involucratus. Involucri phylla solitaria, semiverticillos ramorum sustinentia, sursum decrescentim minora et in bracteas transeuntia. Rami ancipites, laeves, v. acie scabriusculi, basi bulboso incrassati; inferiores terni rarius quaterni, semiverticillati, 1½—2 poll. longi, v. abbreviati basi unibracteati, superiores bini v. solitarii, basi bracteati; ramuli ½ poll. longi, bibracteolati, apice 4—2 spiculas gerentes v. iterato ramulosi et bispiculati, basi vix incrassata ochreaeformi-bracteolati. Ramorum bracteae membranaceae, marginibus chartaceis ochreaeformi-vaginatae, 2—3 lin. longae, v. in ramulis superioribus bractea inferior carinato-lanceolata acuminata, viridis, bracteolâ superiore obtusâ duplo longior. Spicae minimae, elliptico-oblongae, obtusiusculae v. acutiusculae, castaneae, nitentes. Squamae ovales, obtusae, infimarum nonnullae vacuae, reliquae 3—florae. Flosculi laterales masculi, monandri, antheris inclusis, uni-squamulati; squamulae carinato-compressae squamâ multo breviores; flosc. centralis nudus, femineus, cum flosculis masculis quasi flosculum bisquamulatum hermaphroditum represeutans. Ovarium sublagenaeforme, glabrum; stylus breviusculus, bifidus, ramis crassis exsertis. Achenium parvum, in sicco frequentius rugoso-lacunulosum, nitidum v. sub-canescens.

Hab.—In hill forests, from Ceylon through Hindoostan to Birma, Malacca, and the Indian Archipelago, also occurring in the Philippines, Tropical Africa, Mauritius, Fidji islands.

Native names: Harassas lalakki, Sund., according Hassk.; ielat, Mal., but the same name is applied by the Malays to many other Cyperaceæ.

This would appear a very variable plant, judging from Bentham's identification of *H. latifolium* with *H. trinerve.* I myself have not met with the intermediate forms, and I accept here their identity merely on the authority of that distinguished botanist who, no doubt, had a more complete series to compare than I have at present at my disposal. The varieties might be distinguished as follows:—

Var. *a.* **genuinum,**—spicae duplo majores, circ. 2 lin. longae, fructigerae, ovales, fusco-canescentes; achenia oblonga, crasse rostrata praesertim rostro canescente puberulae.—H. latifolium, *L. C. Rich.*, *l. c.;* H. Mauritianum, *N. E. in Linn. IX.* 288; *Kth. Enum.* II. 272; H. giganteum, Wall. Cat. 3404; *N. E. in Linn.* IX. 288; *ejusd. in Wight Contr.* 93; H. diandrum, Dietr. Spec. II. 365; Albikia scirpoides, *Prsl. Reliq. Haenk.* I. 185, *t.* 35; Tunga diandra, *Rxb. Fl. Ind.* I. 184; Hypaelyptum nemorum, *P. d. B. Fl. d' Oware,* II. 13 t. 67; H. ensifolium, Willd herb. 1450; Schoenus nemorum, Vhl. Symb. III. 8. (Rheede XII. t. 58) ejusd. Enum. II. 227.

Hab.—Sumatra; Singapore: *T. Anderson,* No. 204; South Andaman; Birma, Moulmein and Amherst: *Wall.* Cat. 3404; Penang on the hills (rompot ayam incol.): *Wall. Cat.* 3404; Silhet: *Wall. Cat.* 3404; Malay Peninsula: *Griff.* 6271; Fidji islands: *Seemann.*

Var. *β.* **trinerve,** spicae minores, fructigerae globosae, fuscescentes; achaenia laevia, in sicco magis minusve lacunoso-rugata, nitentes, fuscescentes.—Hypolytrum trinervium, *Kth. En.* II. 272; *Steud. Cyp.* 132; *Miq. Fl. Ind. Bat.* III. 332; *Kurz in Tydsch. Natuurk.*

Vereen. Ned. Ind. deel. XVIII. 164; *ejusd. in Bot. Ztg.* 1865, 204; Albikia schoenoides, *Prsl. in Reliq. Haenk.* I. 185, *t.* 34? Hypolytrum schoenoides, *N. E. in Linn.* IX. 283; Scirpus anomalus, *Retz. Obs.* V. 15; Hypolytrum myrianthum, *Miq. Fl. Ind. Bot.* III. 333.

Sub-var. 1, *contracta*;—folia ultra poll. lata; culmi penn. gall. crassi; corymbi (praecipue fructigeri) contracti, ramosissima ramis inferioribus plerumque quaternatis.—Western Java; Sumatra, in Priaman: Diepenhorst (paro-paro inc.; Herb. Bogor. No. 2888.)

Sub-var. 2, *diffusa*;—folia ultra poll. lata, culmi penn. gall. crassi; corymbi divaricato-squarrosi, ramosissimi, ramis inferioribus ternatis. Rather frequent in the hill forests of Western Java, as on the Salak and Pangerango.

It is often difficult to distinguish Sub-var. 1 and 2 from each other, as there are many transgressions.

Sub-var. 3, *gracilis*;—folia vix. poll. lata, 3—3½ ped. longa; culmi graciles; corymbi divaricato-squarrosi, ramosi, ramis inferioribus ternatis.—This form is cultivated in the Botanic gardens, Buitenzorg, and most probably has come from the hill forests of the Pangerango or Salak. It is especially marked by the narrow leaves and the slender habit.

Var. γ **minor,** folia angustissima, ½ poll. lata v. angustiora; culmi graciles; corymbi parvi, ramis abbreviatis vix ramosis; acheniis ut in var. *β*.

Andamans, on Termoklee island; Ceylon: Thwaites, 3468.

2. **H. Borneense,** *Kurz.*—Folia anguste linearia, apicem versus serrulato-scabra, sub-plana, nervis 2 lateralibus in pagina superiore impressis, subtus acute prominentibus; culmi nudi; corymbus parvulus, squarrosus, ramis vix ramosis; achaenia laevissima, nitida, bisulcata.

Rhizoma stoloniferum, horizontaliter repens, squamatum, radices crassas demittens. Folia sub-coriacea, trifarie equitantia, e basi sensim angustatâ linearia, acuminatissima, trinervia, nervis omnibus subtus acute prominentibus, supra autem immersis, marginibus costaque subtus apicem versus spinuloso-scabra, 1—1½ pedalia, 6—8 lin. lata. Culmi foliis longiores, trigoni, nudi, laevissimi; corymbus vix pollicaris in diametro, contractiusculus, basi phyllis 1—2 culmo ipso triplo longioribus sustentus; spicae fructigerae subglobosae, iis *H. latifo-*

liae, var. *β*. trinervis, simillima; achenia nitida, ovata, atrofusca, acuminata, in sicco bisulcata.

HAB.—Borneo, Labuan: *Barber*, No. 193.

This species, in general appearance, resembles *H. latifolium γ. minor*, but may be readily distinguished by the nervature and the bisulcate achens.

(3.) **H. Longirostre,** *Thw. Enum. Pl. Zeyl.* 346.

HAB.—Ceylon: *Thwaites*, No. 3468.

SPECIES DUBIA.

Hypolytrum compactum, *N. E.*, *in Linn.* IX. 280; *Kth. Enum.* II. 272; *Steud. Cyp.* 32; *Miq.*, *Fl. Ind. Bat.* III. 333.

A Luzon species which by Steudel, and subsequent authors, is compared with *Pandanophyllum humile*, Hassk.

II. THORACOSTACHYUM.

Kurz in Tydsch. Nat. Vereen. Ned. Ind., deel. XXVII. (nomen nudum).

Spicae corymbosae, teretes. Squamae undique imbricatae, dein deciduae, inferiorum nonnullae vacuae, reliquae spiculam 6—7 floram androgynam foventes. Flosculi 3 exteriores masculi, sequentes ad squamulas reducti; flosculus summus femineus, uni-sqamulatus. Squamulae squamâ communi breviores et oppositae, carinato-compressae. Ovarium compresso-oblongum, utrinque attenuatum; stylus trifidus. Achenium osseum, lenticulari-compressum, utrinque attenuatum, rostratum.—*Herbae habitu et vegetatione omnino Hypolytri, sed spicis multo majoribus rigide squamatis insignes.*

1. **Th. Sumatranum,** *Kurz.* Folia linearia, plicato-3-nervia, spinuloso-serrulata; culmi foliis longiores, trigoni, oligophylli; corymbus polystachyus, involucratus, divaricato-squarrosus; spicae obovoideo-ellipticae, parvulae, in sicco stramineae; achenia lenticulari-compressa, utrinque attenuata, rostrata, laevia.—Lepironia Sumatrana, *Miq.*, *Suppl. Fl. Sumatra*, 604.

Rhizoma abbreviatum, verticale, radices crassas demittens. Folia firma, densa, trifarie equitantia, linearia, acuminata, plicato-trinervia, margine costâque subtus a medio spinuloso-serrulata, 2—2½ ped. longa, ¼ poll. lata. Culmi folia longitudine superantes, 3—3½ ped. longi, trigoni, striati, glabri, basi paucifoliati. Corymbus polystachyus, divaricato-squarrosus, ramis brevibus triquetris; rami inferiores foliis fere 1—3 ped. longis involucrantibus sustenti, reliqui sensim minora et in bracteas abeuntia. Spiculae 2—5 nae, aggregatae, oblongo-ovatae v. obovoideo-ellipticae, acutiusculae, majusculae, nitentes, in sicco stramineae. Squamae cartilagineo-rigidae, convexiusculae, sursum deorsumque minores, elliptico-oblongae, obtusae; infimae 4—5 vacuae saepe acutiusculae; sequentes spiculam 7-floram androgynam includentes. Flosculi 3 exteriores masculi, monandri, sequentes 2 neutri ad squamulas reducti; flosc. intimus excentricus, femineus, uni-squamulatus, squamulam septimam sterilem amplectens. Squamulae laterales 2 compresso-naviculares, in carinâ ciliolatae, reliquae depressae. Ovarium e basi constrictâ compresso-oblongum, acuminatum; stylus brevis, cum ovario continuus, trifidus, ramis elongatis exsertis. Achenium compresso-lenticulare, utrinque attenuatum, styli basi persistente acuminato-rostratum.

Hab.—Sumatra, in the forests of the Lampong district, near Ipil, Battang lekko: *Teysmann* (H. Bogor. No. 3932).

Native names: Selingsieng (inc. Lampongensium).

2. **Th. Bancanum,** *Kurz, in Tydsch.* Nat. Vereenig. Ned. Ind. XXVII. 286; *ejusd, in Bot. Ztg.* 1865. 204. Folia elongato-linearia, spinuloso-serrulata; culmi trigoni, aphylli; corymbus involucratus, contractus; spicae breviores, ellipsoideae, obtusae, pauci spiculatae, in sicco griseae; achaenia ellipsoideo-trigona, convexa, apiculata.—Lepironia Bancana, *Miq. Suppl. Fl. v. Sumatra*, 604.

"Caulis subnullus; folia densa, trifarie equitantia, elongata, linearia, marginibus carinâque spinuloso-serrulata; culmus trigonus, aphyllus, angulis versus apicem scabris; involucrum inaequaliter 2-4—phyllum; corymbus contractus, ramis 6—10—stachyis, pedicellis ad angulos serrulato-scabris geminis ternis pluribusve confertis; spiculae ellipsoideae, obtusae, squamis infimis vacuis subacutis, reliquis ovalibus obtusis striulatis griseis cum levi rubore (sub anthesi); squamulae interiores 6 (?), quarum exteriores naviculari-compressae, carinâ ciliatae; achaenia in singulâ spiculâ circiter 4, reliquis suppressis, ellipsoideo-trigona, faciebus convexis, sulco interjecto separatis, unâ majore, 2 aequalibus minoribus, crasso-crustacea, styli basi apiculata, (Miq. l. c.)

Hab. Banca, especially on river banks and in swampy places of the forests; Singapore, near swamps: *Wall. Cat.* 3401.

III. Lepironia, L. C. Rich.

Spicae solitariae, infra culmi apice laterales, teretes, multi-spiculatae. Squamae spiraliter arcte imbricatae, deciduae, inferiorum nonnullae vacuae, sequentium paucae passim squamulas steriles plurimas cum flosculo femineo includentes, reliquae multiflorae, androgynae. Flosculi masculi monandri 1—6, vario modo interpositi, uni-squamulati, reliqui ad squamulas reducti; flosculus femineus centralis, nudus. Squamulae carinato-naviculares. Antherae spurie 4-loculares, mucronatae. Ovarium sublagenaeforme; stylus bifidus. Achaenium lenticulare, compressum, obovatum, styli basi persistente rostratum, osseum.—*Herba perennis aphylla habitu Juncorum, rhizomate vage repente squamato, culmis teretibus basi vaginatis, spicis indole* Scirporum *quorundam.*

1. **L. mucronata,** *L. C. Rich. in Pers. Syn.* I. 170; *A. Rich, in Dietr. Class.* 297; *Kth., Enum.* II. 366; *Miq., Fl. Ind. Bat.* III. 346; *Steud., Glum.* I. 181.—Scirpus coniferus, *Poir., Encycl.* 756; *Suppl.* V. 90; Restio articulatus, *Retz., Obs.* IV. 15; Chondrachne articulata, *R. Br., Prod.* 220.

Hab.: Indian Archipelago, Sumatra in Lampongs: *Teysm.* Hb. Bog. 4249; isl. Banca; Borneo, Banjermassing: *Motley*, Hb. 1267, Singapore.

Distrib. New Holland; Madagascar.

Native names: Tikooh *in Lamp.;* Pooron in *Banca.*

Planta elegans, 2—3 ped. alta et altior, vegetatione Juncis accedens. Rhizoma vage repens, hypogaeum, radices crassas perplurimas emittens, squamis chartaceis testaceis v. brunnescentibus striatis obtectum. Culmi pennae scriptoriae crassitudinis v. crassiores, atrovirides, striati, intus transverse septati, in sicco ad septa nodosi, aphylli, basi pauci-vaginati. Vaginae striatae, marginibus membranaceis, mucronatae, culmo magis minusve concolores, basin versus fusco-purpurascentes, infimae 1—2 ovatae v. ovato-lanceolatae e rhizomate orientes; sequentes magis elongatae amplectentes; suprema usque semipedalis, caeteras longitudine multo excedens. Spica solitaria, lateralis, elliptico-ovalis v. oblonga, obtusiuscula v. acutiuscula, multiflora, basi culmi processu dilatato versus apicem terete spurie bracteata. Rhachis elongato-conica, confertissime et spiraliter cicatrisata, sublignea, intus medullosa. Squamae spiraliter dispositae, confertissimae, post acheniorum maturitatem valde deciduae, inaequali lato-oblongae, obtusissimae, concaviusculae, scariosae, ad margines non raro magis minusve laceratae, fusco-ferrugineae v. badiae, apice intensius coloratae, inferiores paucissimae, vacuae, reliquae spiculam squamâ propriâ vix longiorem androgynam continentes. Spicula 12—15 flora, flosculi masc. unisquamulati, 1—6, monandri, reliqui ad squamulas reducti et sine ordine manifesta circum flosculum femin. excentricum nudum dispositi. Squamulae hyalino-albidae, apice brunnescentes, acuminatae; laterales carinato-naviculares, carinâ eleganter ciliatae: staminigerae medianae depressae, marginibus inflexis; steriles lineari-lanceolatae, planae. Antherae dein exsertae, spurie 4-loculares, lineares, atropurpureae, mucrone albo terminatae, loculis longitudinaliter dehiscentibus, filamenta pilosiuscula, glabrescentia. Pollinia, irregulari-ovalia, sulfurea. Ovarium compresso-ellipticum uni-ovulatum, ovulo erecto, glabrum; stylus bifidus. Achaenia plano-convexa, oblonga, utrinque attenuata, marginata, striata, nitentia, testacea, stylo persistente rostellata; rostrum dimidium fere longitudinis achaenii ipsius attingens introrsum curvatum.

IV. Pandanophyllum, Hassk.

Spicae solitariae v. capitato-compactae, teretiusculae, magnae, multispiculatae. Squamae undique imbricatae, dein laceratae et emarcescente-persistentes; inferiorum plures vacuae, reliquae spiculam 5—8-floram androgynam squamâ ipsâ paullo longiores v. breviores gerentes. Flosculi exteriores 3 masculi, monandri, uni-squamulati; sequentes 2—4 steriles squamulis totitem representati; flosculus femineus excentricus unisquamulatus saepius squamulam sequentem vacuam amplectens. Squamulae laterales carinato-compressae, naviculares, squamae contrarie insertae. Ovarium sublagenaeforme v. oblongum; stylus 2—3 bifidus. Achaenium obovatum, styli basi persistente rostratum, utrinque attenuatum, pericarpio carnescente indutum, nucleo lapideo, hilo excavato.—*Herbae perennes, habitu omnino Pandanorum, rhizomate lignescente; foliis trifariis basi complicatis sessilibus v. petiolatis trinerviis; culmis trigonis, e stolonibus abbreviatis squamatis ortis, nudis v. squamatis; spicis solitariis v. capitatis, basi involucratis v. subnudis.*

1. **P. palustre,** *Hassk. Cat. Bog.* 297; *ejusd. Tydsch. Nat. Vereen.* X. 118; *Steud. Glum.* I. 134; *Zoll. Cat.* 61; *Walp. Ann.*

I. 753; *Miq. Fl. Ind. Bat.* III. 334.—Folia lato-linearia, acuminatissima, trinervia, margine costâque spinuloso-serrulata, rigide coriacea; culmi 1—1½ pedalia, aphylli, obtuse trigoni; capitulum oligo-v. polystachyum, compactum, magnum, phyllis 3—4 latis squamaeformibus eo ipso brevioribus v. aequilongis involucratum; squamae lanceolatae, obtusae v. apice dilaceratae, sub-enerviae, chartaceae; achaenia inaequali-oblonga, styli basi acuminata.

Var. α. **Malesica,** capitulis saepe pugni infantis magnitudine, hemisphaericis v. subglobosis, polystachyis; spicis autem duplo v. triplo minoribus.

Var. β. **Silhetana,** capitulis irregulari oblongis, e 3—9 spicis maximis compositis.

Hab.—In damp hill forests in Western Java frequent, as on Pangerango, 3—4000′; on the Salak 4—5000′; var. β, between rocks and tree stumps, Passir Madang, Probakti, 2—4000′; Zollinger. Singapore: *Wall.* 3541 (young inflorescence); Silhet: *Wall. Cat.* 4474 (var. β).

Native names: Bangkonoh *or* Harassas tjaee *in Java.*

Rhizoma crassum, obliquum, radices çrassas demittens. Folia rigide coriacea, trifarie equitantia, lato-linearia, acuminatissima, trinervia, marginibus rectangulariter deviis spinuloso-serrata, subtus in carinâ basi retrorse scabra, apicem versus spinuloso-serrulata, 6—9 ped. longa, 1½—2 poll. lata, supra atroviridia, nitida, subtus glaucescenti viridia. Culmi 1—1½ pedales, deorsum sensim attenuati, obtuse trigoni, basin versus subteretes, glaucescenti-virides, glabri, sublente albido-punctati. Spicae plurimae elliptico—v. conico-oblongae, ½—1 pollicem paene longae, capitato-conglomeratae, involucratae; involucri phylla 3—4 v. 6—8, squamaeformia, coriacea, e basi latissimâ oblongo-ovalia, acutata, planiuscula v. concaviuscula, spicularum longitudine æqualia v. vix longiora. Squamae lato-lanceolatae v. lanceolatae, apice obtusae v. saepius dilaceratae, sub-enerviae, laeves, chartaceae, e flavescente brunnescentes; inferiorum nonnullae vacuae; sequentes spiculam squamâ breviorem 6-floram androgynam includentes. Flosculi omnes uni-squamulati; exteriores 3 monandri, interiores 2 ad squamulas reducti, flosculus intimus excentricus femineus. Squamulae laterales compresso-naviculares, carinâ ciliatae; squamula flosculi femin. linearis, sub-plana, marginibus inflexis. Antherae exsertae, biloculares, ab ovario aversae. Ovarium sublagenaeforme, glabrum; stylus longiusculus, bifidus. Achaenium inaequali-oblongum, utrinque attenuatum, obsolete trigonum, styli basi persistente acuminatum, pericarpio tenui carnescente testaceo, nucleo lapideo nigro.

2. **P. squamatum,** *Kurz.*—Folia lato-linearia, acuminatissima, trinervia, margine costâque spinuloso-serrulata, rigide coriacea; culmi abbreviati, ½—1½—pollicares, squamati, trigoni, obscuri; capitula oligo-rarius mono-stachya, compacta, oblonga; squamae ellipticae, obtusae v. apice laceratae, in sicco striatae, chartaceae; achaenia utrinque attenuata, bicarinata, rostrata.

HAB. Java, in hilly parts of Buitenzorg: *Zippelius* (*in Hb. Bogor.*)

Rhizoma lignescens, verticale v. obliquum, radices crassas demittens. Folia trifarie equitantia, e basi complicatâ lato-linearia, acuminatissima, trinervia, lateribus deviis margine subtusque in costâ apicem versus spinuloso-serrulata, coriacea, 5—6 ped. longa, 1—1¼ poll. lata. Culmi e foliorum axillis erumpentes, abbreviati, ½—1½ poll. longi, undique, praesertim basi, squamis ovato-oblongis concavis acutis striatis obtecti, trigoni, striati, glabri. Spicae 2—3, capitato-conglomeratae, rarissime solitariae, oblongae, obtusae. Squamae undique imbricatae, ellipticae, obtusae v. saepius lacerantes, in sicco striulatae, fuscescentes, inferiores 4—5 vacuae saepe involucrantes, reliquae spiculam 6-floram squamâ propriâ paullo longiorem androgynam continentes. Flosculi 3 exteriores masculi, monandri, sequentes ad squamulas reducti, flosculus intimus excentricus femineus squamulam vacuam amplectens. Squamulae laterales lineares, curvati, carinato-naviculares, in carinis minute denticulatae. Achaenium adhuc (immaturum) oblongum, utrinque acuminatum, bicarinatum, pericarpio tenui coriaceo, nucleo lapideo cinerascente apiculato.

3. **P. Zeylanicum,** *Thw. Enum. Pl. Ceyl.* 345.

HAB. Ceylon: *Thwaites*, *C. P.* 3029; South Andamans.

This species, which is not yet recorded from the Indian Archipelago, differs from the next one, *P. Miquelianum*, especially by the more robust and obtuse spikelets, which form a head, when fully grown, not dissimilar to that of *P. palustre.* The scales are furnished by a broader white (in dried state brown) margin. Dr. Thwaites describes his plant as having a clavate style, but the Andaman specimens have them normally two cleft. I saw the Ceylon plant in the Herbarium of the Botanic gardens at Buitenzorg, but unfortunately I have here no specimen to examine. I strongly suspect that Dr. Thwaites, when describing the plant, has had before him young spikelets only.

4. **P. Miquelianum,** *Kurz.* Folia elongato-linearia, acuminatissima, trinervia, margine costâque spinuloso-serrulata, flaccida, utrinque nitentia, saturate v. flavescente viridia; culmi elongati, 1½—3 pedales, nudi, trigoni, nitentes; spicae solitariae, squamis laete viridibus anguste albide (in sicco fuscescente) marginatis; achenia oblonga, utrinque attenuata, acuminata, vix carinata.—*Lepironia enodis*, Miq., Suppl. Fl. *v.* Sumatra, 603; *Lepir. foliosa*, Miq. l. c. (*spicis adhuc virgineis.*)

Hab. Sumatra, in the jungles of Danoh-tjaloh, Moesi, Palembang: *Teysm. Hb. Bog.* 3686 *et* 4051.

Native name: Rumput selingsieng *in Palemb.*

Rhizoma crassum, obliquum v. subverticale, lignescens, radices plurimas crassas demittens. Folia trifarie-equitantia, lato-, v. angustelinearia, acuminatissima, infra medio paullo angustata, complicata, basi vix dilatata, 4—5 ped. longa, ½—1 poll. lata, margine versus basin et apicem, v. totâ longitudine, remotiuscule spinuloso-serrulata, costâ apicem versus spinulosa, trinervia, marginibus rectangulariter deviis. Culmi e rhizomate stolonibus abbreviatis squamatis orientes, 1½—3½ ped. long., sursum sensim incrassti, obtuse trigoni, striulati, nitentes. Spicae terminales, solitariae, conico-ellipticae v. clavato-oblongae, obtusae, dein acuminatae. Squamae undique arcte imbricatae, emarcescente persistentes, sursum sensim minores, oblongo-lanceolatae v. lato-oblongae, acutatae; superiores obtusiusculae, virides, margine anguste membranaceo albidae (in sicco autem fuscescentes), sub-trinerviae, nervis tenerioribus parallelis percursae; inferiores 9—10 vacuae, sequentes 5—florac. Flosculi omnes unisexuales, exteriores 3 masculi, monandri, intimus femineus squamulam sterilem amplectens. Squamulae flosculorum exteriorum compresso-naviculares, carinâ erose-ciliolatae, medianae depresso-bicarinatae, in angulis ciliolatae. Filamenta dein elongata paullo supra squamulam exserta; antherae lineares filamento dimidio breviores, biloculares, longitudinaliter dehiscentes, flavescente-albidae, apice minute apiculatae. Flosculi feminei excentrici, squamula depressa, linearis, marginibus inflexis squamulam sterilem amplectens. Ovarium sublagenaeforme laeve; stylus breviusculus, ovario continuus, emarcescente persistens, trifidus, ramis inclusis. Achaenium obovatum, basi angustatum, apice styli basi persistente acuminatum, pericarpio tenue carnosulo (in sicco coriaceo) laevi testaceo, nucleo lapideo nigrescente.

Prof. Miquel, in establishing his *Lepironia enodis* had only the full-grown inflorescences before him, which were distributed from the Botanic gardens, Buitenzorg, under No. 3029, and described therefore the plant as having no leaves. But the leaves with young inflorescences were (by mistake probably) distributed at the same time under No. 4051, coming also from Palembang, and upon these specimens he founded his *Lepironia foliosa.*

5. **P. Humile,** *Hassk., Cat. Bog.*, 297; *Steud., Cyp.* 134; *Zoll., Cat.* 61; *Walp., Ann.* I, 753; *Miq., Fl. Ind. Bat.* III, 334; *Oudem., in Bot. Ztg.* 1866, 193.—Folia petiolata, laminâ elongato-ellipticâ retusâ abrupte subulato-cuspidata, marginibus apicem versus spinuloso-serrulatâ; petioli complicati, basi vaginato-dilatati; culmi plerumque geminati, elongati *v.* abbreviati, basi squamato-vaginati; spicae solitariae (rarius binae), squamis fuscescente viridibus plurinerviis; achenia oblonga utrinque attenuata, acuminata, obsolete bicarinata.—Lepistachya praemorsa, *Zipp. M. S.;* Lepironia cuspidata, *Miq. Suppl. Fl. v. Sumatra,* 603; Pandanophyllum Zippelianum, *Kurz in natuurk. Tydsch. v. Ned. Ind.* XXVII. 126; *ejusd. Bot. Ztg.* 1865 204.

Hab.: One of the most common grasses in the hill forests of Western Java, at 3-5000′ ft. elevation; occurs also in Banca: *Teysmann;* and in Sumatra: *Korthals.*

Native name: Sohlenat, Sunda.

Rhizoma crassum, obliquum v. verticale, lignescens, radices plurimas demittens. Folia trifarie equitantia, subcoriacea, petiolata; lamina elongato-elliptica, 1—1½ ped. longa, 1½—2½ poll. lata, basi in petiolum complicatum longitudine ab 1—2½ poll. variantem basi vaginato-dilatatum decurrens, apice retuso abrupte subulato—(—2 poll.) cuspidata, plicata, 3—nervis, margine apicem versus costâque spinuloso-serrulata. Culmi e stolonibus abbreviatis squamato-vaginatis plerumque geminatim orti, nudi, deorsum attenuati, obtuse trigoni, striati, glabri, 1—4 poll. usque ad pedem longi, intense virides opaci, sub lente albido-punctati. Spicae oblongae v. ovato-oblongae, obtusiusculae v. acutiusculae, solitariae, v. passim binae. Squamae arcte imbricatae, emarcescente persistentes, sursum sensim minores; inferiores 3—4 vacuae, lanceolatae v. oblongo-lanceolatae, obtuse carinatae, striatae, opacae, virides, margine membranaceo brunnescentes; sequentes ecarinatae, nervosae, teneriores, flavescente-testaceae v. brunnescentes, nitentes, spiculam 6 floram androgynam foventes. Flosculi omnes uni-squamulati, 3 exteriores masculi, monandri; 2 interiores ad valvulas reducti : flosc. intimus excentricus, femineus. Squamulae flosculorum laterali compresso-navicuculares, in carinis eroso-ciliolatae, medianae depressae. Antherae exsertae. Ovarium sub-lagenaeforme, laeve; stylus brevis ovario continuus, emarcescente persistens, trifidus, ramis elongatis inclusis. Achaenia oblonga, styli basi apiculata, obsolete bicarinata, pericarpio carnescente (in sicco coriaceo) brunnescente asperulo, nucleo lapideo nigrescente.

This is a very variable species, not only with regard to the leaves, which are longer or shorter petioled, but also with reference to the length of the culms, sometimes attaining nearly the length of the leaves, sometimes reduced so as to let the spike appear almost sessile. Sometimes these culms are furnished also with a few bracts.

6. **P. immersum,** *Thw. Enum. Pl. Zeyl.* 433.

HAB. : Ceylon : *Thwaites C. P.* 3819.

Rhizoma crassum, lignescens, radicosum. Folia trifarie-equitantia, 2—2½ pedalia, pollice angustiora, anguste linearia, acuminata, basin membranaceo-marginatum breviter vaginantem versus angustiora, complicato-trinervia, laevia, supra nitida, subtus glaucescentia et opaca, marginibus costâque basin versus remote et minute serrulata v. omnino laevia. Culmi pollicares v. breviores, bracteis sursum majoribus spicâ ipsâ solitariâ sublongioribus obtecti. Bracteae culmeae superiores involucrantes, membranceo-marginatae, lineares, acuminatae. Spica fructigera cerasi minimi magnitudine, densiuscula, squamis late-ovatis acuminatis in sicco fuscescentibus striatis. Achaenia ovata, incurvato-rostrata, ecarinata; pericarpio carnosulo.

V. CEPHALOSCIRPUS, KURZ.

Spicae glomerato-capitatae, multi-spiculatae. Squamae undique imbricatae, emarcescente persistentes, inferiorum nonnullae vacuae, reliquae spiculigerae. Spiculae 7—10 - florae, squamâ propriâ longiores. Flosculi omnes uni-squamulati, nunc 3 exteriores, nunc 3 alii masculs, monandri, reliqui ad squamulas reducti; flosculus intimus femineus squamulam sterilem amplectens. Squamulae laterales carinato-compressae. Ovarium basi stipitiformi-attenuatum; stylus trifidus. Achaenium longe stipitatum, rostratum, pericarpio carnosulo, nucleo lapideo.—*Herba perennis habitu omnino Pandanophyllorum, sed phyllis involucrantibus longissimis etiam adspecta diversa.*

1. **C. macrocephalus,** *Kurz.*—Hypolytrum macrocephalum, *Gaud. in Freyc. Jt. Bot.* 414; *Kth. En.* II. 273; *Steud., Cyp.* 133.

Hab.: Moluccos; *Gaudichaud*; ib. isl. Batjan; *Teysmann. (in Hb. Bog.)*

Rhizoma......Folia......Culmi trigoni, glabri, pedales, basi paucifoliati. Spicae semipollicares, majusculae, plurimae, inaequali-oblongae, compressiusculae, glomeratae; glomeruli phyllis singulis sustenti in capitulam involucratum pollicem dein 1½ poll. crassum compacti. Involucri phylla inferiora 3—4, pedalia *v.* longiora, poll. lata, lato-linearia, subulato trigono-acuminata, trinervia, marginibus rectangulariter deviis, margine costâque subtus apicem versus spinuloso-serrulata, subcoriacea, phylla sequentia mox in bracteas glomerulis ipsis minores lato-ovatas acuminatas transeuntia. Squamae undique imbricatae pellucescente-chartaceae, oblongo-lanceolatae, obtusiusculae, trinerviae, glabrae, nitentes; inferiorum nonnullae vacuae, réliquae spiculam 7—10—floram includentes. Spiculae lineares, compressae, squamâ longiores. Flosculus intimus excentricus femineus uni-squamulatus, squamulam sterilem amplectens; flosculi sequentes 3 *v.* 3 alii extimi masculi, monandri, uni-squamulati, reliqui ad squamulas vacuas reducti. Squamulae laterales compresso-naviculares, carinâ ciliatae, medianae depressae. Ovarium sublagenaeforme, utrinque angustatum, glabrum; stylus longus, persistens, trifidus, ramis elongatis. Achaenia oblonga, basi in stipitem longum gracilem attenuata, tricarinata, stylo persistente longe acuminato-rostrata (rostrum achaenium longitudine paullo superans), pericarpio carnosulo, (in sicco tenui coriaceo) glabro testaceo, nucleo lapideo nigrescente.

I have not Gaudichaud's work above cited for consultation, but I think I am correct in quoting his plant from Kunth's and Steudel's descriptions.

VI. Scirpodendron, Zippelius.

Spicae glomerato-paniculatae, compactae, undique squamatae. Squamae emarcescente persistentes, inferiores saepius tri—superiores unispiculatae, 8—10 florae, androgynae. Flosculus centralis femineus, nudus; flosculi reliqui masculi omnes monandri, uni-squamulati. Squamulae squamae contrariae; laterales compresso-naviculares; vacuae nullae (an semper?). Ovarium lagenaeforme; stylus longiusculus, bi—(an etiam tri?) fidus. Achaenium magnum, obovatum, 6, (12?) costatum, pericarpio carnoso (in sicco corticoso rugoso), nucleo lapideo mucronulato.—*Planta perennis habitu Pandanis veris acaulibus ita similis, ut ab his aegre discernenda nisi inflorescentia.*

1. **Sc. costatum,** *Kurz.* Scirpodendron pandaniforme, *Zipp. MS.;* Pandanophyllum costatum, *Thw. En. Pl. Zeyl.* 433? Scleria macrocarpa, *Wall. Cat.*

Hab.—In the hill jungles of Western Java along the torrents and in swampy places: *Zippelius, &c.* Singapore and Penang: *Wall.* 3538; Ceylon: *Thwaites.*

Native names: Harassas *in Sunda.*

Rhizoma crassum, obliquum, lignescens. Folia coriacea, trifarie equitantia, lato-linearia, acuminatissima, 6—9 ped. longa, pollicem lata et latiora, trinervia, lateribus rectangulariter deviis, margine costâque a medio spinuloso-serrulata. Culmi 1—1½ ped. longi, trigoni *v.* triquetri, glabri *v.* in angulis scabeirimi, aphylli, basi squamati. Panicula compacta, terminalis, pauci-ramea, ramis brevibus crassis simplicibus, inferioribus 3—4 phyllis singulis sustentis involucrantibus. Involucri phylla longissima, 7—2 ped. longa, foliis subconformia. Spicae sessiles *v.* sub-sessiles, compositae, basi bracteâ magnâ chartaceâ e basi latâ oblongâ acutâ concavâ sustentae. Squamae oblongae, obtusiusculae, carinatae *v.* subcarinatae, striatae, membranaceae, inferiores saepe spiculas tres, sequentes spiculam unicam squamâ propriâ breviorem tegentes. Flosculus centralis nudus femineus. Squamulae laterales lato-carinato-naviculares, carinâ ciliolatae. Antherae exsertæ. Ovarium sublagenaeforme; stylus longus, bifidus, ramis brevibus. Achaenia drupacea, magnitudine pisi majoris, in sicco sulcato—6—costata, rugosa; pericarpium in sicco corticosum; nucleus obovatus, obsolete 6—costatus, apiculatus, lapideus.

I am in doubt whether Dr. Thwaites' *Pandanophyllum costatum* is identical with this plant, as his short description does not well coincide with the above characteristic. According to that author the achenes are 6—12 ribbed, but the Malayan species which I have examined, have them all 6-ribbed only.

The Malacology of Lower Bengal and the adjoining provinces ; by FERD. STOLICZKA, ESQ., Ph. D., F. G. S., &c., *Palæontologist of the Geological Survey of India.*

[Received and read 4th November 1868.]

Under the above title I propose to record a series of papers, the special object of which is the exposition of the Molluscous fauna of Lower Bengal and of the adjoining provinces. It is not my intention to follow in these papers any systematic arrangement, but simply to bring the materials, as they are collected, to the notice of Conchologists.

At first sight it may seem that there is hardly a necessity for a series of such papers, as the Molluscous fauna of Bengal is pretty well known through the valuable researches of H. Benson, W. T. Blanford, and others. With regard to our knowledge of the shells, or the solid parts of Molluscs, this statement would deserve a fair consideration, but it is marvellous how very ignorant we are of the soft parts of the respective animals. The course of study pursued in Conchology during the last twenty years, has shewn that no systematic arrangement can be attempted without the due knowledge of the animals, even generic and specific determinations are sometimes impossible to be carried out without them. Comparative anatomy and morphology of our Molluscs are equally deficient as the principal elements.

Strictly speaking it is by no means surprising that the anatomy of our Indian Molluscs is as yet so little known. The shells are easily preserved and more or less commonly found at all times of the year. The animals on the contrary are met with only at certain seasons characterized by a large proportion of moisture in the atmosphere, which combined with the tropical heat often rapidly decomposes the animal substance, while under the knife and the needle. Besides few of our able conchologists had had the opportunity of observing many live animals, and the examination of specimens, preserved in spirit, glycerine, &c., are very easily misleading, so as to give various organs a different interpretation from that to which they are actually destined.

During the course of my papers I shall, therefore, endeavour to pay special attention to the soft parts of the animals, to the anatomical and morphological details. Only the shells of newly discovered species will be separately figured, but of all species, as far as they can be procured, representations of the animals, of the dentition, &c., will be given. I shall feel amply rewarded, if I can see that any of my conchological friends appreciate this course of inquiry; and I will feel greatly obliged if they would favour me with live specimens of Molluscs. During the rains and in the cold weather most of the land shells will survive for 9 and 10 days in a box with a little moistened moss, a few holes being made in the box for the purpose of ventilation. If not procurable alive, specimens in spirit or glycerine* will be also thankfully received.

I do not wish to give my papers a more extensive title, than the one quoted above, because I as yet have only the hopes to procure those specimens which are within my own reach and that of my collectors, but I trust that the area of my research and examination will gradually obtain a wider range. The first paper will be devoted to the examination of some remarkable Molluscs, for a species of which Dr. F. Buchannan 70 years ago proposed the name *Onchidium*.† These animals may be in a certain point regarded as the tropical representants of the slugs, or *Limaces*, which are generally found only in temperate climates. Although I have numerous materials on other groups of Molluscs collected, I have given preference to this one, because the characteristics given of the genus are very deficiently known, and partially incorrectly recorded in the present leading works on Conchology. Dr. Buchannan's description of the type species, *Onchidium typhæ*, is not very clear, neither is it sufficient, and the general belief was, that the species has been lost sight altogether. Nevertheless I find that it was very well known for many years to several of our Indian Conchologists, and it is actually during the rainy season a very common species about Calcutta.

* Glycerine does admirably for these purposes. It is occasionally advantageous to put the animal first in hot water for a few minutes, and after its death in glycerine or spirit, the animal does not shrink afterwards so much as it would when put in glycerine alive.

† An account of the *Onchidium*, a new genus of the class of Vermes, found in Bengal, by F. Buchannan, M. D., A. L. S.;—read June 5th, 1798; Transactions Linn. Society, Vol. V., 1800, p. 132.

No. I. On the genus ONCHIDIUM, with descriptions of several new species; (with plates XIV and XV.)

Order.—PULMONATA.

Family.—ONCHIDIIDÆ.

Genus.—*Onchidium*, Buchannan, 1800.

Char. Body oblong, entirely covered by a coriaceous, more or less tuberculated mantle, projecting at the sides and internally fleshy; foot long, narrower and little shorter than the mantle; head large, distinct; the mouth situated below, forming a longitudinal slit surrounded by thickened lips, and two, more or less, prolonged and thickened buccal appendages, to the upper edge of which are, so to say, the tentacles soldered on, being represented merely by thickened rims; superior to these are the long, retractile pedicles bearing on their tips the eyes. Two cartilaginous plates in the œsophagus are covered with a broad radula furnished with very numerous, small equally formed teeth, the central tooth being pointed and equilateral, the laterals usually somewhat smaller, almost all of equal size, slightly hooked, claw-shaped; no special upper jaw is present. Anus situated at the upper basal end of the foot; pulmonary orifice posterior to it in the mantle. The sexes are united, the common sexual opening being placed more or less close to the right of the anus, in the fold between the inner side of the mantle and the foot; a special male organ is besides situated under the right eyepedicle; it is thick, long, provided with a short flagellum; the propagation is effected by mutual reciprocal impregnation. Shell none. Habit similar to that of the *Limaces*, or rather more to that of sea slugs, as I shall endeavour to prove hereafter.

Before entering upon a description of the various species, it will be necessary to give a detailed statement of the most important and characteristic anatomical and morphological points. I select for this purpose the type species of the genus; any differences in the other species from this type can be afterwards much easier recorded, without giving a repetition of those details. In conclusion I shall allude to the genera *Onchidella* and *Peronia*, which have been considered as distinct from *Onchidium*.

The upper part of the body of all the *Onchidia* is, as stated above, always entirely covered by a more or less coriaceous mantle, the epidermis of which chiefly consists of a chitinous or horny substance, and can be removed from it without producing a change in the colour of the animal. The surface of the mantle is generally finely granulated, but in all our species some larger tubercles are besides found, more or less numerous, and irregularly distributed on it. These larger tubercles can be protruded or retracted at will. When the animal is in a healthy state, they are generally very distinct, each of them bearing one to four jet black dots, the functions of which in the economy of the animal it is difficult to understand, but most likely the pigment which they contain, when added to the mucus secreted by the entire body, acts as a kind of defensive fluid against other animals. The mantle is amply supplied with nerves issuing from the central ganglion, but to the touch, the tubercles do not appear to be much more or less sensitive than the rest of the body ; they are always retracted when they come in contact with a solid object, but soon protruded again. Sickly animals not only change colour, but the body often shrinks to less than half the original size, and all the tubercles of the surface are smoothed down, and assimilated to the mass of the mantle. The mesial portions of the mantle are usually thin, but the sides are very consistent and fleshy, the muscular tissue being solid, very tough in some of the species *(O. tigrinum)*, soft, almost pulpy, in others, *(O. tenerum)*. The internal fleshy part of the mantle is pure white, but the external parts, to a smaller or greater thickness, blackened, and filled with pigment cells, producing the various colours of the animal. Near the edge of the mantle, there are usually some larger cavities in the tissue, as shewn in the section of the portion of the mantle (fig. 3, plate xiv), evidently allowing for an easier motion of these extreme edges.

The foot is composed of numerous transverse muscles and is always shorter and narrower than the mantle; this varies, however, in the different species. In some the foot is only one-third, or one-fourth, of the width of the mantle, in others almost four-fifths of the same, setting aside, however, those variations which merely depend upon the position of the body. When the animal is at rest,—in a sort of contracted position,—the width of the foot is in proportion smaller, than when the animal moves about, in which case the mantle stretches out longitudinally, while the narrowness of the foot appears to be more limited by the transverse muscles.

No generic importance can, strictly speaking, be attached either to the number and size of the pustules on the mantle, nor to the relative narrowness, or width, of the foot. This is a very important statement as regards the classification of the animals, and I shall endeavour to prove its correctness by some observations which I shall subsequently put upon record.

The head is posteriorly on either side connected with the foot by a thin membrane.

Anatomy of *Onchidium typhæ.*

The respective places which the digestive and generative organs occupy divide, so to say, the entire cavity of the body into two parts. Figure 2 on plate xiv represents a specimen, opened along the entire length of the centre of the mantle, the portions of which are removed a little on the sides. The albuminous string of the penis is also a little lifted up, and placed from the right to the left side, so as to allow the ganglion and the penis to become visible. All the other internal organs are in their original position; the head with the œsophagus (oe), salivary glands, (sg); alimentary canal (ac), &c. The signification of the principal other letters is as follows; pe. = pedicle; *p* = penis with the *vas deferens* twisted round it; and (ps) the supplementary albuminous string; *ng* = principal nervous ganglion; the digestive organs with the liver (l) and the anterior portion of the stomach (st), rectum (r), &c., are visible; the generative organs with the ovarium (o), testis (t), large albuminous gland (ag), receptaculum seminis (rs), &c.; *ht* = heart; *l* = lungs; *g* and *v* = the hermaphrodite genital opening, *a* = anus; *ol* = pulmonary orifice. The digestive organs, thus roughly estimated, occupy the greater portion of the front part, and the generative organs that of the hinder part of the body.

In order to understand more clearly the anatomical details, I must direct the attention to figure 5 of plate xiv. This figure represents a very large specimen of *Onchidium typhæ;* the foot has been along its anterior and posterior, and the entire left basal margin detached from the body and folded over to the left side, then the mantle has been cut in two halves and the left half (d) also removed laterally, so as to join the other half only at the pulmonary orifice. The digestive organs have been exposed in the figure on the right and the generative organs on the left side.

Digestive organs and their appendages.

The food first enters through the mouth which, as already stated, is surrounded by thickened, soft and grooved lips, with the œsophagus (oe), a large muscular sack of an oval shape, closed posteriorly. This sack encloses two cartilaginous plates, which are situated in a strongly muscular mass, attached to the posterior and inferior sides of the œsophagus. Sometimes, as in this particular species, these plates resemble a bivalve shell, being convex externally and concave internally; they are white, connected by a membrane below and open above. Their microspcopical structure distinctly shews the formation of a cartilaginous tissue, many of the cells being of irregular shape, others granular and hardened. Externally they are covered by the tongue membrane, or radula, which is provided in its entire extent with very numerous teeth.

This radula is thus very differently formed from the narrow and long lingual ribbon of the *Prosobranchia*. Fig. 4 on plate xiv, represents the relative position of these organs. The cartilaginous plates (cp) actually only give support to the radula (ra), which is by the muscular action of the former pushed out of the mouth, scraping the organic substance in the usual way from below upwards; the food then passes in the cavity behind the plates where the salivary glands (sg) enter. At the beginning of the alimentary canal, immediately behind the catilaginous plates, there is a small fleshy tubercle (to) which appears to act as a tongue, pressing the food down the canal every time that the œsophagus contracts. Each of the salivary glands (sg) is represented by a small, whitish, dendritic organ, connected with each other by a thin string, and by numerous threads with the hepatic mass, enveloping the anterior part of the intestines. The alimentary canal issues at the upper part of the œsophagus, lying in a special muscular cavity of the tissue of the body, it bends downwards, then passes through the hole of the principal central ganglion ring (ng) to the stomach. This consists of two, almost quite separate divisions. The first portion (pst) has the form of a double cone, pointed on either end and widened in the middle; it is soft and composed of numerous folds or partitions. On this anterior portion follows a second one, which is more elongated, consisting of three sub-divisions, being in the middle surrounded and partially divided by a very strong muscular tissue (mst). The extreme end (m) is capped by a separate portion of the liver (l). The intestines (i) issue somewhere at the muscular bridge which connects the two portions of the stomach, being from here in their entire length enveloped in the liver which is readily recognised by the greenish colour of the hepatic cells. The length of the intestines is from 4—5 inches, the rectum (r) being much wider, and passing almost in a straight direction to the anus. Near its termination it is accompanied by two whitish, dendritic organs, (gp and pa), each of which at their posterior ends is connected with a small yellowish brown gland. The latter may represent the kidneys, and the former are probably only albuminous glands, or they may be an equivalent organ of some of the pyloric appendages or the cœca. The anus is situated at the end of the upper base of the foot, it is surrounded by ring muscles, but externally very slightly thickened.

Onchidium typhæ, and probably most of the other species live, on decaying wood and earth, impregnated with organic matter. I have never seen them feeding on fresh grasses. With the solid excrements always a large portion of watery liquid is given out.

Generative organs.

All the species of *Onchidia* which I have examined are hermaphrodites, not as Buchannan stated in the case of *O. typhæ*, supposing the sexes to be distinct. The generative organ occupies the posterior half of the internal cavity of the body (see fig. 2, pl. xiv), sometimes even a little more. The hermaphrodite genital pore (g and v in fig. 5) lies very close to the right of the anus; in this pore a very strong, almost cartilaginous tube, the oviduct, (or here the uterus, ov) terminates, and a short distance upwards gives off a short branch, ending in a flattened large vesicle, which usually is interpreted as the *receptaculum seminis* (rs). The contents of this organ in numerous specimens which I examined was a dark yellowish brown, rather watery substance, containing some solid bodies, resembling the spiculæ of *Spongiæ*, or those peculiar arrows connected with the copulation of *Helices*. The uterus which is only a continuation of the oviduct is, as stated above a thick, white, doubly twisted string, near the middle it is partially enveloped in a mucus secreting, foliated, pale orange gland (as in fig. 2, pl. xiv.)* The contents of this gland is a simple granular

* In figure 5 this gland lies to the right of the testis (t) and to the left of the receptaculum seminis (rs).

substance. It is not clear to what purpose it exists, but probably it is in some way connected with the ovarium or the testis.

The ovarium (as, in fig. 5, or in fig. 2) is of a deep yellowish colour and contains eggs only; these being of an oval form and of various sizes, according to their stages of development; the whole is attached to the uterus by a short string.—It is generally stated that in the PULMONATA, the hermaphrodite gland secretes ova and spermatozoa, but in this case I am certain that they are secreted in two different glands, the ovarium containing, as I stated, merely eggs. The testis (t) is a distinct foliated, or more or less dendritic, purely white gland, which is readily distinguished by its viscous, jelly-like substance. Under the microscope, the contents of the gland had a granular appearance, mingled with a few fat cells, and numerous long thread-like bodies,—spermatozoa. From the testis a very thin hollow string issues, accompanying the oviduct in its entire length and terminating by a special minute pore (g) in the same cavity as the oviduct. This string is evidently the beginning of the *vas deferens*, which continues externally in a grove between the foot and the mantle.

The largest portion of the generative organs are occupied by the albuminous gland (ag) which is of a soft purplish colour, consisting of very numerous folicles attached to short prolongations of the uterus. The albuminous substance has a finely granular appearance under the microscope and is very viscous, adhering to everything that comes in contact with it. It absorbs water to a large proportion swelling up readily in it.

The male copulative organ is at the front end of the body, situated more or less closely to and under the right eye-pedicle. The semen issues, as stated above, first from the genital pore (g), is then conducted in an open canal along the right side between the foot and the mantle, enters the body through a very fine pore (vdo in fig. 5), below, or on the side of, the right buccal appendage, close to the penis opening; then passes through a thin long tube (vd) which is variously twisted round the penis (p) lying on the right side of the body. This tube, the continuation of the *vas deferens* is about 5 inches long, the last inch, or so, forming the penis, which is considerably hardened and straight, situated in a somewhat wider tube and provided at its termination with a short flagellum. In many specimens the *vas deferens* was in the terminal half of its length filled with a similar colouring fluid which I have noticed in the *receptaculum seminis;* thus it is not likely that this substance is secreted in the latter organ, but more likely is formed in the internal portion of the *vas deferens.* Close to the opening of the male genital pore, terminates the supplementary albuminous string (ps), varying from 9 to 10 inches in length. It is much thicker than the *vas deferens* and the contents is a purely white granular, moderately viscous substance. In some other species, this albuminous string is still longer and more developed.

I have only once (on the 22nd September,) observed two specimens of *Onchidium typhæ* in copulation, they were seated one behind the other, the penis enclosed in the vagina for about the length of one inch. Reciprocal impregnation at the same time, as known in *Limaces*, does apparently not take place. Buchannan's statement on this point is not clear; the error as to his believing the sexes to be divided in two animals is thus readily explained, and would have then been easily corrected, had he examined the internal organisation. But although he states that "during copulation the distinction of sexes is very evident, the penis protruding to a great length," it would appear from his previous statement to the effect that "in both, the anus and sexual organs are placed in a perforation in the under part of the tail" as if he had observed that the copulative organ were also situated posteriorly. This is undoubtedly an error, and can only be explained by the fact that the anterior and posterior end were mistaken one for the other, they being actually undistinguishable in a dorsal view when the animal is resting quietly, and has the pedicles and the head retracted, which position it actually assumes during copulation. I mention this point in particular, because it appears to have been accepted by several authors in its integrity, as recorded by Buchannan, though its correctness was rightly questioned by others. Undue importance has been attached to it, so as to support the presumed generic distinctions of *Onchidium*, *Onchidella* and *Peronia.*

The *Onchidia* in general are to all appearance oviparous, laying their eggs in damp places, either under stones or in holes near the surface of the ground, where I found in large numbers very young specimens, resembling in all external characters the full grown animals. Direct observations as to the development of the embryos, etc. remain, however, as yet a desideratum.

Organs of respiration and circulation. (See fig. 5, pl. xiv).

All the *Onchidia* are pulmoniferous, the respiratory cavity occupying about one-fourth of the posterior length of the body. This cavity is situated dorsally immediately under the mantle, its internal walls being folded and fitted out with a soft whitish largely cellular and cavernous epithelium, the lungs; it is anteriorly closed on the left and open on the right side, and the former half is somewhat smaller than the latter. The respiratory opening is a round hole, situated on the lower side at, or near, the end of the mantle; it is surrounded by strong concentric muscles and has occasionally a swollen margin, which can be expanded or contracted at will, sometimes also forming a retractile tube.

The cardial cavity lies on the right side about two-fifths distant from the posterior end, and in front of the respective larger half of the lungs. It is very muscular and encloses the heart, which is represented by a small, reddish, oval capsule, thicker posteriorly than anteriorly. The arterial blood enters the heart from behind in which point,—save that they have lungs,—the ONCHIDIDÆ perfectly agree with the NUDIBRANCHIATA of the OPISTHOBRANCHIA, with which they have so much common in the general form of the body. From the heart issues in front only one thick artery, being at the beginning attached to the wall of the mantle by numerous very thin muscles. A short distance from its issue, it divides in two branches, one supplying the reproductive organs and the other the digestive system. The latter branch again divides before entering that system, one portion being reserved for the digestive organs, and the other supplying the head; this portion of the artery, accompanying the alimentary canal, passes through the large ganglion. From all the internal organs, numerous very thin threads issue, connecting them with the mantle and the foot; some of these threads are no doubt blood-vessels, and others of a muscular and nervous character. The venous blood appears to be conducted to the lungs by an open capillary system, at least I did not observe special vessels for that purpose. A very large number of capillary tubes, connects the upper frontal portion of the pulmonary cavity with the intestinal and the generative organs. The arterial blood is white, and the corpuscles very minute and of an oval shape.

Nervous system and organs of sensation. (See fig. 5, pl. xiv.)

The principal ganglion which is a thick white ring, lies immediately behind the head; a portion of the aorta and the alimentary canal passing through it. This ganglion gives up numerous branches laterally to the base of the eye-pedicles, the tentacular rims and buccal appendages. One thick branch, subsequently dividing, issues below and supplies the head, some of its small nervous threads uniting into a small ganglion between the oral appendages. Another very thick branch also issues from the central ganglion below, and is directed backwards, accompanying the alimentary canal. It divides at the digestive organs in two branches, one supplying these and the other the generative organs. Besides these, there issue from the central ganglion five long threads on each side, two giving the requisite number of nerves to the foot and four (or 8 altogether) to the mantle. They appear, however, to be connected with the other nervous branches of the intestines by numerous very fine threads.

From the generic characteristic which I have previously given, it will be seen that I have made the distinction between eye-pedicles and tentacles. This verbal distinction is, I believe, in most of the Gastropods, an essential one and it is, for instance, not correct to speak in the HELICIDÆ of four tentacles, for they do not all serve the same purposes. Strictly speaking, there is only one pair of each, two tentacles and two pedicles. The presence of only one pair of tentacles,—actually the eye-pedicles,—has been pronounced as a peculiarity of the *Onchidia* and was used as an important distinction from the genus *Vaginulus*. The *Onchidia* possess, however, beside the pair of prolonged pedicles, a pair of true tentacles, which appear as thickened rims on the upper surface of the buccal appendages. Thus the distinction from *Vaginulus*, which has the tentacles free and bilobed, is in this point only a gradual one of development.

When the mantle of an *Onchidium* is dorsally cut open, and the internal organs exposed, the dark pedicles are seen to be attached laterally to the mantle, reaching with their bases beyond the head (see *pe* in fig. 5, pl. xiv ; and the figure between 1 and 1 a). The base of each is flattened, white, cartilaginous, intimately connected with the muscular tissue of the mantle in this place ; above the base numerous nerves enter to it, and the trunk of the pedicle becomes hollow, more cylindrical and soft. The small, black eye is situated eccentrically near the tip, which is pointed, angularly bent and attached by a strong muscle to the internal side of the outer skin (*tp*, in fig. 5) of each pedicle. The muscle then bends backward, and joins the trunk of the pedicle about one-third or one-fourth of the length distant from the tip. The external cover of the pedicle, is formed by the soft skin, in the fold between the head and the mantle.

This organisation of the pedicles fully agrees with that of the HELICIDÆ in general, and makes it perfectly clear that the idea as to the non-retractibility of the pedicles in *Onchidium* cannot be retained. In all the species of *Onchidium*, of which I have observed live animals, I found the pedicles to be almost *entirely* retractile, but it is not usual that an animal, unless strongly irritated, does retract them fully, because the mantle which covers the head gives, as a rule, sufficient protection to them. Whenever specimens are, however, put in spirit, it is a common case that the strongly muscular mantle and the disc of the foot shrink more rapidly than the soft skin between them, and the head with its pedicles, and tentacles and buccal appendages is consequently easily pressed out. Thus the examination of specimens in spirit, evidently seems to have given ground to the idea, that the pedicles in *Onchidium* are not retractile. This observation appears to have been supported by the existence of two indentations, which are formed in the edge of the mantle above the pedicles, when the animal moves about. Occasionally these indentations, or grooves, are traceable for some time even after the death of the animal, but they are by no means permanent, and constantly change in live specimens. Whenever the animal retracts its head, and covers it from above with the mantle, and from below with the front edge of the foot, the indentations perfectly disappear in each such case.

The true tentacles are, as already noticed, in their entire length grown to the upper surface of the buccal appendages, and generally are with their external terminations connected with the extreme outer edges of these. Both the tentacles and the front edges of the appendages are, as a rule, of a yellowish green colour and somewhat thickened; the former more so, being provided with numerous nerves, which issue directly from the anterior edge of the central ganglion, lying at the base of the head, and are a portion of those nerves which supply the lips. During the motion of the animal the tentacles are always moved in front of the edges of the buccal appendages, and when each of them are successively touched with a solid object, it will be observed, that the animal much easier responds to the former than to the latter; the first being the more sensitive organ.

Habits.

Dr. Buchannan says that he found *Onchidium typhæ* always on *Typha elephantina.* This plant is at present not nearly so common as the allied species, *Typha angustifolia.* However, that is no proof that both the species were formerly not more common than they are at present. No doubt, seventy years ago, swampy grounds, overgrown with vegetation, were more extensive about Calcutta, than they are now when our worthy municipality takes such good care to clear everything away! In places, however, (along the Eastern Bengal and the South Eastern and Calcutta railway lines, and in Alipore) where both species of *Typha* grow abundantly I have not been successful in procuring any *Onchidia* on the plants themselves. As a rule, these animals live, like *Limaces*, in damp places, generally close to tanks or ditches, especially those which are supplied during high tide with brackish water. They also seem to be common on the sea-shore, preferring the damp insular climate to that of large continents. Sometimes they are found in places which come under the influence of high tides. They either crawl about on the high ground between the vegetation, or on old wood and stones, etc. During the rainy season, they are naturally most numerous. When kept in a vessel with water, they often go voluntarily into it and remain for some time there, (as I have observed in *Onchidium tigrinum* and *pallidum*) until they are obliged to appear on the surface for the sake of breathing. In this point they fully agree with the species of *Scarabus*, and other estuary shells. *Onchidium tigrinum* sometimes voluntarily remained for 24 hours in brackish water, a small air-bubble being visible near its pulmonary orifice; *Onchidium typhæ* does, however, not stand a long immersion in tank water, and in brackish water it dies much sooner. *Onchidium tenerum* burrows in soft mud, and appears on the surface only in warm weather after the rain. Lesson says of *Ochidium ferrugineum*, that it is a truly marine species, living as a rule, several feet below the surface of the water.

Relations and probable identity of Onchidium with Onchidella and Peronia.

I have given the anatomy of the type species, *Onchidium typhæ*, in detail, because it must form the basis of further comparison with other species, which have been believed to belong to distinct generic types. Cuvier, in his admirable "Memoires, p. serv. l'histoire et l'anatomie des Mollusques," 1817, gave a very good account* of the anatomy of *Onchidium Peronii* from Mauritius, and drew attention to the existence of a small British species, *Onch. celticum.* Lesson, described several species in the "Voyage de la Coquille;" *O. granulosum, marmoratum, ater et ferrugineum.* A very good general figure and correct drawings of the different external organs are given by Savigny of the so-called *Peronia verruculata*, from the red sea, in the French Scientific Expedition to Egypt, (Moll. Pl. III). Quoy and Gaimard, in the "Voyage de l'Astrolabe" (Moll. Pl. XV) figure five species, but in none of them the position of the genital pores has been noticed. No details of the anatomy are given. Gray refers the largely tuberculated species, like *O. punctatum* and *Tongensis* to *Peronia*, the granular ones, like *O. patelloide* and *incisum* to *Onchidella.* Several other species of the same group of Molluscs were described by other authors from Mauritius, the Phillipines, etc. Keferstein lately (Zeitschrift für wiss. Zoologie, Bd. XV, 1864, p. 76-85) published some notes on *Janella, Aneitea,* and allied forms, but unfortunately I have not as yet been able to procure this paper. However, as far as the forms which interest us here specially are concerned there is sufficient for our purpose extracted in Broun's "Klassen and Ordnungen des Thierreiches," Vol. III. On plate 105 a good side view is given of *Peronia verruculata*, shewing the correct position of the pulmonary,

* The figures are reversely drawn, for instance in figures 2 and 5 the external *vas deferens* appears on the left side, and equally so the heart in figure 5, which represents an upper view.

anal and genital openings. Figure 2 on the same plate represents the genital organs, but does not seem to be very correct; in any case it is not sufficiently clear.

The reason,—that forms which appeared to such exact observers, as Cuvier, Lesson, Quoy and Gaimard, in all external characters to be generically identical with Buchannan's *Onchidium*, but which were by others separated as distinct genera,—evidently lies in the insufficient, and partially incorrect account which the last named author gave of his newly proposed genus, though very probably the desire of man, to discover *new* forms, had also something to do with it. The consequence, in short, was that the name *Onchidium* was reserved for the type species *Onchidium typhæ*, and other forms which were better known, than this, were separated into distinct genera. Now, when all the anatomical details of the type species are before us, we shall be able to draw a more accurate comparison between the same and other species.

Cuvier, as I have already stated, gave an excellent account of the anatomy of a Mauritian species which he called *O. Peronii.* Blainville in the 32nd vol. of the Dict. de scienc. nat. p. 280, proposed for this species the name *Peronia Mauritiana*,* as the type of a new genus. When we compare externally the position of the anus, the hermaphrodite and male genital pores, and the pulmonary orifice, then the form of the head and the eye-pedicles &c., of Cuvier's original drawings, with those given of *Onchidium typhæ*, it will be readily seen that no essential distinction between them can be recorded. Even the granulation of the mantle is not much stronger, but it is said that the tubercles form (probably during life) short tufts. Referring to the other anatomical drawings, it must be admitted that they shew a perfect identity with those of *Onchidium typhæ*, if we set aside some minute details which are not perfectly clear in Cuvier's figure, and which are easily explained, when we consider that Cuvier had only specimens preserved in spirit for examination, and that many of those minute organs may consequently not have been preserved. Keferstein's and Savigny's figures of *O. Peronii* or *verruculatum* also fully agree with the typical *Onchidium*, as far as internal characters are concerned; the only difference being again the presence of tufts in place of simple

* The rule, that specific names, unless pre-occupied, must not be changed, ought always to be observed.

granules. I had myself no opportunity of examining any of the forms called *Peronia*, but from the numerous variations in the external appearance of the tubercles, which I have observed in our species (as for instance in *O. tenerum*) I cannot perceive how this character could be considered as of any generic value. Besides that, the authors who acknowledge, upon this ground, the generic distinction of *Peronia*, are far from consistent in dealing with the question, for they refer to *Onchidella* species which are either smooth or granular, some of them being very coarsely granular, and even spinous above. Surely, the distinction between a smooth and granular or tubercular surface is greater than that between the latter and one in which the tubercles bear two or three points in place of only one. The presence of two or three black dots on some of the large tubercles of *Onchidium typhæ* appears to me to be fully equivalent to some of the tufts observed in *Onchidium Peronii*, and very likely in very old specimens these black dots may become pediculated, for I have myself observed them each raised independently from the other. I must here specially call attention to some of the variations in the mantle surface of *Onch. tenerum*, described towards the end of this paper.

Gray proposed for Lesson's species, *Onch. granulosum*, the name *Onchidella*, and referred to this presumed genus all the granular or smooth species, except *Onchidium typhæ*. In what the distinction of *Onchidium* and *Onchidella* ought to consist, I entirely fail to perceive. H. and A. Adams in their "Genera of Shells," II. p. 232, state that the latter differs from the former in having the buccal appendages *lobate*, but then they say exactly the same of *Onchidium*. I am not quite certain about the meaning of the word *lobate* with regard to the buccal appendages, but I think it can only refer to the thickened rims, which I explained as the tentacles and which, with reference to the front edges of the appendages, may be called *lobes*. Wherefrom H. and A. Adams derived the statement regarding the position of the pulmonary orifice "at the right side under the mantle," does not appear evident.

Lesson's figures of the ventral views of *Onch. granulosum* and *marmoratum* do not in the least support any generic distinction among the species described as *Onchidium*. In the former the anal and the respiratory orifices are marked in their proper places, and the correct position of the sexual opening is indicated by the first portion of the external vas deferens. In the view of *O. marmoratum*, the vas deferens begins at the place where the pulmonary orifice is situated, which is no doubt a small error. None of the other figured species which have been referred to *Onchidella*, appear to me to add anything in support of a generic distinction, and thus I think that a very strong reason exists to withdraw both the generic names, *Peronia* and *Onchidella*, and refer the respective species to *Onchidium*.

The only other closely allied genus which belongs to the family ONCHIDIIDÆ is *Vaginulus* (*Veronicella* apud H. and A. Adams). Mr. W. Theobald, Junr., described one species from Burma, *V. Birmanicus*, and my friend, Mr. G. Nevill, lately obtained near Calcutta two specimens which appear to belong to the same species. I hope to return to this subject as soon as I am able to procure better live specimens of our own and the Burmese forms.

Description of Bengal species.

1. **Onchidium typhæ,** Buch., 1800. Pl. xiv, Figs. 1—5.

Body during the motion of the animal much elongated and narrow, rather convex, anteriorly and posteriorly obtusely rounded; mantle above greenish, of various shades, covered with very numerous smaller and larger tubercles, which are nearly equally distributed over the whole upper surface. The smaller tubercles vary a little in their size, but the larger ones have pretty nearly the same dimensions, those about the centre of the back being slightly higher than others. These tubercles are at their bases and at the sides somewhat darker than the body, the top being, however, usually paler and provided with from 1—4 jet-black dots. None of the tubercles are permanent, they can be, in the live animal, always retracted in the skin which is rather tough.

The head is of considerable size, dark greyish, in front covered with numerous, rather large whitish warts; the buccal appendages are blackish, with their front edges and the tentacles yellowish green; the pedicles are thick, concentrically roughly wrinkled, slightly bluish, transparent at their base, greenish for the greater part of their length, pale near the tips, where the small black eyes are situated. The mantle is below blackish, with a grey or brown tint, pale at the margins; the foot is greenish yellow, the dark colour of the digestive and the pale reddish colour of the generative organs shining through the skin. The width of the foot, which is little shorter than the mantle, amounts to about $\frac{3}{5}$ths of the width of the latter, but when the animal creeps about, it may be estimated at $\frac{4}{5}$th of that width; it is truncate in front and rounded posteriorly. The anus lies at the upper basal end of the foot, the opening being small and not distinct, covered by the terminal free edge of the foot. The pulmonary orifice is situated immediately beyond the anus, its internal margin is smooth. The hermaphrodite genital pore is a longitudinal slit, surrounded by swollen lips, situated about $\frac{1}{10}$th of an inch distant to the right of the anus. The external vas deferens, in the fold between the foot and the mantle, is marked as a white groove, and terminates in a minute pore below the right buccal appendage. The male genital pore lies in front, below the right pedicle. The dentition has been described previously (see p. 91, pl. xiv, fig. 6a).

The length of large specimens is about $2\frac{1}{2}$ inches, and the width varies from one-third to one-fourth of it, when the animal moves about in its ordinary way. The usual length of pedicles is about half an inch. Old specimens, when fresh caught, very often secrete from the smooth lower portion of the mantle, a deep carmine red, gelatinous substance, of a distinct alkaline character. The substance coagulates in spirit, but is partially dissolved by, or is at least made thinner in, glycerine.

I have already mentioned, that this species is the commonest, and as yet the only one which was found near Calcutta. It is seen crawling about on old bricks, in ditches on the maidan, about the fort, along the Tollis-nullah (canal), and locally also on the banks of the Hooghly.

2.—**Onchidium pallidum**, *Stol.*, Pl. xv, Fig. 1.

Body elongated, moderately elevated, rounded anteriorly and posteriorly, generally covered with copious mucus. The mantle above is pale yellowish white, with a central, blackish, longitudinal stripe, commencing above the head, and extending posteriorly to about $\frac{3}{4}$th of the length of the body. It is accompanied on either side by a pale yellowish or greyish stripe, and the interspaces between these and the central stripe, are somewhat darker than the general colour of the body. The entire surface is almost equally granular, with a small number of more or less regularly distributed larger tubercles, each provided with one, seldom two black dots. The larger tubercles were in one specimen arranged in two longitudinal rows on either side of the dorsal stripe, but in other specimens, they were irregularly placed. The black central stripe is widest in the middle, with a pale spot in the centre in which are situated three black dots; these being only observable in large specimens. The edges of the mantle are slightly thickened; its colour below being of the same, uniform, pale yellowish white hue, as above. The foot is obtusely pointed posteriorly and truncate in front; it is greyish yellow, varying in tints according to its expansion and consequent transparency; the colour of the internal organs is traceable through it.

The head and eye-pedicles are dark, with a distinct greenish tinge; the mantle and the buccal appendages paler; the front edges of the latter and the tentacles pale yellowish green. The length of the pedicles is generally less than half an inch, and they are somewhat thinner than in the previous species; the eyes are black.

The anus lies at the end of the foot; the pulmonary orifice just behind it, being rather small and surrounded by thickened margins. The hermaphrodite genital pore lies to the right, quite close to the anus; the external vas deferens enters the body on the side below the right buccal appendage, and the penis opening is situated in front, below the right pedicle. Young specimens are paler in colour than old ones, and the dorsal stripe becomes occasionally rather indistinct.

The disposition of the internal organs entirely agrees with the type species, *Onchidium typhæ*. The internal vas deferens is fully four inches long; the supplementary albuminous string, near the penis, is about 5 inches long, much shorter than in the previous species, but thicker in front; the liver at the end of the stomach is a large, dendritic gland; the receptaculum seminis is very large and folded; uterus thick and twisted, and like the small albuminous gland and the testis pure white; the large albuminous gland is purple or rose-coloured, the folicles being filled with a granular substance, which has the appearance of undeveloped eggs. The ovarium is deep yellow, containing large oval eggs. The cardial cavity extends to nearly half the length of the body, but the heart itself is only about $\frac{3}{7}$th of the length, distant from the posterior end. The penis is about $\frac{8}{10}$th of an inch long, thick and strongly constricted near the end, the flagellum being very short.

The dentition (fig. 1d) is similar to that of the last species, the lateral teeth are rounded at the base with one large and one small incurved denticle. I counted about 150 cross series and about 500 teeth in each, the formula thus being 250-1-250.

The finely granular mantle with few scattered larger tubercles readily distinguish this species from the previous, and the large quantity of mucus which it secretes, has not been observed in any of the other forms. The narrower form and greater convexity of the body are equally characteristic distinctions between the present species and *O. tigrinum*, n sp.

The species was found at Port Canning, and appears to be rare. I first obtained two large specimens through my friend G. Nevill. Both had in front on the right side a small portion of the edge of the foot detached (see fig. 1a), just on the place where the external vas deferens turns towards the buccal appendages. This detached portion had exactly the same structure as the rest of the foot disc, but whether it is an accidental formation, or a normal one, assisting during the act of copulation, I am not in a position to ascertain at the present. In several small specimens which I subsequently obtained myself on the banks of the Mutlah river, that particular detached piece was entirely wanting.

3.—**Onchidium tigrinum,** *Stol.*, Pl. xv, Fig. 2.

Body large, ovate, depressed; mantle strongly coriaceous, hardened, provided with sharp edges. The upper surface is entirely covered with small granules, between which more or less numerous large elongated tubercles are interspersed. Specimens of different sizes vary in this point a great deal; when young the tubercles are equally distributed between the granules, being three or four times as large, and each bearing a black dot at the tip, but being pale at the base. Old specimens have either two or three irregular rows of large elongated tubercles on each side of the back, or the larger tubercles are more numerous, more equally distributed and spinulose, so as to give the surface a very rough appearance. The latter stage is met with only in quite fresh and very large specimens; when they are kept for only a short time, all the fine spines are retracted in the mantle.

The colour is above pale green with numerous blackish, irregular spots, which are generally more numerous about the centre of the back and at the edges of the mantle, than between both. Young specimens are more uniformly coloured. In the old ones, the green colour is sometimes rather dark, so as to make the spots less conspicuous; in others there is a distinct blackish green irregular stripe along the centre of the back, of about the same length as the foot; two similar blackish stripes originate one behind each of the pedicles, running a short distance from it more or less parallel to the dorsal stripe, till all three join near the posterior end. Both the central and the lateral stripes are not continuous, they are moreover formed by the spots becoming more or less confluent. Young specimens have the mantle below uniform, light bluish with very numerous and minute white dots; large ones have occasionally a number of dark green or rusty, more or less confluent spots along the lateral margins, and the general colour is paler. The foot is comparatively narrow, about one-third of the width of the body and when contracted about one-fourth only; it is of a uniform dark bluish grey colour, sub-truncate anteriorly and rounded or obtusely pointed posteriorly, with the edges free and sharpened all round.

The head and the pedicles are dark green, the latter far apart, thick at the base, very thin in the middle, with slightly thickened tips which bear the black eyes at their upper surface. The buccal appendages are of moderate size, blackish, with greenish grey front edges, and the tentacular rims yellowish green. The male genital pore is very distinct, situated in front at the base of the right pedicle; the anus and the pulmonary orifice are normal, the hermaphrodite opening about $\frac{1}{8}$th of an inch distant to the right of the anus, elongated, and surrounded with swollen lips; the external vas deferens enters the body below the right buccal appendage, but very close to the lips of the mouth, passing obliquely through the tissue towards the male genital pore.

All the internal organs agree with the type species. The ovarium is small, orange yellow; the testis, and its supplementary gland, white, the albuminous gland and the uterus pale yellowish white. The receptaculum seminis is a comparatively very small globular capsule, the oviduct being, however, very strong, almost horny; the portion of the liver covering the end of the stomach is cup-shaped and small; the intestines and the rest of the liver normal; the penis above an inch long, with a setous flagellum; the internal vas deferens is about 5 inches, and its supplementary albuminous string about 8 inches long, almost equally thin throughout. The pulmonary cavity is large with numerous cross-folds, the lungs yellowish. The heart is small, white, the aorta at the beginning not much narrower, the thicker branch going to the digestive organs.

The radula is particularly narrow in this species, but the teeth are very similar to those of *Onch. typhæ*, the laterals being only a little larger.

This species is rather common along the banks of the Mutlah at Port Canning, it is generally seen creeping about on old wood. It survives a long immersion in brackish water, but shrinks and soon dies in sweet water. I often found it in holes or at the roots of bushes on the bank of the river during low water; when the water rose the specimens must have been fully for 8 hours submerged. The largest specimen, measured, was two inches long, and about the middle $1\frac{2}{10}$ of an inch broad.

The broad, depressed form of the body, the narrow foot, thin eye-pedicles and the solid coriaceous structure of the mantle, readily distinguish this species from others.

4.—**Onchidium tenerum,** *Stol.*, Pl. xv, Fig. 3.

The general form of the body is oval, more or less elongated, but very high, it is remarkably soft, almost pulpy in fresh caught specimens, always enveloped in a thin layer of secreted mucus. The ground colour of the upper surface of the mantle is greenish grey, irregularly mottled and spotted with dark. Two obtusely elevated, somewhat undulating and pale coloured, ridges run from the edges of the mantle above the eye-pedicles posteriorly near to the end, enclosing a central area of the back, in which a number of very large oval tubercles are situated. These are of a greenish colour, covered with smaller warts, their tips being yellowish, and each of them provided with from 1—3 black dots. Full grown specimens have besides a row of similar large tubercles running externally and parallel to the ridges which enclose the central dorsal area. The entire mantle is more or less finely granular. All the tubercles are much less developed in young specimens, and even in old ones their form constantly changes, on account of the softness of the body, in which they can be entirely retracted, making the mantle to appear uniformly convex. Young and half grown specimens generally have on the external side of the dorsal ridges, two or three of the blackish spots larger, separated by oval pale orange spots which sometimes are partially confluent, forming longitudinal stripes, the orange colour also partially extending on the ridges themselves.

The mantle below is uniform pale greenish grey, with very minute and numerous white dots, the same being also traceable on the sides of the foot. The latter is blackish green, little shorter than the mantle, obtuse or slightly rounded in front, pointed at the posterior termination when free, but when the animal moves about on a flat surface, it appears rounded. The width of the foot is on an average $\frac{3}{4}$th of that of the body, occasionally somewhat less. The head is very large, greenish, covered in front with numerous ashy warts: the buccal appendages laterally widely expanded, with the front edges slightly swollen, the tentacular rims above them being very thin, and of an ashy grey colour. The eye-pedicles are stout at the base, when extended about half an inch long, slightly warty, concentrically wrinkled, with the tips distinctly swollen, globular, pale yellowish or reddish, bearing the black eyes almost centrally situated in a lighter transverse fold. The lips of the mouth are whitish, strongly thickened and folded. The anus is as usually placed at the upper terminal base of the foot; the pulmonary orifice is removed from it and close to the posterior end of the mantle; it is large, surrounded by a strong swollen margin, internally white, with 8—10 small tubercles, which continue interiorly as short ridges. The hermaphrodite pore is also somewhat removed from the anus, about half an inch distant from it to the right, but situated as in all other *Onchidia* in the fold between the mantle and the foot. The external vas deferens is a distinct narrow groove, entering the body at the outer base of the right oral appendage, although it seems to continue below the mouth, issuing internally quite close to the penis opening. The penis pore itself is large, placed laterally below the right eye-pedicle.

The internal organisation does not essentially differ from the type. The œsophagus is comparatively small, the alimentary canal rather long and thick; the liver extensive and deep greenish; stomach very muscular and large. The internal vas deferens is very thin, yellow, about three inches long, and twisted round the penis which is about $\frac{8}{10}$th of an inch long, very thick, but otherwise not offering any distinctions. Its supplementary albuminous string is thick, white, and at least 12 inches long, it almost occupies one-third of the body cavity just behind the head. The hermaphrodite organ is not very extensive, the large albuminous gland of a purplish colour; ovarium deep, yellow; testis white, small albuminous gland yellowish white; the vas deferens, issuing from the testis, is very thin, accompaning the strong and thick oviduct; the receptaculum seminis is represented by a small, oval, dark coloured gland, closely attached to the oviduct.

The nervous ganglion behind the œsophagus is particularly large, sending numerous branches in all directions. The dentition is also similar to the other species, the centrals have a very small point, and the laterals form distinct hooks with an upright point at the end.

The softness of the body, its great height, the peculiarly formed tubercles of the mantle, and the situation of the pulmonary, hermaphrodite and male genital openings, are the characteristic distinctions of this species.

It has been found, at the end of the rainy season,—in September and October,—on the banks of the Mutlah river at Port Canning, but appears to be rare. Its habits are peculiar; it burrows in mud, sometimes several inches deep, and appears on the surface merely after, or during, the rain of a warm day. This evidently accounts for the softness of the body. A few specimens which I kept in a glass instantly burrowed in the soft earth, lying in holes in an oblique or perpendicular position with the posterior tip of the mantle, where the pulmonary orifice is situated, exposed so as to permit free access of air. They sometimes did not appear on the surface for many days, except when covered up and then placed in the sun.

Explanation of letters in Plates XIV and XV.

œ.—œsophagus.

ac.—alimentary canal.

ps.—supplementary albuminous gland of the penis.

l.—liver.

r.—rectum.

t. (or *ts*) testis.

o. (or *as* in fig. 5) ovarium.

p.—penis.

pp.—penis opening.

sg.—salivary glands.

pe.—eye-pedicle.

tt.—tentacle, except in fig. 1a, of Pl. XIV, being = buccal appendage.

i.—intestine.

pst.—first portion of the stomach.

st.—middle portion of the stomach.

mst.—muscular, middle part of the same.

m.—terminal part of the same.

ag.—albuminous gland of the generative organs.

as.—in fig. 2, albuminous gland of the testis.

ht.—heart.

rs.—receptaculum seminis.

gp. and *pa.*—supplementary glands (kidneys, &c. ?) of the rectum.

g o. or *g v.*—hermaphrodite genital opening.

a.—(in figs. 2 and 5) anus.

ol.—pulmonary orifice.

l.—lungs.

rm.—retractile muscle.

n.—nerves.

ng.—chief ganglion.

dn.—nerve of the digestive organs.

bs.—base.

cp.—cartilaginous plates supporting the radula.

to.—tongue.

ra.—radula.

go. (in fig. 1. c) middle genital pore.
f.—foot.
d.—dorsal part of the mantle.
vd.—vas deferens.
vdo.—opening by which the external vas deferens enters the body.
ba, in fig. 5.—buccal appendage.
tp.—external covering of the eye-pedicle.
ov.—oviduct.

Pl. XIV.

Fig. 1, 1 a, 1 b, 1 c, dorsal, ventral, side and front views of *Onch. typhæ;* the figure between 1 and 1 a, represents the eye-pedicle, isolated and enlarged.

Fig. 2. A large specimen of *Onch. typhæ*, cut open along the centre of the back, the internal organs being exposed.

Fig. 3. A small portion of the edge of the mantle showing the internal cavities.

Fig. 4. Œsophagus, cut open, with the radula, salivary glands, &c.

Fig. 5. Internal organisation of *Onch. typhæ.*

Fig. 6, radula, 6 a, central and a few lateral teeth, 6 b, side view of the central, and 6 c side view of the lateral tooth; all greatly enlarged.

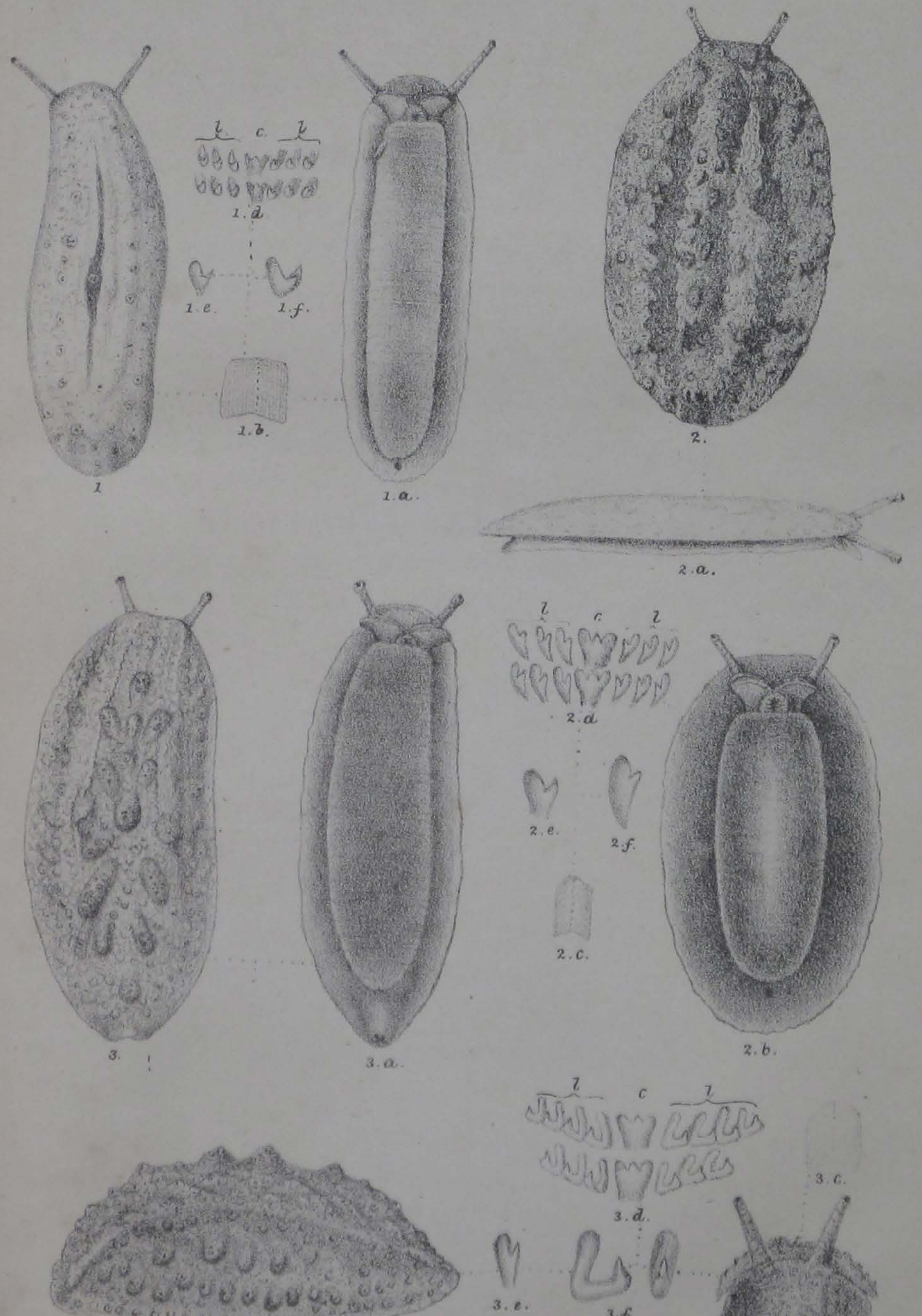
Pl. XV.

Fig. 1, and 1 *a*, dorsal, and ventral, views of *O. pallidum;* 1 *b*, radula, 1 *d*, central and lateral teeth, 1 *e*, side view of a lateral tooth ;.

Fig. 2, 2 *a*, 2 *b*, dorsal, side, and ventral, views of *O. tigrinum;* 2 *c*, radula; 2 *d*, central and lateral teeth; 2 *e*, side view of a central, 2 *f*, side view of a lateral tooth.

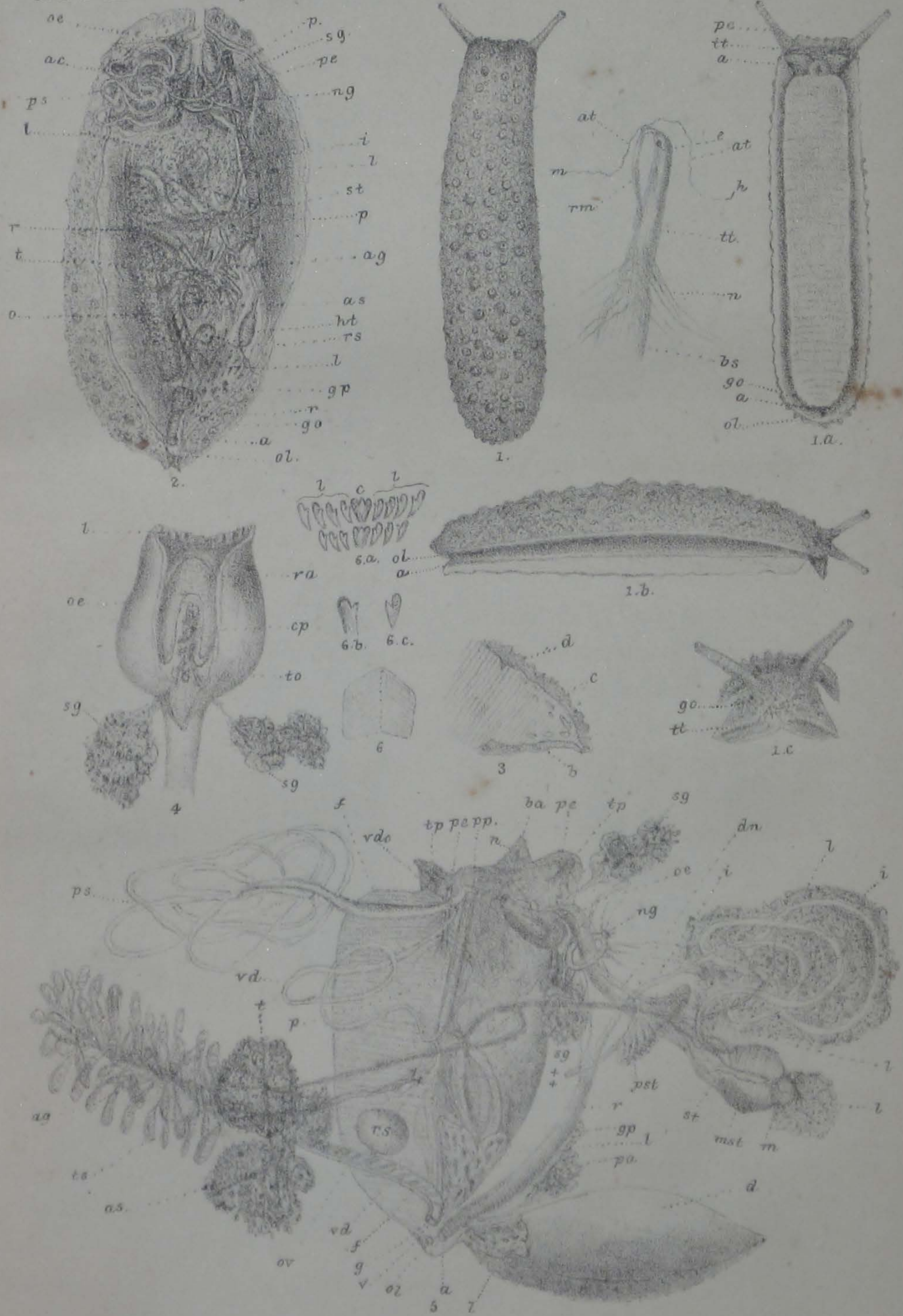
Fig. 3, 3 a, 3 b, 3 g, dorsal, ventral, side, and front, views of *O. tenerum;* 3 c, radula, 3 d, central and lateral teeth, 3 e, side view of a central, 3 f, side and front views of a lateral tooth.

N. B.—The figures of the teeth are in all cases enlarged.



Calcutta

1. Onch. pallidum; 2. Onch. tigrinum; 3. Onch. tenerum.



Onchidium typhæ, Buchan.

Notes on the Flora of Manbhúm; by V. Ball, Esq., *B. A., Geological Survey of India.*

[Read 4th Nov., 1868; received 5th Nov., 1868.]

The district of Manbhúm which, until comparatively recent times, formed a portion of those *terræ incognitæ*, the *jungle mehals*, has not been altogether neglected by naturalists. The fauna, first examined by Col. (then Lieut.) Tickell, and more recently by Captain Beavan, is now pretty well known.

The flora of the northern portion of the district in the vicinity of the grand trunk road, received the attention of several distinguished botanists, but in the southern portion plants never have before been collected.

Dr. Hooker, in his introductory essay to the Flora Indica, after noting the character of the flora of the humid Eastern ghats of Orissa, which, owing to circumstances which he describes, are during both monsoons, daily affected by moist sea breezes, states that the vegetation of the interior of the province (which includes the greater portion of Manbhúm) is quite unknown, except from a few notices in Major Kittoe's journey to the Sumbulpúr valley.

Dr. T. Anderson's paper in the journal* is devoted to an account of the flora of northern Manbhúm, (in the vicinity of the trunk road), Behár and Parisnáth hill, upon which latter, temperate forms, all of Himalayan species, are found. His list contains most of the species which I have met with in the lower portions of Manbhúm; there are, however, some important additions.

As it is often equally important in botanical examinations to trace a resemblance as well as a difference between the floras of adjoining areas, I have ventured to give the following account of the portions of the district which have been visited by me during my geological Survey.

As on a previous occasion, I must again acknowledge the assistance which I have ever readily received from Mr. Kurz, who has examined all my collections, and who also paid me a short visit when I was encamped near Beharináth hill. Such assistance is invaluable in Calcutta where, in order to consult the Herbarium and the Botanical

* J. A. S. B.

library, it is necessary to undergo so much trouble and expenditure of time, as is involved in a trip to Seebpúr.

The district of Manbhúm forms portions of three of Dr. Hooker's provinces, Behár, Bengal and Orissa, the larger portion being included in Orissa. As I expect to have further opportunity of examining that province throughout, I shall for the present confine myself to a description of the more salient features of the flora; reserving the detailed list of plants to some future time. The physical characters of the district of Manbhúm may be most clearly comprehended by dividing it up into a series of six zones as follows:

1st. A zone in which metamorphic rocks alone prevail, and of which the general altitude is probably about 4 to 500 feet, and which is studded with small hills rising 3 to 400 feet higher.

2nd. The Damuda valley in which the two coal fields of Ranigunj and Jherria are situated. This zone includes the hills of Pachete and Beharináth, formed of the youngest sedimentary rocks and rising to the heights, respectively, of 1,600 and 1,480 feet.

3rd. A zone similar to the first, in which metamorphic rocks only occur, and which is studded with many hills of which Susinia (1400′), Rugonathpúr and Sindurpúr are the principal. It includes the valleys of the Selye, Dulkissur and Cossye rivers.

4th. A zone upwards of two-thirds of which are in no respect different from the preceding one, but of which the remaining portion, the western, is occupied by the Bhaghmuri plateau, one of the most important spurs running from the highlands of Chota-Nagpúr. It is formed of granitic gneiss which weathers into huge and magnificent monoliths. The general level of the plateau is probably about 1,500 feet above the sea, that of the plain at the base being 720 feet.

5th. A zone similar to No. 3, in which a few unimportant hills occur. The rocks belong to two formations the metamorphic, or gneiss series, and the sub-metamorphic, or slate and quartzite series.

6th. Finally Manbhúm is separated from Dhalbhúm and Singhbhúm on the south by a series of ranges of hills formed of the harder rocks belonging to the sub-metamorphic series: quartzites, tough schists, slates, and trap. Between these ranges which rise to various heights from 1,000 to 3,000 feet, are deep valleys in which the vegetation, owing to the greater amount of moisture, is different from that of the open plains.

At first sight, there is much in the general aspect presented by the flora of Manbhúm and the adjoining districts, which is most disappointing; instead of meeting with a realization of one's ideal of a tropical jungle, the effect produced by the vegetation is, in many places, not strikingly different to what we have been accustomed to in the British Isles.

Dr. Hooker first drew attention to the park-like aspect which prevailes in the drier and clearer portions of these districts.

Bassia, the *tamarind*, the several species of *Ficus*, *Butea* and the *Sal*, representing, without any great stretch of the imagination being necessary, the *Oaks*, *Pines*, *Sycamores*, *Maples* and *Poplars* of temperate climes.

It is only on the hills, and in the valleys of the sixth zone, that one meets with anything like typical tropical jungle; even in these comparatively favourable localities there are no tree-ferns, nor palms, and but few mosses, orchids or herbaceous ferns.

Contrasting the flora in detail with that of the British Isles, one is struck by the absence of plants belonging to such common orders as *Rosaceæ*, *Cruciferæ*, *Geraniaceæ*, *Violaceæ* and the rareness of species belonging to *Ranunculaceæ*, *Umbelliferæ* and *Scrophularineæ*.

On the other hand, many of the pond-weeds, *Chara*, *Nymphæa*, *Potomogeton*, *Alisma*, &c., as well as grasses, *Cyperus*, *ferns*, *Drosera*, *Arums*, *Oxalis*, *Mistletoe*, some of the smaller *Labiatæ*, and both herbarceous and arboreal forms of *Leguminosæ*, together with a *Salix*, vividly recall their European congeners. Lichens might be added to this list. It is interesting to observe that these are seldom to be found, except on the northern or sheltered faces of the trees, and rocks upon which they grow.

Throughout the jungles both of the plains and hills, the deep glossy green of the *Sal*, *Shorea robusta*, Roxb., gives a marked character to the foliage. In the early part of the year, the white floral leaves of *Combretum Roxburghii*, and other species, produce a pleasing contrast in the sea of green which meets the eye in every direction. At the commencement of the hot weather, the greater number of the trees lose their leaves which, in some species, are immediately replaced, when lovely contrasts are produced by such varied hues as the deep purple of the young leaves of *Schleichera trijuga*, Willd., with an infinitude of shades of red, white and green on the surrounding trees.

While the trees remain leafless, the aspect of the jungle is bleak and wintry, this is intensified by the action of the jungle fires, which scorch up all the herbage, so that there is often little shade to be found, when most wanted from the hot sun of April.

The inflorescence, as a general rule, is of a dull and subdued character. That of the *Sal* produces a peculiar hazy appearance over the green foliage. The most brilliant flowers are those of *Bombax Malabaricum*, *Butea frondosa* and *B. superba;* perhaps the most beautiful are the white and delicately-violet tinted blossoms of a species of *Bauhinia*. In the flat portions of the district which constitute the 1st, 2nd, 3rd, part of 4th and 5th zones, a four-fold division according to the character of the vegetation may be made.

First. Original jungle land in which trees are of large size.

Second. Stunted jungle land from which timber is regularly cut, and where the trees are never allowed to attain respectable dimensions.

Third. Dry, gravelly and raviny or rocky ground incapable of supporting a tree jungle.

Fourth. Land under cultivation, or which has at some former time been under cultivation.

In the *first* division the characteristic trees are the following:

Shorea robusta, Roxb.
Terminalia glabra, Roxb.
Buchanania latifolia, Roxb.
Semecarpus anacardium, L.
Grislea tomentosa, Roxb.
Croton oblongifolium, Roxb.
Phyllanthus emblica, L.
Lagerstrœmia parviflora, Roxb.
Symplocos racemosa?
Conocarpus latifolia, Roxb.
Holarrhæna antidysenterica, Wall.
Randia dumetorum, Lam.
R— longispina, DC.
Eugenia jambolana, Lam.

Gardenia latifolia Ait.
G— sp. (lucida ?)
Pavetta Indica, Linn.
P— parviflora, Roxb.
Wendlandia tinctoria, DC.
Cassia fistula, Linn.
Calosanthes Indica, Blume.
Stereospermum suaveolens, DC.
Ægle Marmelos, Corr.
Carissa Carandas, L
Zizyphus œnoplia, Mill.
Combretum Roxburghii, DC.
Casearia tomentosa, Roxb.
Glochidron Sp.
Nauclea parvifolia, Roxb.
N— cordifolia, Roxb.

Herbaceous plants are scarce in jungle of the above character, doubtless they are more abundant during the rains.

The large scandent creepers are more commonly met with on the hills, but they also occur in the older jungles, the principal species are *Bauhinia Vahlii* and *Butea superba*.

Parasites and epiphytes are represented by two species of *Loranthus*, two of *Viscum* and a few orchids.

It is often to be observed that some one of the trees, mentioned in the preceding list, occurs in such abundance throughout a limited area, as almost to exclude all other species; some circumstances, which it is impossible to detect, giving it pre-eminence in the struggle for life. The species so occurring are :

Shorea robusta, Roxb.
Terminalia glabra, W. and A.
Holarrhæna antidysenterica, Wall.
Conocarpus latifolia, Roxb.
Eugenia Jambolana, Lam.
Casearia tomentosa, Roxb.

Modification of the character in the vegetation can, however, in two instances at least be traced to its prime causes, viz. the vicinity either of hills or of rivers. The species which are most frequently found at the foot of the hills are :

Combretum Roxburghii, D'C.
Lebidieropsis orbiculata, Müll.
Nyctanthes arbor tristis, L.
Schleichera trijuga, Willd.
Flacourtia sapida, Roxb.
Terminalia chebula, Retz.
Antidesma bunias, Spreng.
A— diandrum, Tul.
Feronia elephantum, Corr.
Ichnocarpus frutescens, R. Br.
Bauhinia variegata, Lin.
B— purpurea, Lin.
Ventilago calyculata, Tul.
Rivea ornata, Choisy.
Hoya viridiflora, R. Br.

The species occurring on river banks are :

Terminalia arjuna, W. and A.
Eugenia sp.
Melanthesa rhamnoides, Bl.
Salix tetrasperma, Roxb.
Hyptianthera stricta, W. and A.
Erycibe paniculata, Roxb.
Briedelia tomentosa.
Barringtonia acutangula, Gaertn.
Butea parviflora, Roxb.
Olax scandens, Roxb.
Cæsalpinia digyna, Rottl.
Millettia fruticosa ?
Zizyphus œnoplia, Mill.
Vitis sp.

The *second* division, the stunted jungle, can hardly be said to possess any characteristic vegetation of its own, rather, it may be said that in it the types of the three others meet. The vegetation of the original jungle is encroached upon by that which accompanies cultivation, and the absence of large trees and shelter tends to produce the dry raviny, ground, of the *third* division which can only support its own spare vegetation, consisting chiefly of—

Phœnix acaulis, Buch.
Calotropis gigantea, R. Br.
Vitex trifolia, L.
Barleria cristata, L.
Lepidagathis cristata, Willd.,

with grasses and dwarfed bushes of Zizyphus, Sal and Diospyros.

In the *fourth* division the influence which clearing and cultivation exercise upon the flora, is marked and irradicable, and though deserted village lands often relapse into jungle, such jungle always contains trees which, never occurring in the primitive forests, proclaim, by their presence, the antecedents of that particular spot.

The trees most commonly occurring in cleared or cultivated areas are:

Bassia latifolia, Roxb.
Butéa frondosa, Roxb.
Diospyros exsculpta, Ham.?
Zizyphus jujuba, Lam.
Ficus Indica, L.
F— religiosa, L.
Alangium deca-petalum, Lam.
Trophis aspera, Retz.
Mimusops elengi, L.
Alstonia scholaris, R. Br.
Terminalia bellerica, Roxb.
Bombax Malabaricum, DC.
Spondias mangifera, Pers.
Odina wodier, Roxb.

Other trees occur, but more sparingly, and they may possibly have been introduced.

Of herbaceous plants, a long list might be quoted, the rice-fields alone furnishing a large number. The most common forms met with in the hedge rows and groves are:

Clerodendron infortunatum, L.
Argemone Mexicana, L.
Hygrophila spinosa, T. Anders.
Aerva lanata, Juss.
Solanum xanthocarpum, Schrad.
Cordia Myxa, L.
Trichodesma Indica, R. Br.
Sida Asiatica, L.
S— cordifolia, L.
S— humilis, Willd.
Jatropha gossypifolia,
J— Curcas, L.
Abrus precatorius, L.
Cardiospermum Halicacabum, L.
Bryophyllum calycinum.

The bushes of *Zizyphus jujuba* are generally covered with a beautiful net-work of dodders, both species *Cassytha filiformis* and *Cuscuta reflexa* (?) occurring abundantly.

Besides the above, some of which though not indigenous are perfectly naturalised, there are a number of trees which are regularly cultivated; they are—

Mangifera Indica, L.
Moringa pterygospermum, Gaertn
Punica granatum, L.
Psidium Guava, L.
Anona squamosa, L.
Tamarindus Indica, L.
Ricinus communis, L.
Azadirachta Indica, Ad. Juss.
Zizyphus jujuba, Lam (var.)

On the bunds of tanks, the following trees are generally planted.

Acacia Arabica, Willd.
—— farnesiana, Willd.
Borassus flabelliformis, L.
Terminalia Arjuna, W. and A.

Plumieria alba, Jacq.
Nerium odorum, Ait.

A very beautiful effect is often produced by the so-called matrimony of the species of *Ficus* with other trees, more especially with the *Tal, Borassus flabelliformis* : the seeds of *Peepul*, dropped by birds into the angle formed by the leaf stalk of the *Tal*, produce trees which ultimately envelope with their roots and stem the whole of their foster parent.

The flora of the tanks and jheels is interesting, as it approaches in character that of the ponds and lakes of Europe. The principal species are :

Nymphæa lotus, L.
N— stellata, Willd.
Hydrilla verticillata ?
Ottelia alismoides, DC.
Nelumbium speciosum, Willd.
Limnanthemum cristatum, Griseb.
Potamogeton natans, Linn.
Azolla pinnata, R. Br.
Marsilea quadrifoliata, L.

At the edges :

Exacum sulcatum.
Drosera Burmanni, Vahl.
Scirpus mucronatus.
Fuirena ciliaris.

A number of species of *Cyperus* and grasses.

On all the smaller hills up to 1,000 feet, the greater number of species occurring on the plains are to be met with, and in addition to them many species of both trees and herbaceous plants, which are never found below ; on the highest hills the jungle consists almost exclusively of *Bambusa stricta*, with an undergrowth in which the blue flowers of *Strobilanthes auriculatus* and *Dædalacanthus purpurascens* are the most prominent forms.

The following is a list of the most characteristic trees occurring on the hills :

Kydia calycina, Roxb.

Cochlospermum gossypium, D'C.
Dillenia pentagyna, Roxb.
Sterculia urens, Roxb.
Chickrassia tabularis, A. Juss.
Zizyphus rugosa, Lam ?
Nauclea parvifolia, Roxb.
Hymenodictyon thyrsiflorum, Wall.
Flacourtia cataphracta, Roxb.
Spermodictyon azurea.
Nyctanthes arbor tristis L.
Celastrus paniculatus, Willd.
Dalbergia latifolia, Roxb.
Albizzia procera, Bth.
Acacia tomentosa, Willd.
Ficus parasitica, Koen.
Hibiscus vitrifolius, L.
Helicteres Isora, L.
Butea superba, Roxb.
Grewia hirsuta, Vhl.
G— elastica, Royle.
Flemingia strobilifera, R. Br.
—— nana, Roxb.
Desmodium latifolium, D'C.

The useful plants of Manbhúm may be classified into those yielding:
Food, Drugs, Fibres, Dyes, Lac, Oil, and Timber.

Food. I have in a previous communication to the Society* shewn what a large number of jungle products are used as articles of food; and that a considerable portion of the poorer natives derive from them their principal subsistence during several months of the year.

Drugs. A large number of the well-known drugs of India occur in Manbhúm; of others, some of which are possibly peculiar to that part of the country, I have made a small collection, but am unable to say whether they really are equal to their reputed virtues.

In making enquiries on these subjects, I have often been struck with the curious contrasts of the deep knowledge possessed of the specific virtues of certain plants, and the dense ignorance and supersti-

* J. A. S. B. 1867, Vol. XXXVI. Pt. II. No. II. p. 73.

tion which attributes fantastical virtues to others. The same man who may bring you the roots of one plant, which are of known medicinal value, will shew you the seeds of another which he asserts are of infallible efficacy in certain diseases, when tied round the neck on a string. I have seen a man going about, with a small parcel of medicine suspended from one of his ears, which he complacently told me, was for the purpose of killing, what he fancied was a worm in his tooth.

Fibres. The fibres of many of the large scandent creepers are used in the manufacture of coarse ropes. I have never been able to ascertain that the fibre of the Mudar, *Calotropis gigantea*, is collected, though it is one of the most valuable in India.

Dyes. Coloured clothing is scarcely ever worn by the natives of Manbhúm, so that there are very few dyes in use. On special occasions when gaudy clothing is required, yellow, which is produced by turmeric, seems to be the favourite colour. Non-permanent dyes are sometimes made out of some of the brilliant coloured blossoms of *Butea superba*, *Grislea tomentosa*, &c.

Lac. The principal lac yielding trees are *Plas*, *Butea frondosa* and *Khúsúm*, *Schleichera trijuga* : the lac is purchased at a very low rate by the Mahajúns, and yields them a considerable profit when they bring it to markets attended by the regular dealers.

Oil. There are a number of trees yielding a variety of oils, for some of which medicinal virtues are claimed, others produce inferior oils, which are used either in their food, by the very poorest classes, or for burning. It is unnecessary to detail the plants here, as they are all well-known to yield oil. Were it not that crops of oil-yielding plants such as *Mustard*, *Guizotia*, *Sesamum*, *Castor Oil*, &c., are extensively grown throughout the district, more importance would attach to the jungle oils than does at present.

Timber. The useful timber to be found in Manbhúm, is very limited in quantity, the forests covering but a small portion of the area. Already contractors, and their agents, have reached the hills on the Dhalbhúm frontier, and at the rate at which Sal is now being cut for Railway sleepers the supply cannot last for many years.

Although *Sal* is the only timber cut for exportation, about 30 species of trees, yielding either ornamental, or strong and durable woods, occur in tolerable abundance.

In the report of the Jury in Section IV, Class IV, of the Madras Exhibition, 1855, there is a list given of woods with their respective properties. Many of the species mentioned, are to be found in Manbhúm. From the information contained in this list, from personal observation, and other sources, I have drawn up the following enumeration of timber trees with their local names and special properties :

Names.	Local names Bengali.	Character of timber.
Acacia Arabica, ...	Babúl.	Hard and tough, but small sized, used for wheels.
A— catechu, ...	Koir.	Small, produces *kut.*
Ægle marmelos, ...	Bael.	Wood, strong.
Alangium decapetalum, ...	Ankúra.	Wood, beautiful.
Artocarpus integrifolia, ...	Kantal.	Excellent, used for furniture.
Azadirachta Indica, ...	Neem.	Beautiful, suitable for ornamental work.
Bassia latifolia, ...	Mhowa.	Strong, but tree is too valuable to be cut down.
Barringtonia acutangula, .	......	Useless.
Bauhinia variegata, ...	Katchna.	Little use.
B— malabarica, ...	......	Said to be hard.
Borassus flabelliformis, ...	Tal.	Used for rafters, &c.
Buchanania latifolia, ...	Piál.	Useless.
Butea frondosa, ...	Plás.	„
Casearia tomentosa, ...	Moun.	„
Calosanthes Indica, ...	Sona.	Soft, useless.
Cochlospermum gossypium,	Gol-gol.	Useless.
Conocarpus latifolius, ...	Dow.	Very strong and useful, light-coloured.
Croton oblongifolius, ...	Pútha.	Reddish, cracks.
Dillenia pentagyna, ...	Kurkotta.	Strong and durable wood, splits easily.
Feronia elephantum, ...	Kuth-Bael.	Hard, strong, heavy wood.
Ficus Indica, ...	Bur.	Branch stems, heavy, hard, suitable for tent poles.
„ religiosa, ...	Pipul.	Useless.
Flacourtia sapida, ...	Benchi Kátái.	Hard, does not warp.

Names.	Local names Bengali.	Character of timber.
Gardenia latifolia, ...	Pepero.	Close-grained.
Holarrhæna antidysenterica	Kúrchi.	Useless.
Lagerstrœmia parviflora,...	Seed or Seedhar.	Wood said to be good.
Mangifera Indica, ...	Am.	Durable, used for making packing-cases.
Melia azadirach, ...	Bukum ?	Durable and handsome.
Nauclea cadamba, ...	Kadam.	Used for furniture.
N— cordifolia, ...	Petpuria.	Yellow, used for common purposes, easily worked.
Nyctanthes arbor tristis, ...	Seolee.	Hard, but small.
Odina Wodier, ...	Amárá.	Central wood useful.
Pavetta Indica, ...	......	Timber small.
,, tomentosa, ...	......	Hard, but small.
Phyllanthus emblica, ...	Aura.	Hard, valuable.
Rottlera tinctoria, ...	......	Wood soft and inferior.
Schleichera trijuga, ...	Khúsúm.	Strong, suitable for spokes, &c.
Semecarpus Anacardium, .	Belá.	Useless.
Shorea robusta, ...	Sál.	Extensively used in India for rafters, sleepers, &c.
Sterculia urens, ...	Keonge.	Soft and useless.
Stereospermum suaveolens,	Párul.	Strong and elastic.
Strychnos nux vomica, ...	Kúchilá.	Hard, used for plough-shares.
Eugenia Jambolana, ...	Jám.	Not attacked by white ants.
Tamarindus Indica, ...	Emle.	Hard, durable.
Trophis aspera, ...	Soura.	Only used for fuel.
Terminalia glabra, ...	Asun.	General work, durable under water.
T— chebula, ...	Hurtoki.	Coarse, but sound and durable.
T— bellerica, ...	Bhora.	White and soft.
Zizyphus jujuba, ...	Bier.	Hard and useful, but of small size.

Contributions to Indian Malacology, No. X. Descriptions of new species of Cyclophoridæ, *of* Ennea *and* Streptaxis *from the hills of Southern and South-western India; by* William T. Blanford, *A. R. S. M., F. G. S., &c.*

[Read 3rd February,—received 18th February, 1869.*]

The shells described in the following pages are some very interesting forms discovered by Major Beddome and Mr. Fairbank in South Canara, the Pulney hills, and the ranges on the frontier of Travancore. All belong to the Malabar province, a remarkable zoological "outlier" of the Malay fauna.

The first three species, all of which have been discovered by Major Beddome in the hills of Travancore and the neighbourhood, differ from any previously described, so much, as to constitute a section or sub-genus by themselves. Instead of the colouring so generally characteristic of *Cyclophorus* and its allies, these species have a peculiar olivaceous epidermis, highly polished in two of the species, much as in *Pupina* and the allied genera, while in the third form the shell has a silky appearance, due to minute striation. Another peculiar character is the constant occurrence of two keels, one just at the periphery, the other at or near the base of the shell, the two being separated by a smooth space. Other spiral sculpture is found in two of the species, but these two keels are the most conspicuous; less so, however, in *Cyclophorus Beddomei*, than in the other forms. The operculum in all three species, closely resembles that in the Burmese type of *Pterocyclos*. It it horny and double, with the edges of the whorls composing it free, and is surrounded by a marginal groove between the free edge of the outermost whorl, and that of the inner membranaceous lining of the operculum. It differs from the *Pterocyclos* opercula in being concave externally, instead of flat or convex. Too much importance, however, must not be assigned to these minute characters of the operculum.

The new section appears to me quite as distinct from *Cyclophorus*, as *Cyclotus* and *Leptopoma* are, and not quite so well distinguished as *Pterocyclos*; I, therefore, class it as a subgenus of *Cyclophorus*.

* Printed in this number of the Journal by special order of the Council.

DITROPIS.* Subg. nov.

Testa translucens, subvitrea, epidermide olivaceâ nitidâ instructa, carinis duabus, vel pluribus, unâ ad peripheriam, alterâ subtus ab illâ interspatio discretâ circumdata. Operculum corneum, arctispirum, duplex, laminâ internâ membranaceâ, externâ crassiusculâ, marginibus anfractuum liberis, ambabus sulco marginali disjunctis. Animal ignotum.

Shell translucent, almost vitreous, covered with a smooth olivaceous epidermis, with two or more spiral ribs, one of which is always at the periphery of the last whorl, and a second below, separated by an interval from the other. Operculum horny closely wound, composed of two laminæ, separated by a marginal groove, the inner membranaceous, the outer rather thick, and with the edges of the whorls free. Animal unknown. Type, *Cyclophorus planorbis*, n. sp.

I have examined the lingual ribbon of one species. It only differs from that of *Cyclophorus* in the form of the lateral teeth, and in their denticulations being shorter and more numerous. In *C. (Ditropis) convexus*, the species examined, the central tooth has 7 denticulations, that in the middle being the largest: all the lateral teeth apparently had 5 denticulations, but it was very difficult to count those in the outermost laterals correctly.

1.—Cyclophorus (Ditropis) planorbis, n. sp.

Pl. XVI, fig. 1.

Testa latissime umbilicata, depressa, discoidea, vitrea, tenuis, olivacea, glabra, obsolete striatula, polita. Spira plana, nucleo non exserto, sæpe eroso, sutura impressa, ad anfractum ultimum et supra et in umbilico costâ sublatâ intus marginata. Anfr. 4—4½, *convexi; ultimus antice vix descendens sub-quadrangularis, supra atque subtus convexus, carinis duabus validis circumdatus, unâ ad peripheriam, alterâ juxta basin ad latus externum. Umbilicus perspectivus, omnes anfractus exhibens. Apertura obliqua, sub-quadrata intus albido-labiata ; peristoma incrassatum, rectum, non-expansum. Operculum intus convexum, extus concavum, marginibus anfractuum externorum laciniatim elongatis.*

Exempli majoris diam. maj.	8½,	*min.* 7,	*alt.* 2,	*ap. diam.*		1¾,	*millem.*
,, *minoris* ,,	7	,, 5½	,, 1½	,,	,, *(fere)*	1⅓	,,

Hab. " *Calcad hills,*" *ad fines provinciæ Travancore in Indiâ meri-*

* Etym. δις, twice ; τροπις, a keel.

dionali, haud procul a promontorio meridionali Indiæ "Cape Comorin" dicto.

Shell very broadly umbillicated, depressed, discoidal, thin, glassy, smooth and polished, with obsolete striation. Spire perfectly flat; the apex not rising above the surface; suture impressed; the nucleus is generally wanting, being apparently remarkably liable to erosion. Whorls 4 to 4½, slightly convex above, the last descending but slightly near the mouth, and nearly square, with two keels, the one rather high up, forming the periphery of the shell, the other at the outer side of the base; these keels can be traced upon the penultimate and part of the ante-penultimate whorl, both on the spire and within the umbilicus, forming a distinct rib inside the suture. Aperture oblique, nearly square, with a white internal lip; peristome thickened, all in one plane and not expanded. Operculum convex and smooth inside, the margins of the whorls externally much elongated and torn, especially towards the margin.

Major diameter, from the edge of the peristome to the opposite margin 0.34 inch, minor diam., at right angles to the other, 0.28, height 0.08. A smaller specimen measures 0.27 and 0.2 in the two diameters and 0.5 in height.

Although this shell resembles some *Cyclophori* in form, it differs from all species hitherto known in several characters and certainly forms the type of a distinct section.

2.—Cyclophorus (Ditropis) Beddomei, n. sp.

Pl. XVI, fig. 2.

Testa latissime umbilicata, depressa, discoidea, tenuis, olivacea, confertissime striata, parum nitida, spiraliter costata. Spira plana, sutura valde impressa. Anfr. circa 4, (primo in exemplo unico deficienti) convexi, primi fere glabri; penultimus costis 2—3, supra unâ, infra in umbilico juxta suturam ornatus, ultimus antice descendens, teres, juxta suturam et subter peripheriam glaber, 7—costatus, costis 4 superioribus, quarum extera ad peripheriam, 3 basalibus ab superis intervallo disjunctis. Umbilicus perspectivus. Apertura diagonalis, rotunda; peristoma simplex, rectum, breviter adnatum, nigrescens, intus tenuiter albido-labiatum. Operculum fusco-corneum, intus convexum, limbo tenuissimo circumdatum, extus concaviusculum, marginibus anfractuum parum elevatis.

Diam. maj. 8, *Min.* 6¾, *axis* 2½ *millem., ap. diam. intus* 2.

Hab. Travancore.

Shell very widely umbilicated, depressed, discoidal, thin, olive-coloured, very closely and minutely striated, less polished than the other species, and covered with spiral ribbing. The spire is flat, or nearly so, but the innermost whorls being deficient in the only specimen sent for description by Major Beddome, it is impossible to say whether the apex is slightly exserted or not. The suture is much impressed. Whorls about 4 in number, convex; the last one descending near the mouth, smooth near the suture, both above and below, with 7 spiral ribs; 4 above, the outermost forming the periphery of the shell, and 3 below, separated from the others by a smooth space; 3 of the upper and 1 of the lower can be traced on the penultimate whorl near the suture, but become obsolete on the inner whorls. The umbilicus exposes all the whorls below. Aperture diagonal, round, peristome only joined for a very short distance to the penultimate whorl, thickened, all in one plane and not expanded, faintly edged with white inside, blackish externally.

The operculum differs from that of *Cyclophorus planorbis* by the edges of the whorls being less produced externally, and by its being in consequence less concave. Major diameter 0.31 inch, minor 0.27, axis 0.9.

This species recently found by Major Beddome in the Travancore hills, is easily distinguished from the last species by its numerous spiral ridges, and by the absence of the glassy surface, so characteristic of both the other species. But two specimens have been found, of which I have only seen one.

3.—**Cyclophorus (Ditropis) convexus**, n. sp.

Pl. XVI, fig. 3.

Testa aperte umbilicata, depresso-convexa, tenuis, nitida, vitrea, glabra, olivacea, minnutissime et obsolete decussato-striatula. Spira convexa; apice obtuso; sutura impressa intus marginata. Anfr. 4, *convexi; ultimus versus aperturam paullum descendens, teres, juxta suturam fasciâ latâ fuscâ pictus, extus pallidior, carinâ unâ validâ ad peripheriam, alterâ ad basin circumdatus; umbilico perspectivo, omnes anfractus exhibens, confertim spiraliter liratus. Apertura obliqua rotunda; peristoma rectum simplex, incrassatum atque continuum. Oper-*

culum fusco-corneum, per-simile illi Cyclophori planorbis, *marginibus externis anfractuum laciniatim productis.*

Diam. maj. 6½, *min.* 5½, *axis* 3½ *millem. ap. diam. intus* 2¼.

Hab. *Cum* C. planorbo *in montibus* Calcad Hills *dictis.*

Shell openly umbilicated, depressly convex, thin, smooth, shining, glassy, of an olive colour, with minute sub-obsolete decussating striæ, only visible beneath a powerful lens. Spire convex, apex obtuse, suture impressed and with an internal margination, due to the prolongation on the inner whorls of the keel surrounding the shell. Whorls 4, convex; the last descending slightly near the aperture, and becoming paler in colour in front on the outer half of the surface only, so that a band of darker colour surrounds the shell close to the suture. Of the two keels one is at the periphery, and rather lower in position than usual, owing partly to the raised spire, the other is at the base, rather towards the umbilicus, which exhibits all the whorls, and is closely spirally ribbed inside. Aperture round, oblique, peristome in one plane, simple, thickened. Operculum very similar to that of *Cyclophorus planorbis*, with the external edges of the whorls lengthened, ragged and split up into a fringe-like edge. Major diameter 0.26, minor 0.22, axis 0.14 inch.

This very beautiful little species has much more of the character of *C. (Ditropis) planorbis* than of *C. Beddomei*, having the same glassy structure and high lustre. The convex form is peculiar and very unusual amongst the *Cyclophoridæ*.

The next two species are at least equally peculiar with the last three, and I was for some time much puzzled as to their position amongst the *Cyclophoridæ*, until more close examination of the operculum, revealed its peculiar structure and its resemblance to that of *Opisthoporus*. Mr. Benson, some years ago, proposed that should other species be found, resembling *Opisthoporus* in the characters of the operculum, but wanting the sutural tube, they should be classed with the typical forms under the name *Cœlopoma.** This remark, however, was especially intended to apply to *Cyclotus variegatus* and its allies, with which the types of *Opisthoporus* had been classed by Dr. Pfeiffer. In point of fact, the sutural tube of *Opisthoporus* is

* Ann. and Mag. Nat. Hist. for 1855, Ser. 2, Vol. XV. p. 15.

a generic character of higher importance than the structure of the operculum, so much so, that I believe, as I pointed out in 1864,* that *Opisthoporus* can only rank as a sub-genus of *Spiraculum*, Pearson, which has a totally different operculum but a similar sutural tube. The similar structure of the operculum in the species lately discovered in the hills of Southern India, by no means serves to prove any very close affinity to *Opisthoporus*, since the characters of the shell are totally distinct. With the exception of the absence of the sutural tube, this is not the case with *Cyclotus variegatus* and its allies. I do not think the present forms would have been classed by Mr. Benson in the same genus as *Opisthoporus*, and as I am inclined, after a good deal of study of the *Cyclophoridæ*, to consider the opercula alone as quite insufficient for the foundation of generic groups, and to attach far less importance to their characters than has hitherto been done by Mr. Benson and Dr. Pfeiffer, I am even less disposed to class together dissimilar shells solely on account of the opercular structure than those naturalists are.

The operculum of the new genus appears to me, despite its resemblance to that of *Opisthoporus*, to be a modification of a slightly different type. That of *Opisthoporus* is produced by variation of the typical *Cyclotus* operculum, but with less closely connected whorls. That of the genus now proposed, I consider a modification of the *Cyathopoma* operculum, in which the calcareous outer edges of the whorls, instead of being merely slightly curved towards the centre and free, are so much more curved that the outer edge of each joins the next interior one. Another modification of the same occurs in *Jerdonia*, in which the same outer edges are lamelliform and flat, each overlapping the inner one.

Undoubtedly all these numerous forms of *Cyclophoridæ* are very puzzling. The types of land Mollusca are after all few compared with those of most other forms of terrestrial animal life, and the tendency to variation amongst them is excessive, and in the *Cyclophoridæ* especially, the operculum has evidently become a very variable portion of the organism. It is very difficult to determine, in a case like the present, whether it is wise to found a new group or not. Still the two shells now to be described differ so much from all other

* Ann. and Mag. Nat. Hist. Ser. 3, Vol. XIII. p. 451.

known forms in the combination of characters presented, that such appears the only course open, and as will be seen presently, the characters of the lingual dentition fully bear out the separation.

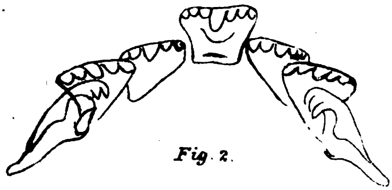


Fig. 2.

Cyclophorus (Ditropis) convexus.

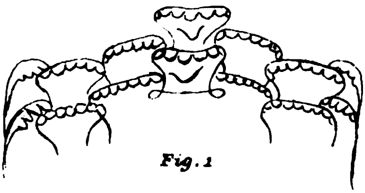


Fig. 1

Mychopoma limbiferum.

MYCHOPOMA* gen. nov.

Testa in speciebus notis turbinata epidermide fuscâ, crassâ, hirsutâ induta. Apertura intus corrugata. Operculum simile ei generis Opisthopori, *e duobis discis multispiris, parallelis, interno membranceo, externo calcareo compositum ; laminâ spirali erectâ interpositâ, interspatiis vacuis.*

Shell, in the two species hitherto known, turbinate, covered with a thick dark-coloured epidermis, more or less hairy. Aperture crenulated within. Operculum very similar to that of *Opisthoporus* in structure, composed of an external calcareous and an internal membranaceous layer, both multispiral and united by a spiral lamina at right angles to them, the spaces between the whorls of which are vacant. The operculum is flat or nearly so, rather thick, and with a marginal sulcation.

Of this type also I have examined the lingual dentition of one species, *M. limbiferum.* The central tooth much resembles that of *Cyclophorus* in form, but it has 7 nearly equal denticulations. The inner lateral teeth are much broader, and differently placed from those in any other *Cyclophoridæ* which have been, so far as I know, examined. They also have 7 denticulations, and the same appears to be the case in the outermost laterals, on which, however, it is difficult to count the exact number. These outermost teeth differ greatly in form and position from the usual type amongst the *Cyclophoridæ,* and rather resemble those of *Paludina* or *Valvata.*

* Typus M. hirsutum, Beddome, MS. Etym. μυχος an inner chamber, πωμα operculum.

4.—**Mychopoma hirsutum,** Beddome, MS. Pl. XVI, fig. 5.

Testa mediocriter umbilicata, depresso-turbinata, solidiuscula, epidermide crassâ, fuscâ, liris spiralibus sub-confertis et lineis elevatis confertissimis obliquis decussatim ornatâ; intra suturam, ad peripheriam, atque circa umbilicum pilis longiusculis confertim fimbriata induta; sub epidermide albida, decussato-costulata, liris spiralibus plus obliquis, minus validis quam extra epidermidem. Spira convexo-conoidea; apice prominulo, papillari; sutura profunda, pilis fere obtecta. Anfr. 5—5½ *convexi, ultimus teres, antice parum descendens. Umbilicus perspectivus, omnes anfractus exhibens, fimbriâ hirsutâ partim celatus, intus spiraliter liratus. Apertura diagonalis, rotunda, intus sublactea atque lineis horizontalibus fuscis signata; peristoma sinuatum, duplex, extus expansiusculum crispatum, intus corrugatum, margine columellari repando, solo, glabro et simplice. Operculum multispirum, crassum, extus concaviusculum, calcareum, albidum, intus planum membranaceum. Diam. maj.* 8½, *min.* 7, *axis* 5½, *ap. diam. intus* 3½ *millcm.*

Hab. In montibus Calcad *atque* Myhendra *dictis, in regione Travancorica Indiæ meridionalis.*

Shell umbilicated, depressly turbinate, rather solid, covered with a thick dark coloured epidermis, which has strong raised decussated sculpture of spiral ridges and very close oblique costulation: at the periphery and around the umbilicus there is a fringe of close, rather long hairs, and the outer series continued on the inner whorls forms a sutural fringe also. Beneath the epidermis the shell is white with decussating lines, the spiral sculpture being more pronounced and the ribbing corresponding to the lines of growth less so than outside the epidermis. Spire convexly conoid, the apex prominent and papillar, suture deep, nearly concealed by the hairy fringe within. Whorls 5—5½, convex, the last cylindrical, descending but very little in front. Umbilicus pervious, exhibiting all the whorls, spirally ribbed, partly covered by the surrounding hairy fringe. Aperture diagonal, round, rather milky inside, with dark horizontal lines corresponding to the spiral ribs on the shell; the peristome is thick and double, curved backwards near the umbilicus, the internal portion with minute pearly white denticulations, largest on the outer (dextral) margin and gradually decreasing slightly in size on the upper and basal edges, vanishing entirely near the umbilicus; the external peristome is slightly expanded, the edge cut into minute teeth like those of a saw except on the inner or columellar margin. Operculum externally slightly concave, white, calcareous; the spiral sculpture obsolete near the centre in old specimens; internally membranaceous. Major diameter 0.34, minor 0.28, axis 0.22, diameter of the aperture 0.14 inch.

This is a very curious and interesting species which, while differing in many respects from any known form, has marked affinities with shells belonging to distinct groups. Had the shell been discovered without the operculum, there could have been very little hesitation in considering it a large form of *Cyathopoma*; the sculpture and general shape are precisely those of the types of that genus, and in some species, as *Cyathopoma filocinctum*, there is a thick epidermis, and also the very singular internal crenulation of the mouth, which is more marked in the present shell than in any allied species. The operculum, however, is totally different: instead of the whorls having the curious raised and incurved edges so characteristic of *Cyathopoma* they are flat and almost obsolete near the centre, on the outer surface, being far less distinct than in typical species of *Cyclotus*.

The hairy fringe around both the periphery and the umbilicus so closely resembles that in *Cyclophorus (Craspedotropis) cuspidatus*, Bens., that there can be no question of a certain affinity between the two species, and there is considerable resemblance in their general form. The apertures, however, differ greatly, and there are marked distinctions in the operculum.

On the whole, I think it highly probable, that the present generic type, and perhaps *Craspedotropis* also, will finally have to be considered as sub-genera of *Cyathopoma*.

5.—**Mychopoma limbiferum,** n. sp. Pl. XVI, fig. 4.

Testa anguste umbilicata, turbinata, tenuis, epidermide deciduâ, fulvâ, strigis fuscis, obliquis spiralibusque notatâ, vel unicolori fuscâ, fimbriam pilorum brevium circa umbilicum ferente, induta; sub epidermide albida, liris confertis spiralibus ornata. Spira conica; sutura valde impressa. Anfr. 5½ *convexi, ultimus teres, antice sub-descendens. Apertura obliqua, fere circularis: peristoma duplex; externum limbo sub-late expanso circumdatum, ad angulum aperturæ antice porrectum; internum vix discretum intus sub-distanter corrugatum; margine columellari amborum valde repando, glabro, vix expansiusculo. Operculum minus crassum* *quam in* M. hirsuto, *extus concaviusculum, laminâ calcareâ ad centrum carente, intus planum.*

Exempli majoris diam. maj. 7, *min.* 6, *axis* $5\frac{1}{2}$, *ap. diam. intus* $2\frac{3}{4}$, *millem.*
„ *minoris* „ $5\frac{1}{4}$ „ $4\frac{1}{2}$ „ $4\frac{1}{4}$ „ *intus* 2 „

Hab. In summis montibus Pulney *dictis; detexit S. Fairbank.*

Shell narrowly umbilicated, turbinate, thin, covered with a thick deciduous, yellowish brown epidermis, with dark spiral and oblique stripes, or more frequently perhaps altogether dark brown, with a fringe of short hairs round the umbilicus: beneath the epidermis, the shell is white with close spiral sculpture. In some specimens, as in *M. hirsutum*, there are oblique raised lines outside the epidermis, but they are not always conspicuous. Spire conical, suture deep. Whorls $5\frac{1}{2}$ convex, the last cylindrical, scarcely descending towards the aperture which is oblique and nearly circular. The peristome is much curved back, near the umbilicus, where it is almost simple and scarcely expanded: elsewhere the outer portion is sharply reversed, forming a broad rim at right angles to the axis of the whorl on the outer and basal margins, while near the penultimate whorl, it is produced in front. The inner portion of the peristome scarcely projects beyond the outer; it is corrugated within, but not nearly so closely or strongly as in *M. hirsutum*, and the corrugation is very faint towards the base, and entirely wanting at the angle of the aperture and on the collumellar margin. Operculum thinner than in the last species, and the calcareous external portion less developed, and entirely wanting at the centre.

Major diameter in a large specimen 0.28 inch, minor diameter 0.25, axis 0.22, diameter of the aperture inside 0.11. Of a small specimen, the respective measurements are 0.21, 0.165, 0.16 and 0.08.

This is a very different shell from the last, being much higher in the spire with a broader edge to the mouth. The name is taken from the last peculiarity. Only a few specimens were found by Mr. Fairbank. It appears to inhabit the tops of the Pulneys at a height of about 7,000 feet.

6.—**Pterocyclos ? tristis,** n. sp. Pl. XVI, fig. 9.

Testa late umbilicata, depressa, tenuis, epidermide crassâ, fulvescenti-brunneâ induta; sub epidermide albida, striatula. Spira convexa. Apice parum exserto, per-obtuso, suturâ profundâ. Anfr. 5 *rotundati; ultimus teres, longe sensim descendens. Apertura obliqua, rotunda;*

peristoma brevissime adnatum, duplex; internum parum porrectum, superne juxta suturam vix sinuatum; externum leviter expansum, continuum, a peristomate interno sulco discretum, supra ejus sinum in alam verticalem parvam, instar tubuli imperfecti, antice spectantem anfractum penultimum non attingentem, breviter cucullatim productum. Operc? Diam. maj. 19½, *min.* 16, *axis* 9½, *mill. Ap. diam. intus* 6½.

Hab. In provinciâ South Canara; *detexit H. Beddome.*

Shell widely umbilicated, depressed, thin, covered with a thick, olivaceous brown epidermis; beneath the epidermis white, faintly striated. The epidermis is closely rugately striated near the suture. Spire convex; apex scarcely exserted, obtuse; suture deep. Whorls 5, rounded, the last cylindrical, descending very gradually for a considerable distance behind the aperture. Mouth oblique, circular; peristome double, the two portions divided by a groove; the inner slightly projecting, with a very small, almost obsolete sinus above, close to the suture; the outer a little expanded, and produced above into a short vertical wing, opening in front, and forming an imperfect tube; it is just above the imperfect sinus in the inner peristome, and does not touch the penultimate whorl. Operculum unknown. Major diameter 0.8, minor 0.62, axis 0.36; diameter of the aperture 0.26 inch.

In the absence of the operculum, it is not easy to say if this shell should be classed as *Cyclophorus* or *Pterocyclos.* It might even be a *Rhiostoma*, and would in that case be another instance of the occurrence on the Malabar coast of Burmese and Malay forms, unknown elsewhere throughout the Indian Peninsula. In the extremely small wing not touching the penultimate whorl, the absence of a deep incision in the interior peristome beneath the wing, the large mouth, and uniform colouring, the species differs from all Indian forms of *Pterocyclos.* There can be no question of its being dintinct also from all known forms of *Cyclophorus*, but, except for the wing, it approaches very nearly to *C. ravidus*, Bens., and *C. annulatus*, Trosch., both of which, however, are flatter.

7.—**Spiraculum Fairbanki,** n. sp.

Testa late umbilicata, depressa, sub-discoidea, decussatim striata, griseo-albida, irregulariter castaneo-strigata et maculata, fasciâ inter-

ruptâ sub-peripheriâ aliâque latâ in umbilico castaneis. Spira fere plana; apice prominulo papillari; sutura valde impressa. Anfr. 5 *rotundati; ultimus teres, antice sensim descendens, spiraculo brevi sub-verticali truncate-conico, cum anfractu penultimo conjuncto,* 4 *mill. pone aperturamsito munitus. Apertura diagonalis, circularis; peristoma duplex; internum breviter porrectum obtusum, ad suturam angulatim sinuatum; externum continuum expansum, supra sinum instar alæ cuculliformis, anfractui penultimo appressæ exstans, versus basin columellæ processum linguiformem emittens. Operculum corneum, intus valde concavum, extus convexum, apice planulato, marginibus anfractuum lamelliferis. Diam. maj.* 14½, *min.* 11½, *axis* 6, *ap. diam. intus* 4 *mill.*

Hab. In montibus Pulney *dictis, Indiæ meridionalis. S. Fairbank.*

Shell broadly umbilicated, depressed, nearly discoidal, greyish white with irregular streaks and spots of chesnut and two bands of the same colour; one, somewhat interrupted, below the periphery, the other, broader, within the umbilicus. Spire almost flat, the apex prominent and papillar, the suture deeply impressed. Whorls 5 rounded, the last cylindrical, gradually descending in front and furnished, (0.16 inch behind the aperture), with a short nearly vertical spiracle, in the form of a truncated cone, and joined to the penultimate whorl. Aperture diagonal, circular, the peristome double, the internal portion projecting slightly and obtuse, with a rather shallow angular sinus near the suture: the external peristome is continuous, expanded, dilated above into a projecting wing which runs forwards for some distance along the last whorl in front of the aperture, and is bent downwards at the end. Near the base of the columellar margin there is a small gutter-shaped projection. The operculum is very concave within, externally convex, flattened at the apex, with free lamellar edges to the whorls as in the typical species of *Pterocyclos.* Major diameter 0.58, minor 0.47, axis 0.23, diameter of the aperture within 0.16 inch. A rather smaller specimen measures 0.64 by 0.52 in its two diameters.

This species has not been figured as I hope to be able to give illustrations of all the known forms of *Spiraculum* on one plate.

The genus *Spiraculum,* previously to Mr. Fairbank's discovery, was not known to occur in Southern India. Its detection serves to add another to the Burmese and Malay forms represented in the hill groups of that region. In 1866, I described another species, *Sp. Beddomei** from the Eastern hills near Vizagapatam (J. A. S. B. Vol. XXXV. Pl. II. p. 31). The present form differs from *Sp. Beddomei* in several characters, the principal being the prominent apex, the form of the sutural tube and the presence of a small linguiform process at the left side of the peristome near its base. The last character indeed is quite peculiar, and serves alone to distinguish the present species. In size, and somewhat in form, there is a decided resemblance to the Burmese *Sp. Avanum*, in which, however, there are not only important distinctions in the form of the peristome, the recurved sutural tube, &c., but the operculum is also very different, being flat precisely as in the Burmese forms of *Pterocyclos*, while in *Spiraculum Fairbanki*, it is as convex as in *Ptercyclos rupestris*, or *Pt. bilabiatus.*

Mr. Fairbank only obtained 11 specimens of this interesting form. They were found in a Shola at some distance from Kodai Kanal, the hill station on the Pulneys, on the road to the Kukal Shola.

8.—**Cataulus Calcadensis,** Bedd. MS. Pl. XVI, fig. 8.

Testa sub-perforata, fusiformi-turrita, solida, confertim sub-sinuate costulata. Spira ovato-turrita ; apice acutiusculo ; sutura valde impressa. Anfr. 8½, *convexi, ultimus parum angustior, demum breviter solutus, antice porrectus vix descendens, carinâ basali validâ, compressâ, costulatâ, antice dilatatâ munitus ; periomphalo mediocri, costulato. Apertura sub-circularis, fere verticalis, canali ad latus sinistrum marginis basalis patente, ore subtus dextrorsumque spectante ; peristoma incrassato-expansum, sub-duplex vel duplex, internum obtusum, externum expansum, revolutum, postice et ad canalem basalem productum, margine columellari insuper angustiori, cum anfractu penultimo haud juncto. Operc ?*

Long. 21, *diam.* 7, *apert. diam. intus* 3½ *millem. Apertura cum peristomate incluso canali* 6½ *millem. longa. Exempli minoris long.* 16, *diam. cum perist.* 5¾, *diam. minor* 5, *apert. intus* 3 *millem.*

Hab. 'Calcad Hills' *extra fines provinciæ Travancore.*

Shell sub-perforate, fusiformly turrited, solid, closely and rather

* In the habitat of this shell, there is a misprint. *Kimery* hills should be *Kimety* hills.

sinuously costulated. Spire ovately turrited, apex rather acute, suture much impressed. Whorls 8½, convex, the last a little smaller, quite free from the other whorls for a short distance behind the mouth, but not descending much, not nearly so far as *C. tortuosus* is represented as doing. The basal keel is strong, compressed, transversely ribbed, and becoming larger in front; the space inside the keel around the umbilicus is of moderate size and ribbed. Aperture nearly circular, and almost vertical, the opening of the basal canal being at the left side and not in the same plane as the aperture, but turned a little downwards and to the right. Peristome thickened double, the inner portion obtuse, the outer expanded, turned back, produced below the canal and above near the suture, narrower on the inner margin and not touching the penultimate whorl. Operculum unknown. Measurements of 3 specimens in decimals of an inch.

Length,	Major diameter, peristome included,	minor diameter,	width of aperture inside,
0.84	0.28		0.14
0.76	0.26	0.23	0.14
0.64	0.23	0.2	0.12.

Length of the aperture and outer peristome in the larger specimen from the base of the canal to the end of the projection above 0.26 inch.

At first sight, this shell bears a most striking resemblance to *C. tortuosus*, Chem., but the last whorl is much less produced, and there appear, judging from the description and figures of Chemnitz's species, to be several slight but not unimportant distinctions in sculpture and form. Amongst the Ceylonese species, the nearest approach to the present is made by *C. decorus*, Bens., and *C. Blanfordi*, Dohrn, but no Ceylonese kind is known with the last whorl free. The previously described *Cataulus* from the base of the Anamullay hills resembles *C. Calcadensis* in the sinistral position of the keel, a character not noticed by Pfeiffer in his description.

Since finding the present species I learn from Captain Beddome that he has met with a third Indian *Cataulus* in Travancore.

So far as I am aware, the Nicobar locality of *Cataulus tortuosus* has not been confirmed. The discovery of so closely allied a form as that now described, in Southern India tends to make it probable that the species described by Chemnitz may prove to be Indian. Two other shells attributed by Chemnitz to the Nicobar Islands, *Helix hæmastoma*, L., and *H. Nicobarica*, Chem., have not since been brought thence. It is just possible that the former may occur, though I cannot help thinking it improbable, but as the locality for *Helix Nicobarica* is now distinctly ascertained to be the neighbourhood of Cuddapah, far inland and amidst a fauna and flora which resembles that of the Cape of Good Hope nearly as much as it does that of the Nicobar Islands, I utterly disbelieve in the occurrence of the species in the latter locality. The fact that both *Helix Nicobarica* and *H. hæmastoma* are Indian or Ceylonese, tends to increase the probability of *Cataulus tortuosus* being also an Indian shell.

9.—**Opisthostoma macrostoma,** Beddome, MS.

Pl. XVI, fig. 7.

Testa perforata, conoideo-ovata, albida vel pallide rubella, subdistanter oblique filiformi-costulata, sub lente spiraliter minutissime et confertissime striata. Spira elevato-conoidea, lateribus convexis; apice acutiusculo; sutura valde impressa. Anfr. 5½, *convexi, apicales normales non-diviantes, penultimus vix major, ultimus confertius costulatus, brevissime constrictus, antice sigmoideo-deflexus. Umbilicus ab anfractu ultimo non-occultus. Apertura retrorsa sub-rotunda, fere verticalis; peristoma brevissime ad anfractos duos, penultimum et ante-penultimum, adnatum, duplex, internum continuum expansiusculum, externum, expansum breviter interruptum. Long.* 3, *diam. major* 3, *min.* 2 *millem. Ap. diam. cum perist.* 1½ *millem.*

Hab. In montibus Bramagiri *dictis, in regione* Wynaad, *haud procul a littore Malabarica Indiæ. H. Beddome detexit.*

Shell perforated, conoidly ovate, white or pale reddish in colour with sub-distant oblique filiform costulation, which becomes closer on the last whorl: beneath a microscope there is very fine close spiral striation, very difficult to detect in general, as in other species of *Opisthostoma* and many *Diplommatinæ*.* Spire elongately conoid with convex sides, the apex rather acute, suture deep. Whorls 5½ convex, the apical ones not excentric as in the other Indian species; the penultimate whorl very little larger than those above it. The last whorl is constricted as usual. In front of the constriction it is

* In a good light it may easily de detected in *O. Crespigni*, H. Ad.

deflected inwards, but less sharply so than in *O. Fairbanki*, and it does not conceal the umbilicus, the curve being more as in *O. Nilgiricum.* Aperture reversed, nearly circular, almost vertical, having scarcely any inclination upwards. Peristome attached for a short distance only, touching both the penultimate and ante-penultimate whorls, double, both portions expanded, the outer more broadly reflexed, and interrupted for a short distance where attached, inner peristome continuous. Length 0.12, breadth measured across the peristome 0.12, shorter diameter 0.8, breadth of the aperture including the peristome 0.6 inch.

This is the largest form of the genus yet met with, exceeding even the Labuan species *O. Crespigni*, H. Ad. It is much more pupa-shaped than that kind is, but much less so than the two previously described Indian forms, from both of which it may easily be distinguished by the apical whorls not being excentric, as well as by its much greater size.

As the figure *of O. Fairbanki* in the Proceedings of the Zoological Society for 1866, Pl. XXXVIII, is rather too small to give a good idea of the form, and the sculpture had been omitted, two figures are given in the plate belonging to this paper, figs. 6, 6 a. For the drawings I am indebted to the kindness of Captain Godwin Austen. In fig. 6 a, representing the shell from below, the view is a little from the side; when seen from beneath in the line of the axis, the umbilicus is completely concealed by the last whorl, a character peculiar to *O. Fairbanki.*

From the figure just referred to in the Proceedings Zoological Society, the idea is conveyed that *Opisthostoma Fairbanki* is a much smoother species than *O. Nilgiricum.* This is due to the accident that the draughtsman had only the former species before him, and copied the figure of the other. In reality, the sculpture is about equally strong on both forms, the only difference being, that it is a little closer in *O. Nilgiricum.*

In the 3rd supplement to Dr. Pfeiffer's monograph of the *Helicidæ* just published, I see with some surprise that he retains H. Adams' genus *Plectostoma.* The author of that genus admitted in the Proceedings of the Zoological Society for 1865, p. 755, that it was identical with *Opisthostoma*, and subsequently in the Proceedings Zoological

Society for 1866, p. 447, announced the discovery of the operculum, as I had anticipated.

10.—**Ennea sculpta,** n. sp. Pl. XVI, fig. 10.

Testa profunde et flexuose rimata, sub-cylindrica, solidula, cerea, diaphana, nitida, costis verticalibus sub-flexuosis ornata. Spira turrita, sursum vix attenuata; apice obtuso; sutura impressa. Anfr. 8, *primi* 2 *lævigati, cæteri sub-confertim costulati, ultimus* ¼ *longitudinis fere æquans, antice sub-ascendens, basi compressus. Apertura verticalis, truncato-ovata, lamellâ unâ parietali intrante juxta angulum, aliis profundis* 4 *palatalibus, secunda minori, unâ columellari valida torta, in apertura vix conspicuâ, coarctata. Peristoma undique expansum, albidum, ad basin late repandum, marginibus callo lamelliferi junctis. Long.* 8½, *diam.* 2½, *millem. Ap. cum perist.* 2 *mill. longa.*

Hab. In montibus Pulney, *Indiæ meridionalis, detexit* S. Fairbank.

Shell deeply and flexuously rimate, sub-cylindrical, rather solid, translucent with a low glossy lustre and of the colour of wax. Spire turrited and elongate, becoming very little smaller above and bluntly terminated at the apex; suture impressed, whorls 8, the first two smooth, the others with strong vertical sub-flexuous ribs, the last whorl ascending slightly in front, compressed at the base. Aperture vertical, truncately oval, with a re-entering parietal plait close to the angle, a very deep columellar fold, scarcely perceptible from the aperture, but strong and twisted within, running up till it nearly joins the parietal plait, and 4 palatal lamellæ, the second of which from above is very small. These, like the columellar fold, are situated so far back, that they are with difficulty to be made out from the aperture. Peristome white, expanded, curved back slightly near the base, margins united by a rather thick callus on which is the parietal lamella. Length 0.34, diameter 0.1, length of aperture, peristome included, 0.08 inch.

This form has some slight resemblance to *E. Pirriei*, Pfr., but has very much stronger sculpture, and the lamellæ around the aperture, are very different.

I have another *Ennea* from the Nilgiris which I have hitherto considered a small variety of *E. Pirriei*, but it appears to differ in the possession of a strong transverse basal plica. In both forms, young specimens appear to have the lamellæ of the aperture quite as well developed as adults, so that they must be formed and re-absorbed, as I have shewn to be the case in the *Plectopylis* section of *Helix:* Ann. and Mag. Nat. Hist. Ser. 3, Vol. VII. p. 244. Pfeiffer—Mon. Vol. IV. p. 342,—describes the occurrence of the columellar plicæ in the young of *E. Pirriei.*

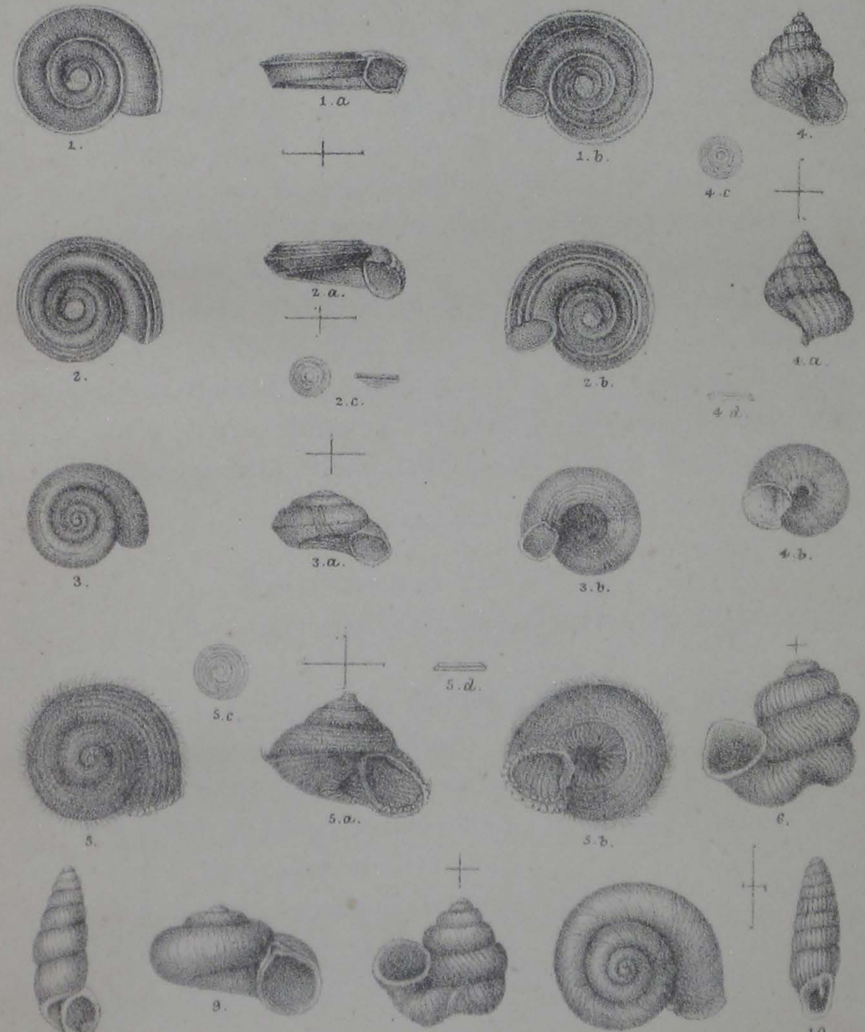
11.—**Streptaxis Canarica,** Beddome, MS. Pl. XVI, fig. 11.

Testa umbilicata, depressa, ovata, cerea, nitidula undique flexuose capillaceo striata. Spira convexa; apice obtuso; sutura vix impressa sub-marginata. Anfr. 5½, *parum convexi, penultimus postice acute carinatus, ultimus valde antrorsum devians, post aperturam fossiculis brevibus tribus constrictus, subtus convexus, ad basin circa umbilicum compressus. Apertura obliqua, irregulariter semiovata, lamina unâ parietali torta valida et dentibus sex in peristomate fere æquidistantibus coarctata. Peristoma albidum, undique sub-late expansum, ad angulum sinuatum, marginibus callo lamelliferi junctis. Diam. maj. vix* 8, *min.* 5½, *alt.* 3½ *mill; apert. cum perist fere* 3 *mill. longa,* 2¾ *lata.*

Hab. In Provincia South Canara, *haud procul a littore occidentali Indiæ.*

Shell umbilicated, depressed, ovate with considerable lustre and the colour of wax, with close rather irregular and flexuous hair-like striation both above and below. Spire convex, apex obtuse, suture scarcely impressed, sub-marginate. Whorls 5½, very little convex, the penultimate sharply keeled on the side opposite to the aperture, last whorl very excentric, with three distinct depressions behind the peristome; compressed beneath, especially near the mouth. Aperture oblique, irregularly semi ovate, with 7 teeth; 1 lamelliform doubly curved and re-entering for a short distance on the callus, uniting the margins of the peristome, and 6 in the peristome itself nearly equidistant from each other: of these two are on the outer margin, one at the curve where the peristome bends round towards the umbilicus, and 3 along the inner, or columellar, margin. The two lowest of the latter are the closest together of any. Peristome white, expanded, curved back considerably close to the junction with the last whorl. Major diameter 0.32, minor 0.22, height 0.14 inch, aperture 0.12 inch long, 0.11 broad.

This is the first strongly keeled species which has been met with in India. In form it much resembles the Molmain *S. Sankeyi*, Bens.



1. *Cyclophorus (Ditropis) planorbis.*
2. *C. (Ditropis) Beddomei.*
3. *C. (Ditropis) convexus.*
4. *Mychopoma limbiferum.*
5. *M. hirsutum.*
6. *Opisthostoma Fairbanki.*
7. *O. macrostoma.*
8. *Cataulus Calcadensis.*
9. *Pterocyclos tristis.*
10. *Ennea sculpta.*
11. *Streptaxis Canarica.*

The sculpture is peculiar. But a single specimen has been obtained by Major Beddome.

Cyclophorus ravidus, Bens., has been found by Major Beddome, on the Anamullay hills, and in the Wynaad. In both localities it attains a considerably larger size than the type. The Annamullay form is 27 mellimeters by 22, that from the Wynaad, 24 mill. by 19½. The operculum, when in good condition, has raised margins to the whorls. I am inclined to consider the species identical with the Ceylon *C. annulatus*, Troschel.

Auricula nitidula, described in No. VIII of these contributions, J. A. S. B. Vol. XXXVI, Part II, p. 64, proves to be a variety of *A. Gangetica* of Benson, with a thicker and darker coloured epidermis, but not otherwise differing. The dark coloured variety occurs also in the Ganges delta, where it has been found by Dr. Stoliczka.

Explanation of Plate XVI.

Fig. 1, 1 a, 1 b, *Cyclophorus* (*Ditropis*) *planorbis*, W. Blanf., magnified 2 diameters.

„ 2, 2 a, 2 b, *C.* (*Ditropis*) *Beddomei*, W. Blanf., ditto.

„ 2 c, Operculum of ditto ditto.

„ 3, 3 a, 3 b, *C.* (*Ditropis*) *convexus*, W. Blanf., ditto.

„ 4, 4 a, 4 b, *Mychopoma limbiferum*, W. Blanf., ditto.

„ 4 c, 4 d, Operculum of ditto ditto.

„ 5, 5 a, 5 b, *M. hirsutum*, Beddome, ditto.

„ 5 c, 5 d, Operculum of ditto ditto.

„ 6, 6 a, *Opisthostoma Fairbanki*, W. Blanf., magnified 10 diameters.

„ 7, *O. macrostoma* Beddome, magnified 4 diameters.

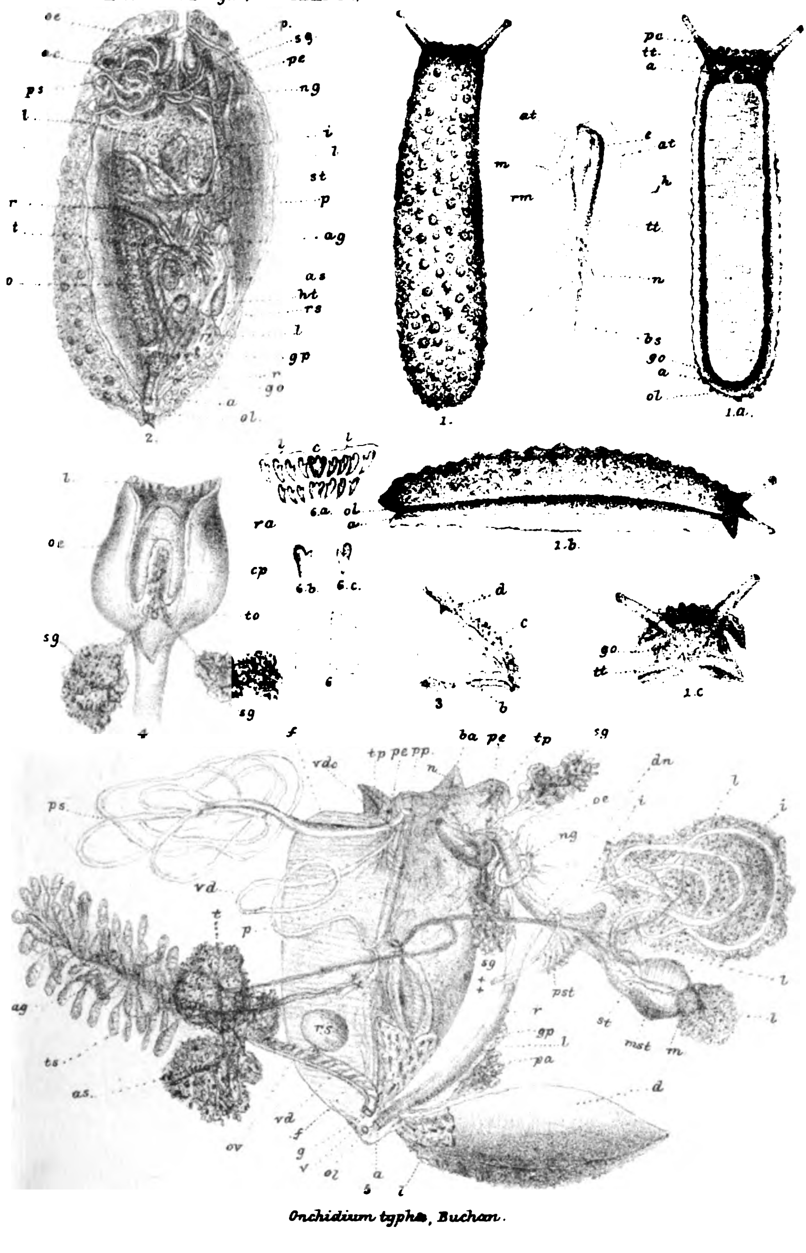
„ 8, *Cataulus Calcadensis*, Beddome, natural size.

„ 9, 9 a, *Pteroryclos tristis*, W. Blanf., natural size.

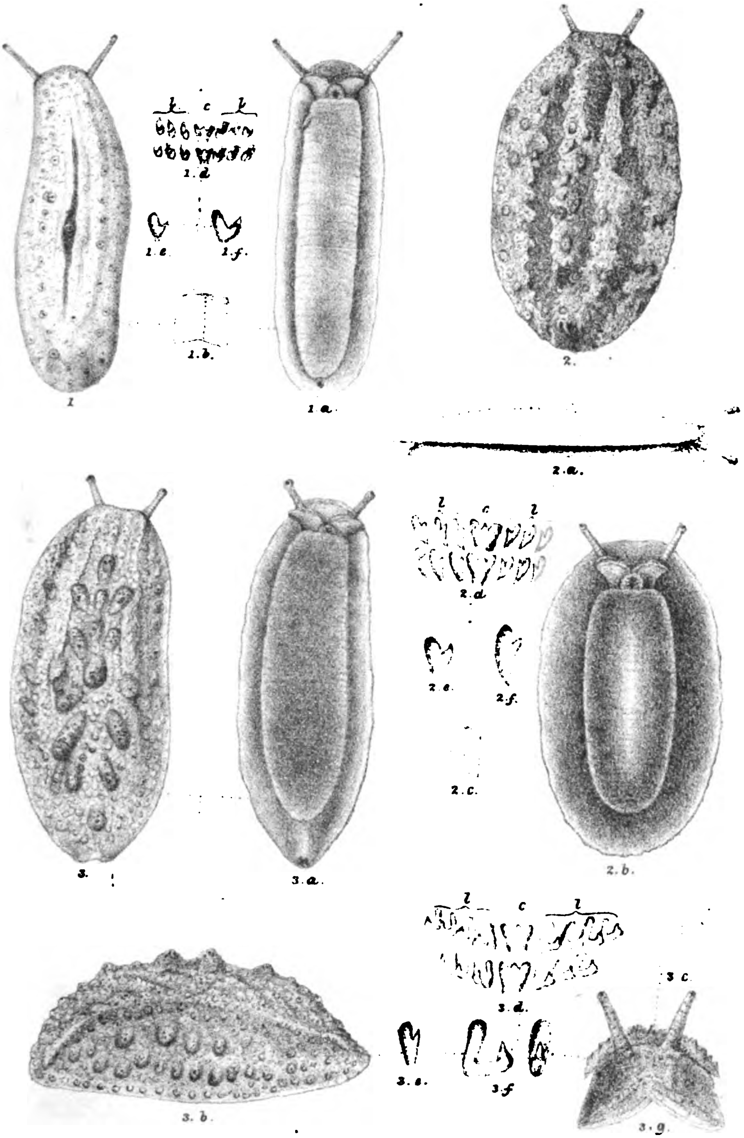
„ 10, *Ennea sculpta*, W. Blanf., magnified 2 diameters.

„ 11, 11 a, 11 b, *Streptaxis Canarica*, Beddome, ditto.

1. Delphin... sub disjuncta H. Ad.
2. Cylindrobulla pucilla, Nev
3. „ sculpta, „
5. ... cincta, Nev
6. „ delicatala, „
6. Lobiger viridis, „
7. Broderipia eximia, Nev.

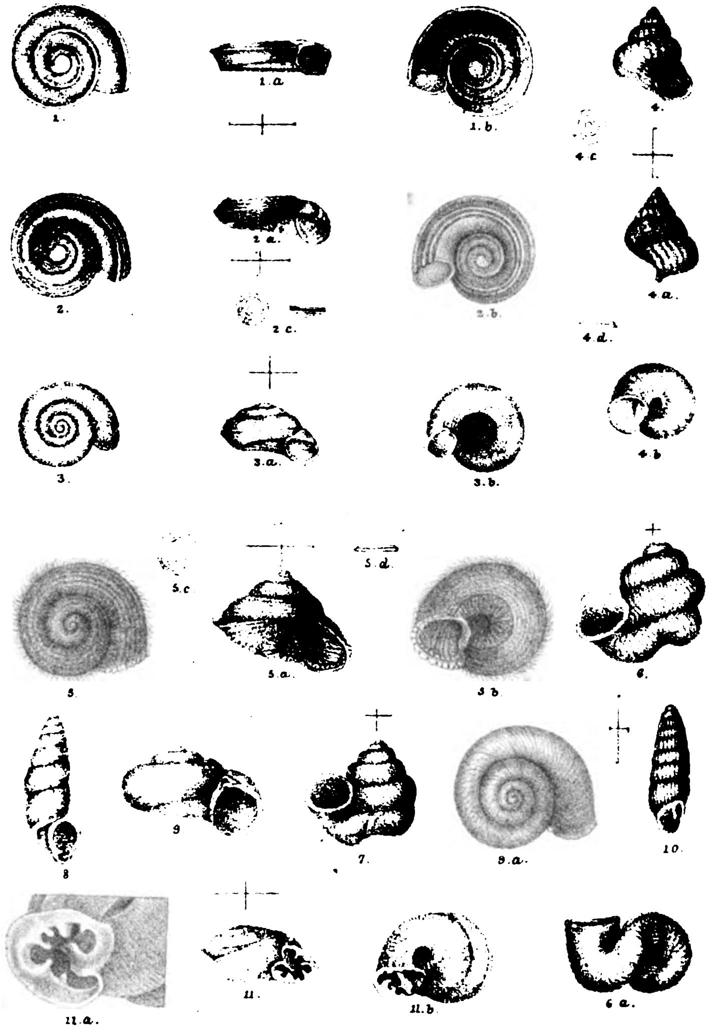


Onchidium typhæ, Buchan.

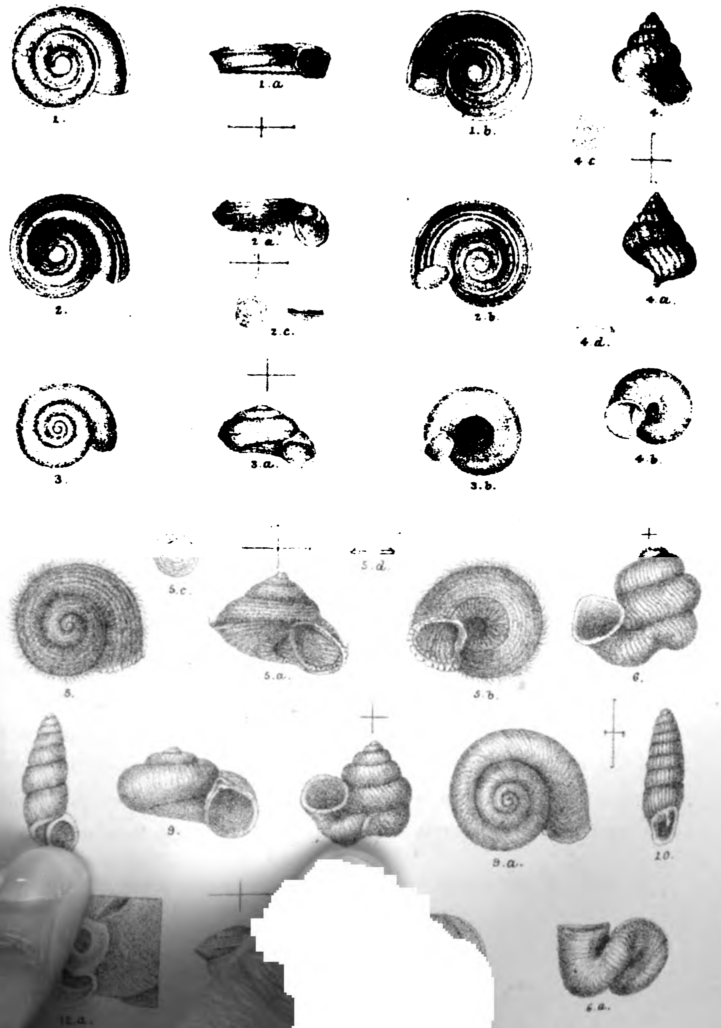


Calcutta

1. Onch. pallidum; 2. Onch. tigrinum; 3. Onch. tenerum.



1. *Cyclophorus (Ditropis) planorbis.*
2. *C. (Ditropis) Beddomei.*
3. *C. (Ditropis) convexus.*
4. *Mychopoma limbiferum*
5. *M. hirsutum*
6. *Opisthostoma Fairbanki.*
7. *O. macrostoma.*
8. *Cataulus Calcadensis.*
9. *Pterocyclos tristis.*
10. *Ennea sculpta.*
11. *Streptaxis Canarica*



1 *Cyclophorus (T*
2. C. (*Ditropis*
3. C. (*Ditrop*
4 *Mychop*
5 *M. hi*

stoma Fairbanki.
rostoma.
llus Calcadensis
ocyclos trochis
lea sculpta

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Part II.—PHYSICAL SCIENCE.

No. III.—1869.

Remarks on the species of Pandanus; by S. Kurz, Esq., *Curator of the Calcutta Herbarium.*

[Received and read, 4th November, 1868.]

Since the publication of my revision* of Indian screw-pines, and their allies, in Seemann's Journal of Botany, Vol. V. p. 93 etc., I had the opportunity of consulting Gaudichaud's work, "Voyage autour du monde sur la Bonite," and this gives me an opportunity for a few additional remarks.

Although I am at present unable to recognize several of Gaudichaud's species, the study of the carefully executed plates of this work have considerably added to my knowledge of screw-pines. From the analyses of *Freycinetia* and *Sussea* it appears quite clear, that the *Pandaneæ* and *Freycinetieæ* cannot be separated from each other, as

* In this paper some errors and omissions have crept in, which I now take the opportunity of correcting.

Typha elephantina p. 95, read: folia ... basi triquetra lateribus concavis, supra plana; instead "excavato-trigona."

II. Pandaneae, p. 94, add: Ovarium superum.

III. Cyclantheae, p. 94, add: Ovarium inferum. The Freycinetieae are to be transferred to II, Pandaneae.

Pandanus furcatus, var. Indica, p. 102, read: drupae valde convexae, for "concavae."

Pandanus laevis, p. 127, read: spadix masc. etc., sed hae laevissimae, instead "brevissimae."

I have formerly believed, having lain too much stress upon the number and the position of the ovules. Gaudichaud's genus *Sussea*, and especially *Souleyetia Freycinetioides* make it now even difficult, to retain *Pandanus* and *Freycinetia* as distinct genera. The only differences of some value, to distinguish them, seem to rest in the general habit, and the more or less regular superposition of the pendulous ovules along the marginal placenta. The ripe seeds in *Freycinetia* seem all to be furnished with a black and hard testa, while in *Pandanus*, they are only covered by a white membrane.

In revising Gaudichaud's species, I am now able to rectify my sections, formerly proposed, and I do this in recapitulating at the same time all the legitimate species, but omitting all those dubious ones, which have been already enumerated in my above quoted paper. It is impossible to form a correct idea, how far several of Gaudichaud's species of *Pandaneæ* are really identifications with Bory St. Vincent's Mascarhen species, bearing homonymous specific names, as the plates are accompanied only by an incomplete explanation of the figures. My own idea is, that they are most probably respective identifications; Gaudichaud's *Roussinia Indica*, l. c. t. 21, at least, is a copy of Rheede's figures of *Perin Kaida (Pandanus unipapillatus, Dennst.)*

Dr. F. von Müller has recently published some notes on Australian *Pandaneæ*, mentioning therein two additional species of Pandanus, *P. aquaticus*, and *P. monticola*, *F. Muell.* (*Fragment. Phyt.*, V, p. 40). Unfortunately the names of these species are not accompanied by a description.

PANDANUS, *Rumph.*

SECT. I. ACROSTIGMA. Drupae simplices; stigmata stricta, simplicia, spinescentia, extrorsum vergentes; filamenta libera; antherae acuminatæ; ovula solitaria. (*Fisquetia*, Gaud., ex parte.)

* *Stigmata persistentia (i. e. non nisi cum toto pericarpio separanda.)*

1. **P. caricosus,** Rumph.; Kurz, in *Seem. Jour. of Bot.*, V, p. 100.

2. **P. affinis,** Kurz, loc. c., p. 101.

3. **P. foetidus,** Rxb., Kurz, loc. c., p. 101. Fisquetia macrocarpa, Gaud., Bot., Voy. Bonite, t. 4, figs. 2-8.

P. ovatus (*Fisquetia ovata*, Gaud., loc. c., *t.* 4, *fig.* 1,) seems to belong to this section.

** *Stigmata secedentia, (i. e. imâ basi fragilia.)*

4. **P. ornatus,** (*Fisquetia ornata*, Gaud., loc. c., t. 5, *fig.* 1, 8 *et* 9; *et F. militaris*, Gaud., ib. f. 2-7.)

I would have united this species with my *P. helicopus*, but Gaudichaud's plant has the peduncle below the syncarpe straight, while *P. helicopus*, in a young stage has it always spirally twisted, becoming afterwards lengthened and pendulous; also the serrature of the leaves are in Gaudichaud's figure much sharper.

5. **S. helicopus.** Kurz, loc. c., p. 101.

Of this species the male flowers are still unknown, and it is doubtful, therefore, whether it should be placed in *Acrostigma*, or rather form a distinct subsection of *Ryckia.*

Sect. II. Ryckia. Drupae simplices; stigmata introrsum vergentes, secedentia, spinescentia, saepissime furcata, strictiuscula, v. a dorso depressa; filamenta racemosa, v. palmatim connata; antherae aristatae, v. apiculatae; ovula solitaria. (*Barrotia*, Gaud. ex parte.)

* *Stigmata brevia, a dorso plano depressa, spinescentia, bi- rarius tri- furcata v. simplicia, ossea.*

6. **P. furcatus,** Rxb., Kurz, loc. c., p. 102.

Barrotia diodon, Gaud., loc. c., t. 8, *fig.* 9-14, apparently belongs to this species, but *Barrotia monodon*, ejusd., loc. c., *fig.* 14-25, can with equal probability represent very young drupes of *P. furcatus*, or full grown ones of the two following species.

7. **P. labyrinthicus,** Kurz, loc. c., p. 103.

8. **P. nitidus,** Kurz, loc. c., p. 103.

** *Stigmata brevissima, a dorso oblique depressa, marginibus rotundatis v. crenulatis.*

9. **P. graminifolius,** Kurz, loc. c. 104.

10. **P. Ceramicus,** Rumph., Kurz, loc. c. 104.

Sect. III. Keura. Drupae in phalanges connatae, raro unâ alterâve simplice intermixtae; stigmata sessilia, v. sub-sessilia, peltata, v. reniformia; filamenta connata; antherae aristatae; ovula solitaria, (Kurz loc. c., cum syn.; *Tuckeya*, Gaud.; *Vinsonia*, Gaud.; *Barrotia*, Gaud., ex parte; *Hombronia*, Gaud.; *Eudouxia*, Gaud.?; *Dorystigma*, Gaud.?)

11. **P. Leram,** *Jones* (non Kurz), P. Leram *β*. macrocarpa, Kurz loc. c. 106.

Pandanus Leram, as represented by Fontana in Asiatic Researches, is my *var. β. macrocarpa* of my supposed *P. Leram.* The same variety agrees apparently very well with *Eudouxia macrocarpa*, Gaud., loc. c., t. XVIII, and perhaps also with *E.? Delessertii*, ejusd. loc. c. f. 7-8, notwithstanding an apparent slight difference between the stigmata. Both forms, *P. Leram*, Jones, and *P. Andamanensium*, as I now shall call the form, described by me erroneously as *P. Leram* of Jones, occur on the Andaman islands, but I only could obtain of the former very old fruits, an account of which the recognition of the real form of stigmata was very difficult. In the Bot. Gardens, Calcutta, drupes of true *P. Leram* (coming from a plant in the gardens, said to be introduced from the Nicobars) are preserved, but also in a state unfit for a correct decision. The young plant (the old one having been destroyed by the Cyclone in 1864,) would also differ from *P. Andamanensium*, by the form of the leaves which are almost cuspidato-acuminate, and not simply acuminate. This appears to be one more reason for retaining the two forms as distinct species, until a re-examination of more complete specimens may enable me to give a more satisfactory explanation of the point in question.

12. **P. Andamanensium,** *Kurz. P. Leram*, Kurz loc. c. 105, *excl. var. β. (non Jones)*.

13. **P. dubius,** Spreng., Kurz loc. c. 127.

Hombronia edulis, Gaud., loc. c. t. XXII, *of* 17, is not likely distinct from *P. dubius*, and *Barrotia tetrodon*, Gaud., loc. c., t. XIII, f. 1—8, has all the appearance of being only a young syncarpe of the same plant.

14. **P. Kaida,** Kurz. *P. Candelabrum?* Kurz loc. c. 27, *excl. syn. omnibus, excepta citat Rheediana.*

15. **P. Candelabrum,** P. d. B., Fl. d'Oware I. 37, t. 21-22; Kth. Exum. III. 97, (non Kurz) from Western Africa.

I have little doubt that Gaudichaud's *Tuckeya Candelabrum* (loc. c. t. XXVI, *f.* 10—12) represents the true *P. Candelabrum*, and have, therefore, changed the specific name of the previous species which is restricted to Inda.

16. **P. verus,** *Rumph., Kurz loc. c.* 125.

I believe that all the *Pandani veri* of Gaudichaud have to be regarded as identical with the present species, as *Pandanus Linnaei*, Gaud. loc. cit t. XXII, *f.* 1—8 ; *P. Chamissonis, ejusd. loc. cit., f.* 9 ; *P. fragraus, Rumphii, Rheedei, Loureiri, Menziesii, Boryi* and *Douglasii*, figured loc. cit. plate XXII. The two latter look somewhat similar to forms of *P. Andamanensium*, but such elongate drupes are found also occasionally in Indian forms of *P. verus.*

17. **P. laevis,** Rph., Kurz. loc. cit. 126.

18. **P. utilis,** Bory, Kurz. loc. cit. 131.

Here, as in the case of the former, I cannot agree at all with the view taken by Mr. Gaudichaud, as regards the definition of species, and I have good reason to believe that all the following of his proposed species have to be considered as synomyms of *P. utilis.*

Vinsonia utilis, Gaud. loc. cit., t. XVII. *f.* 1—5 *et t.* XXIII, *f.* 1—6 *et* 9—18 (*germinatio*) ; *Vins. stephanocarpa*, ejusd. loc. c. t. XVII, *f.* 2—6 *et* 7-8 ; *Vins. purpurascens*, ejusd. loc. c. *t.* XVII, *f.* 6—9 ; *Vins. humilis*, ejusd. loc. c., *f.* 10-11 ; and *Vins. elegans*, ejusd. loc. c., *f.* 12-13, all figured on plate XVII.

The last three forms are Wallich's *P. lucidus*, and are included loc. cit. under my *var. β. lucida.*

The drupes of *Vinsonia palustris*, ejusd. loc. cit. t. XVII. *f.* 18—23 are undistinguishable from those divided forms of *P. utilis*, of which I have given a few characteristic representations in Dr. Seemann's Journal v. t. 64.

19. **P. lucidus,** (*Vinsonia ? lucida*, Gaud., *loc. c. f.* 14-15.)

This species, although very near to *P. utilis, var. lucidus*, is apparently distinct, differing in the form of the stigmata. A very good representation of it, exists in the Library of the Bot. Gardens, Calcutta, under the name of "*Pandanus lucidus*," Wall., but it is not the species which is now cultivated under that name in the gardens.

20. **P. sylvestris,** (*Vinsonia sylvestris*, Gaud., *loc. c. t.* XVII, *f.* 16-17).

21. **P. Pervilleanus,** (*Vinsonia Pervilleana*, Gaud., loc. c., t. XXXI, *f.* 1—7 ; probably including also *Vins. drupacea*, ejusd., l. c. f. 8—13).

Besides the above named apparently well-founded species, the following somewhat dubious forms belong also to the section *Keura.*

Dorystigma Madagascariense, Gaud., loc. cit., t. XXXI, *f.* 12—13, and *D. Mauritianum*, ejusd., loc. cit., t. XIII, *f.* 25—27,

Sect. IV. Microstigma. Drupae simplices; stigmata sessilia, semilunata, reniformia, hippocrepiformia v. bilobata; filamenta connata; antherae truncatae v. apiculatae; ovula solitaria. (*Foullioya*, Gaud.; *Lussea*, Gaud. ex parte; *Jeanneretia*, Gaud.; *Heterostigma*, Gaud.?; *Bryantia*, Gaud.?).

* *Stigmata terminalia, bilobata, lobis integris v. bilobulatis; filamenta connata; antherae apiculatae.* (*Foullioya*, Gaud.)

22. **P. racemosus.** (*Foullioya racemosa*, Gaud., l. cit. t. XXVI, *f.* 1—9, et *Foullioya maritima*, ejusd., l. cit. f. 21—24).

** *Stigmata terminalia, reniformia v. hippocrepiformia; filamenta racemose connata; antherae truncatae.* (*Jeanneretia*, Gaud.)

23. **P. humilis,** Rumph., Kurz loc. cit. 105. *Sussea microstigma*, Gaud. loc. cit., t. XXV, *f.* 8—10.

Gaudichaud's figure represents a polygamous plant, not yet recorded in the genus *Pandanus.* The form of the anthers agree pretty well with those derived from the male spadices.

23. **P. littoralis,** (*Jeanneretia littoralis*, Gaud., loc. c., t. XXV, *f.* 1—7).

Sussea lagenæformis, Gaud., loc. c., t. XXV, *f.* 11—14, and *Heterostigma Heudelotianum*, ejusd., loc. cit., f. 15—31, I have not as yet been able to discriminate.

24. **P. latifolius,** Rph., Kurz l. c. 105.

The position of *P. latifolius* must still remain undecided, but it is certainly a very distinct species. The leaves, when recently dried, are scented and used by the Malayan ladies in their toilette cases, like the spathes of *P. verus* and *P. laevis.*

25. **P. conoideus,** (Thouars?), (*Sussea conoidea*, Gaud., loc. cit., t. XXIV).

This is a very distinct species.

*** *Stigmata lateralia.* (*Bryantia, Gaud.*)

26. **P. butyrophorus,** (*Bryantia butyrophora*, Gaud., loc. cit. t. XX).

This species very much resembles *P. Ceramicus* in the form of the syncarpe and of the drupes. The syncarpe of *P. Ceramicus*, however, is drooping when ripe, and the stigmata are also differently formed.

SECT. V. SOULEYETIA, Gaudichaud. Drupae simplices; stigmata semilunata v. subhippocrepiformia, subsessilia; ovula 3 placentae basilari instructa.

27. **P. freycinetioides,** (*Souleyetia freycinetioides*, Gaud., loc. c., t. XXIX).

Gaudichaud includes *Souleyetia* in the FREYCINETIEAE, but I think the respective species is more correctly referred to *Pandanus*.

Notes on the Geology and Physical features of the Jaintia hills;— by CAPTAIN H. H. GODWIN-AUSTEN, F. R. G. S., *Topographical Survey of India.*

[Received 16th December, 1868, read 3rd Feb. 1869.]

The western boundary of the district of the Jaintia hills, is the river Mangat, crossed on the direct road from Lailangkot to Jawai; the valley is deep and extremely picturesque; the hills rising from the narrow strip of rice land at the bottom in steep slopes of grass and wooded ravines and close under the crest into precipitous scarps. Among others the Nongjerong hill presents very conspicuous features. The geological formation is here of metamorphic rocks, a well stratified gneiss, and in the bed of the river the boulders are almost entirely of that rock, mixed with quartzitic sandstone, and a few boulders are of a dark green trap.

Ascending from the river to the top of the slopes of the left bank, and passing the village of Simunting on the right, a short distance, the first patches of a stratified rock are seen, a coarse gritty sandstone of light colour, forming the tops of the little eminences and never exceeding here perhaps 20 feet in thickness. They are lost sight of as soon as the descent into the Mantadu commences, where the metamorphic rocks, dipping at high angle and with a E. N. E. strike, are seen again: the sandstone series reappearing when the opposite ascent is crowned. A strong interbedded conglomerate is very noticeable here, always lying at the base of this formation.

Its chief peculiarity now consists in the beds of dark purple hue, in others so fine, white or chalky in appearance, that they might almost be mistaken for the latter rock. Broken up and mixed with water it is used largely as a whitewash for native huts. Sandstone now forms the mass of all the elevated points in Jawai, and is conspicuous near the dâk bungalow, resting horizontally on the highly tilted older rocks. On the hill mass of Chirmang, south of Jawai and the Mantadu, its thickness has greatly increased, bringing in above the conglomerate thinner and finer beds, and less sandy in composition. Here we find traces of the carbonaceous shales and in places a dark, hard, earthy coal, invariably thin-bedded and altogether very local in its distribution. To the east of Latuber the same features may be seen all the way to Satunga, the metamorphics appearing on the higher parts of the plateaux, where the sandstone only occurs in isolated thin patches.

But at Satunga, we are introduced to a new series altogether, *viz.* the limestone (*nummulitic*), of which an outlier forms a mass with low perpendicular and jagged sides to the right of the road, and on the very edge of the southern depression of the level of the country. To the south-west one or two wooded isolated knolls shew the limits of the northern extension of that rock. It rests in this locality on the sandstones also associated with coal beds; and there is no doubt that these last are of secondary age, the prototypes of rocks better developed under Cherra Poonjee and thinning out at Maobelarkar, on the road to Shillong. There is also an appearance of a break in the succession between these secondary strata and the nummulitics, pointing to a long lapse of time, and to very different conditions of the surface, before the deposition of the limestone began. Here we are I think also near the confines of the tertiary sea in which those rocks were formed, as shown by the thinning out northwards of the limestone beds.

Proceeding south to the low range of hills of which War Hill Station forms the highest point, the limestone has greatly increased in thickness, and is superimposed at the same time by beds of quite a different mineralogical character, being nodular, ferruginous and highly fossiliferous. Above this well marked horizon no limestone with *Nummulites* was seen; local unconformity of these last is noticeable, and either due to a falling in of the limestone, or, as I am more inclined to think, to a prior denudation of the limestone surface. The fossils are minute with an occasional Gastropod of larger size. This ridge, on the north of which lies Nongkli, well known as one of the last strongholds of the Jaintias during the rebellion of 1861-62, is succeeded on the south by the main ridge and the watershed of the hills, the stream at Nongkli being a feeder of the Kopili. Crossing a low pass at the head of the last mentioned stream, the view that suddenly opens out, is almost Himalayan; below lies the deep valley of the Umsnat, backed on the east by the high mass of Marangksi, its precipitous cliffs shewing out grandly against the noble forest that covers all else. In this great section, everything above the Nummulitics is exposed, this last forming the bottom beds in the valley succeeded by the fossiliferous ferruginous strata, and again above by an enormous thickness of soft, thick-bedded sandstone of light ochre tint;—this higher mass is the universal rock of all the higher forest-clad hills running thence due east to Asalu. In the bed of the Umsnat, the limestone is almost horizontal, but lower down has a very slight dip southward. It also thickens in this direction very rapidly with interstratified beds of sandstone.

The whole mass preserves its horizontality, and there is nothing very noticeable over a large and broad band, save that with the deepening valley lower beds of the limestone are exposed, but in no spot did I see sandstone of secondary age, or one that could be mistaken for it. The Umsnat joins the Simleng, and the united streams become the Lubah, which forms a junction with the Barak near Molagul. The Simleng and Lubah form a deep valley with an east and west strike, and the mass of the upper nummulitic or tertiary sandstone rises precipitously on the south, forming a ridge parallel with it. Upon this line, the first bending over to the south commences. The best section for observing this peculiar formation is near Katom, where the Lubah turns south in a gorge, cutting diagonally right across the whole mountain mass. The solid limestone of great thickness, perhaps 1,000 feet, and the higher sandstones all have the same great incline, becoming afterwards perpendicular and being succeeded at this above mentioned point by a thin-bedded series of newer rocks, clays and sandstones, of various colours and hardness. The angles of dip vary slightly north and south of the perpendicular, they shew a great crushing, perhaps folding of the beds.

As we leave the higher hills for the low eminences (Tilas) the sandstones become coarser, having scattered through them strings of small pebbles, as also large lumps of lignite. In one place the whole of the roots and part of the trunk of a large tree were seen in the perpendicular strata of the river bank. These last mentioned rocks evidently are of lower Sewalik age, and are capped unconformably further into the plains, by masses of irregularly bedded clays and conglomerates, which pass under the present alluvial surface.

Before closing my remarks on the geology of the Jaintia Hills, the nummulitic coal should be alluded to. This has long been known to exist at Lakadong, and was there, I believe, once worked. The same formation occurs at many points further east, particularly near Narpo, at no great distance from the Lubah river, navigable for small boats; its value has yet to be made known and perhaps established. There is no reason why beds of considerable extent should not, with proper search, be discovered. Its position, high in the nummulitic limestone, is precisely the same as that at Cherra Poonjee. This coal is no where met with east of the Lubah and Umsnat rivers.

The most striking feature of this part of the Khasia range of hills, is the extremely even height of the central mass. Nowhere is this so well seen as from the peaks of the north Cachar range Marangksi, &c., the dead level line of the whole mass as far east as Timang Hill Station, is from here most noticeable; even the Shillong peaks make hardly any shew in the distance. This central mass or high table land is all of gneiss associated with granite, generally at a high angle with a W. S. W. to E. N. E. strike, and the denudation it has been subjected to must have been enormous prior to the secondary epoch. It falls very gradually to the south for a long distance, with a last sudden dip over Jaintiapur. On the north the lower levels are successively reached by a series of steps, that can be followed for many miles, the last descent being the greatest, corresponding to the like sudden depression at Nunklow, &c. Timang and Saranthu mark the limit of this table-land on the east, and overlook the far lower country of the valley of the Kopili. In the Jaintia district the trap rock comes in with the fall in the country, and the high isolated peaks to the south of the Mangkhen are found to be a continuation of the quartzitic sandstones of the Shillong peak, &c., almost perpendicular, but lying up against an amygdaloid trap, associated with a true granite which comes in with an east and west run on the north, and forms the remarkable rounded bosses, such as Billu Kongor, &c. Granite also occurs contiguous to the gneiss north of Nartiang, and thence in an easterly direction immediately north of Nongjinghi which is almost the highest point of the Jaintia hills, 4,563 feet above sea level. The Nongjinghi ridge is gneiss, resting against the granite. As at Lailangkote in the Khasia hills, the trap is closely associated with the granite, and in such situations the titaniferous iron sand is found in great quantity, and smelting furnaces are seen in all the adjacent villages. This dark green trap appears to have been injected between the granite and gneiss, or between the former and the quartzitic sandstones at or about the period of the great disturbance and change in the metamorphic series. The parallelism of the drainage lines south-east of Jawai, is very remarkable, and with the cross-drainage at right angles breaks the country up into irregular parallelograms, which probably display a monster jointing of these metamorphic rocks.

The most remarkable lines taken up in succession by different great valleys and ravines are—1st, a main line, rather irregular, but to which all lines to the south conform, commencing on the west at Karpentèr village on the Mangat; that river carries it to Jarain, E. N. E., up to the junction of the Kawa Manvi with the Mantadu, north-westerly by the Keremontha ravine past Wapùng into the Umpa-ai and by the Mùrin into the Kopili near Thelgasi; this last river continuing on for many miles with a north-east course, altogether constituting a great physical feature extending from west to east for 55 miles. The 2nd line, at an average distance on the south of 6 miles, can be traced from Pomtadong, past Thangbuli, to the Mantadu river at the junction of the Baliang, on the left bank, following this last named river, over the watershed into the Lonnang river, and in succession by the Umkorpong to the north of Satunga, where this river turns sharp at right angles to the south. Yet the same direction can be carried on to Umthnong, and is lost in the sudden W. S. W. bend of the Kopili.

The third line can be taken up at the base of the hills near Jaintiapur, by the river Rangpàni, into the Umchaliang, S. W. to N. E., crossing the Mantadu, on again to the Làma river, past Thampianai G. T. S., into the Pamesken, and by a succession of ravines to the north-west of Khleriat, where the last stream, the Shashem, turns to the S. S. E. The same run, but with a more east and west course, is taken up in succession on the north by the Muntang and Munriang rivers, tributaries of the Kopili, and lastly by the Mankhen.

These great lines of continuous depression are again displayed further on the south and east and shew there a decided curvature. I may note the Lubah, Simleng and Artan into the head waters of the Kopili, north of Sherfaisip, and again further south the deep depression marked by the valleys of the Kùmra Làrang, Kayeng into the Jatinga and, taken upon the north of the main watershed at Asalu, by the valley of the Dhansiri. To the south of this the strata are found tilted high in that direction giving the more pointed shape to the peaks of the south-west Burail range. The line is intimately connected with the original elevation of the whole mountain mass, and the parallel continuous lines, already noticed, are doubtless due to the same parallel forces of elevation. As might be expected the geological formations all coincide with these great natural flexures, carrying the nummulitic series with its limestones, and the cretaceous rocks, far north on the Kopili, and thus into the valley of Assam.

Camp, North Cachar, December, 1868.

Descriptions of marine Gastropoda from Ceylon, &c. ;—
by MESSRS. G. AND H. NEVILL.

[Received and read 3rd February, 1869.]

This paper is a continuation of the one we had the honour of placing before the Society at the August meeting of last year (1868). These new species, as likewise those previously described, were, with one exception, collected in the Southern Province of Ceylon, mostly near Balapiti; the *Rapana*, one of us had previously also found at La Réunion (Bourbon). We have also seen several of the small species of TROCHIDÆ from Bombay and Arakan, probably all of them are to be met with along our coasts, though the small and interesting little species, we have here named *Euchelus Seychellarum*, we have never met with anywhere in these seas, except at the Island of Mahé, one of the Seychelle group.

Clanculus Ceylonicus—N. S., Pl. XVII, Fig. 7.

T. parva, turbinata ; anfractibus senis, convexiusculis, albescentibus, prope suturam posteriorem maculis fuscis transversaliter prolongatis notatis, ad suturam anteriorem puncturatis ; costulis spiralibus quinis in quoque anfractu granulosis ; sutura subprofunda ; ultimo anfractu ad peripheriam subrotundato ; basi leviter convexiuscula, granulato-costulata, umbilicata : umbilico margine incrassato ac denticulato circumscripto ; apertura quadrangulari, labro intus crasse costulato, labio calloso, recto, ad medium obsolete, antice crasse dentato.

Alt. 7 *Mil.—Diam. maj.* 7 *Mil.*

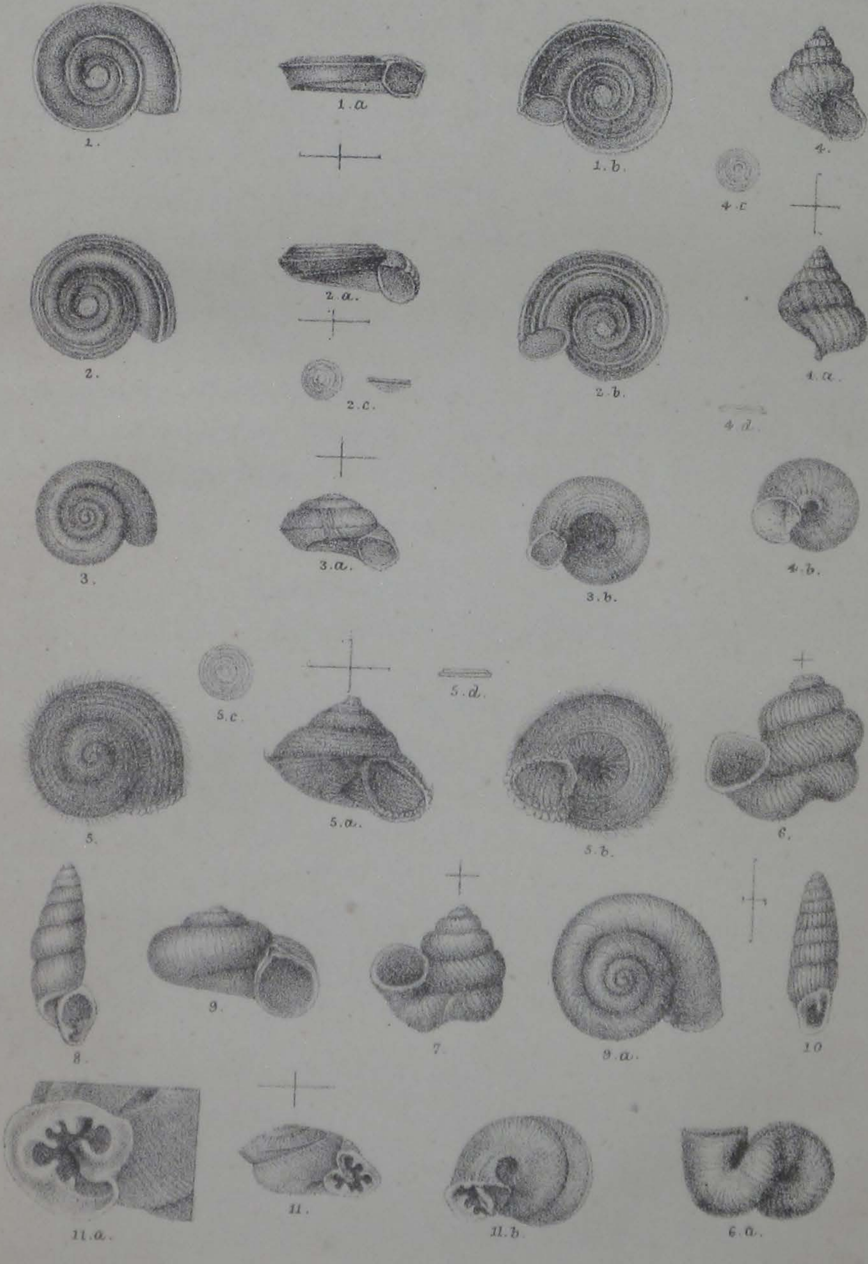
Abundant.—S. Prov. Ceylon ;—also occurs at Bombay.

Euchelus Seychellarum—N. S., Pl. XVII, Fig. 10.

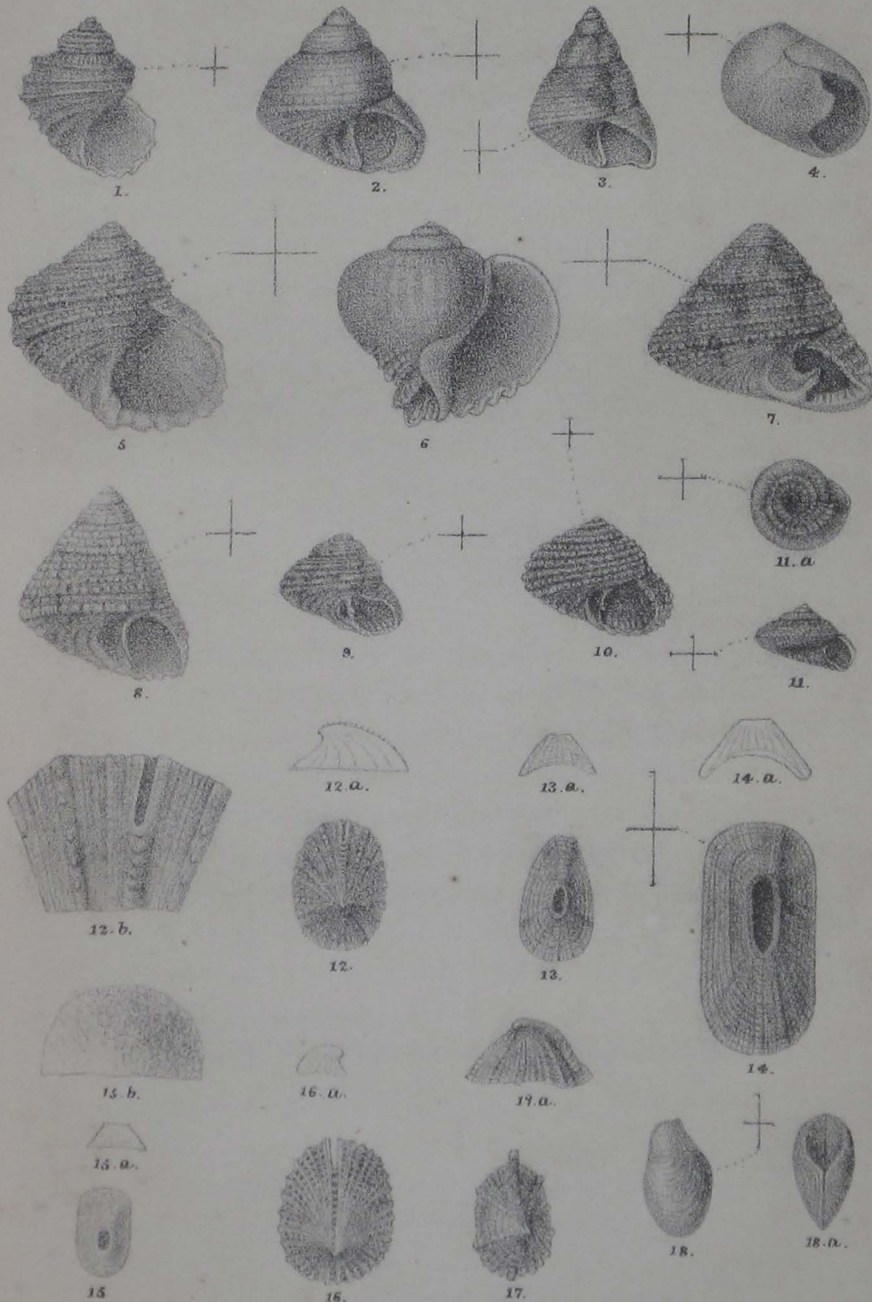
T. parva, depresso-conica, sub-globulosa, alba, solidula ; anfractibus quaternis, convexiusculis, suturâ impressâ junctis, costulis spiralibus minute sed confertim granulatis ornatis ; ultimo anfractu ad peripheriam rotundato ; basi convexâ, spiraliter granulato-costulata, anguste umbilicata ; apertura subrotundata : labro uniforme arcuato, ad marginem obtusiusculo, intus sulcato ; labio recto, oblique decurrente, antice denticulo parvo instructo.

Alt. 2½ *Mil.—Diam. maj.* 3 *Mil.*

Scarce.—Island of Mahé (one of the Seychelle group).



1. *Cyclophorus (Ditropis) planorbis.*
2. *C. (Ditropis) Beddomei.*
3. *C. (Ditropis) convexus.*
4. *Mychopoma limbiferum.*
5. *M. hirsutum.*
6. *Opisthostoma Fairbanki.*
7. *O. macrostoma.*
8. *Cataulus Calcadensis.*
9. *Pterocyclos tristis.*
10. *Ennea sculpta.*
11. *Streptaxis Canarica.*



1. Gibbula (?) sub-plicata
2-3. — Stoliczkana
4. Pisulina Adamsiana
5. Tallorbis roseola
6. Rapana bella
7. Clanculus Ceylanicus
8. Gibbula Dupontiana
9. — Blanfordiana
10. Euchelus Seychellarum
11. Solarium impressum
12. Emarginula papilionacea
13. Fissurella canalifera
14. Macroch. sculiformis
15. Fissurella (?) scrobiculata
16. — capuloidea
17. Sub-emarg. Oldhamiana
18. Rocellaria cordiformis

Gibbula Dupontiana—N. S., Pl. XVII, Fig. 8.

T. parva, trochiformis, pallida, transversaliter maculis irregularibus fuscis notata; anfractibus costulis senis spiralibus, crassis circumdatis, prope suturam angustioribus, transversaliter lineis subtilissimis obliquis ornatis; ultimo anfractu ad peripheriam angulato, ad basin applanato, profunde umbilicato; aperturâ sub-quadrangulari, labro ad marginem acuto, intus sub-incrassato; labio tenui, simplici, leviter arcuato.

Alt. 7 *Mil.—Diam. maj.* 6 *Mil.*

Common on sea-weed at low water, S. Prov. Ceylon.

This species is named after M. Dupont, of Mauritius, whose indefatigable zeal has so greatly increased our knowledge of the interesting fauna of that Island. The nearest shell, I know of, to the above is one described by Reeve as *Ziziphinus vexillum* (G. Nevill).

Gibbula Blanfordiana—N. S., Pl. XVII, Fig. 9.

T. parva, turbinata, depresso-globulosa, solida, alba, rubide variegata et marmorata; spira ad apicem sub-obtusa; anfractibus quinis, postice sensim angustioribus, ad medium sub-angulatis, spiraliter costulatis: costulis senis, crassiusculis tenuioribus alternantibus; ultimo anfractu ad peripheriam rotundato; basi convexiuscula, umb-ilicata: umbilico callositate albida, paulo incrassata, circumscripto; apertura sub-rotundata, labro crassiusculo, intus striato, ad marginem eleganter crenulato, postice paulo deflexo; labio prope recto, oblique decurrente, levi, ad medium paululum incrassato.

Alt. 5½ *Mil.—Diam. maj.* 6½ *Mil.*

Not uncommon;—S. Prov. Ceylon; found on sea-weed at low water.

A somewhat allied species to the above was described by Deshayes in his work on the shells of Bourbon, as *Turbo* (!) *filifer*, the differences in the umbilicus, the columellar margin, &c., however, distinguish it at the first glance. I have also seen this species from Arakan, in Mr. H. F. Blanford's fine collection; like the following, it probably has some considerable range in these seas. (G. Nevill).

Gibbula Stoliczkana—N. S., Pl. XVII, Figs. 2-3.

T. conoidea, parva, solidula, olivacea seu rufescens, maculis transversalibus pallidis notata, aut minute variegata, epidermide fulvescente induta; anfractibus senis, sub-planis, suturâ impressâ sejunctis, spira-

liter minute sulcatis: sulcis liris depressis latioribus, æqui-distantibus separatis; ultimo anfractu maximo, ad peripheriam angulato; basi leviter convexa, spiraliter striata, profunde et anguste umbilicata, in excavatione umbilici albida; apertura oblique quadrangulari, intus callositate moderata ac lævi instructa; labro ad marginem sub-obtuso, labio prope recto, albido, antice truncatim desinente.

Alt. $6\frac{1}{2}$ *Mil.—Diam. maj.* 5 *Mil.*

Not uncommon, in the same places as the preceding.

This pretty little species varies immensely, not only in colour and size, but also as regards the convexity of the whorls and the angle of the spire. There are specimens from Arakan and from the Andamans, in the collection of Dr. Stoliczka, after whom the species is named, and who kindly assisted us in drawing up the descriptions of the species noticed in this paper.

Gibbula ? sub-plicata—N. S., Pl. XVII, Fig. 1.

T. turbinata, tenuis, semipellucida, alba; anfractibus quinis, tubulosis, ad suturam applanatis, spiraliter costulatis: costulis in anfractu penultimo tribus, omnibus valde prominentibus, interstiis profundis, distantioribus separatis, in anfractibus superioribus transversaliter cancellatis seu scrobiculatis, in ultimo spiraliter subtilissime striatis; anfractibus omninis ad suturam transversaliter plicatis; basi subconvexa, anguste umbilicata, quatuor costulis spiralibus ornata, interstiis duobus, prope umbilicum sitis, transversaliter costulatis; apertura fere circulari, margine simplici circumdata, labio moderate insinuato; superficie interna paululum margaritacea.

Alt. 5 *Mil.—Diam. maj.* 4 *Mil.*

Rare;—S. Prov. Ceylon.

There is some difficulty in determining in what genus, or sub-genus to place this curious little species, the thinness of shell and the peculiar sculpture of the body-whorl, as well as the slightness of the internal pearly layer, make its position, as long as the animal and operculum are unknown, somewhat doubtful.

Tallorbis—N. Sub-G.

T. sub-orbiculata, subconica, columellâ solidâ, antice applanatâ, transversaliter plicata et abrupte termiata instructa; habitu generi, Thalotia *dicto, affinis.*

We experience some considerable difficulty in determining the exact position of the above sub-genus. *Thalotia* appears to be the one to which it is next allied, though the general form, sculpture and substance are very far removed from any species of that genus with which we are acquainted.

Tallorbis roseola—N. S., Pl., XVII, Fig. 5.

T. depresso-conica; anfractibus quinis, in latitudine rapide crescentibus, suturis profundis sejunctis, spiraliter distanter costulatis: costulis in anfractu penultimo tribus; omninis distantibus, tuberculis numerosis, roseis eleganter ornatis, interstiis latis, una stria spirali in medio divisis, transversaliter cancellatis; basi convexa, similariter ornata; apertura ampla, subrotundata, margaritacea, intus in adultis speciminibus lævi, in junioribus sulcata: labro haud incrassato, ad marginem crenulato, labio tenui; columella antice incrassata, subreflexa, plicis tribus, tortis instructa.

Alt. 11½ *Mil.—Diam. maj.* 11 *Mil.*

Very rare;—S. Prov. Ceylon.

Pisulina—N. G.

T. crassiuscula, polita, semi-globosa, neritiformis, spirâ brevi, apertura sub-orbiculari, integrâ, haud umbilicatâ instructa; labio columellari applanato, calloso, in medio dentiforme dilatato, labro simplici.

This genus approximates so closely to *Calceolina* of A. Adams, that we entertained doubts, as to whether it was desirable to separate it, the remarkable protuberance of the inner columellar lip, however, decided us on doing so, though, until the animals and opercula (if any?) have been carefully examined, we shall feel some doubts, as to whether both of them are not mere sections of *Teinostoma.*

Pisulina Adamsiana—N. S., Pl. XVII, Fig. 4.

T. parva, alba, lævis, solida; spira obtusa; anfractibus quaternis, superis interne, sicut in speciminibus Neritarum, evanidis; sutura indistincta; labio columellari calloso, polito, lævi, denticulo lato, depresso ad medium munito; labro intus paululum incrassato, polito, ad marginem acuto.

Alt. 4½ *Mil.—Diam. maj.* 4 *Mil.*

Dead, on the sands; S. Prov. Ceylon.

We have named the above interesting little species after Mr. Henry Adams, who has most kindly given us much valuable assistance and aid, besides describing many of our new Mascarene shells.

Rapana bella—N. S., Pl. XVII, Fig. 6.

T. pyriformis, tenuis ; anfractibus quinis, convexis, suturâ impressâ junctis, ultimo anfractu valde inflato ; spira brevi, obtusiuscula ; superficie alba, fasciis ac striis roseolis, transversaliter elongatis notata, ac striis spiralibus, postice sub-obsoletis, antice ad basin crassis, lamellatis, seu crispiculatis ornata ; apertura lata, arcuata, postice sub-angulata antice multo angustiori ; labro simplici, tenui ad marginem undulato ; labio levi. imprimis antice calloso ; basi producta, antice canali brevi recurvato, terminata, umbilicata : umbilico carinâ rugatâ seu lamellosâ circumscripto,

Alt. 21 *Mil.—Diam. maj.* 22 *Mil.*

Very rare. Bourbon and Ceylon.

Wood in his "Catalogue of Shells" (pl. 18, fig. 31b) figures a shell apparently belonging, to this species, under the name of *Bulla rapa*, Lin., from China. Hanley, however, in his "Ipsa Linnei Conchylia" states that Linnæus' *Bulla rapa* is identical with Lamarck's *Pyrula papyracea*, a quite different species from the present one.

Emarginula papilionacea—N. S., Pl. XVII, Fig. 12.

T. ovato elongata, subconica, moderate elevata, tenuis, alba ; apice subcentrali postico, acuminato ac incurvo ; superficie, costulis radiantibus quindecimis fortioribus, sub-tuberculatis ac scrobiculatis, lineis alteris numerosis tenuioribus, rugulatis interpositis ornata ; fissura antica moderate incisa, subangusta, postice elevata ac rugulosa ; superficie interiori nitida, radiatim leviter sulcata, impressione musculari quadripartita, partibus duabus anterioribus multo minoribus quam posteribus, omnibus triangularibus convergentibus.

Long. 12½ *Mil.—Diam.* 9 *Mil.*

Very rare,—S. Prov. Ceylon.

There is no species at all resembling this handsome shell ; the internal impression bears a rather striking resemblance to a butterfly, the shell is sufficiently transparent for it to be clearly discernible from the exterior.

Emarginula capuloidea—N. S., Pl. XVII, Fig. 16.

T. parva ; regulariter ovata, capuloidea, tenuis, pellucida, apice postico, arcutatim incurvato, instructa ; superficie costulis per-numerosis acutis, æquidistantibus, tenuioribus alternantibus notata, interspatiis *profunde ac rude scrobiculatis; aperturæ marginibus valde crenulatis; fissurâ centrali, antica, anguste et moderate incisâ; impressione palliali postice rotundata, prope apicem lateraliter profunde insinuata, antice prolongata ac gradatim latiori, ad terminationem truncata.*

Long. 5½ *Mil.—Diam.* 4 *Mil.—Alt.* 3 *Mil.*

Very rare,—S. Prov. Ceylon.

The nearest allied species to the above, that we know of, is *E. crassicostata*, Sow., it is, however, smaller, more elevated, not narrowed anteriorly and the sculpture is somewhat different.

Sub-emarginula Oldhamiana—N. S., Pl. XVII, Fig. 17.

T. oblonga, conico-elevata, solida; apice acuto, sub-centrali, sinistrorse incurvato; superficie externa virescenti, in parte anteriori 5-6—*costata: costâ mediâ maxima, ad marginem aperturæ valde prominenti, intus profunde canaliculata, in parte posteriori costis senis radiantibus instructa; omninis plus minusve rugatis, atque costulis et striis numerosis interpositis, versus apicem obsoletis notata; superficie interna albida; impressione palliali magna, prope marginem anteriorem profunde insinuata.*

Long. 12 *Mil.—Diam.* 7½ *Mil.—Alt.* 9 *Mil.*

S. Prov. Ceylon, Scarce.

The shell approaching nearest to the present species is *S. Panhiensis*, Q. and G., from which it differs by the peculiar sinistral bend of the apex, which is likewise more decidedly central by the greater production of the anterior rib, forming a far more prominent canal, by the great inequality of the radiating ribs, &c.

Solarium impressum—N. S., Pl. XVII, Fig. 11.

T. late-conica, depressiuscula, solidula, rufulâ seu radiatim fusco strigatâ; anfractibus quinis, depressis, suturâ profunda junctis, spiraliter quatuor seu quinque striis minute granulosis notata, striis incrementi obliquis sub-distincte decussatis; suturis impressis earumque marginibus paulo incrassatis ac granulatis; ultimo anfractu ad peripheriam sub-carinato, ad basin convexo, profunde umbilicato; umbilici margine incrassato granulatoque: granulis albidis, mediocriter prominentibus; apertura oblique quadrangulari marginibus simplicibus instructa.

Alt. 3 *Mil.—Diam.* 5½ *Mil.*

S. Prov. Ceylon.

Though possessed of no very distinctive characteristics, there is no species, I know of, with which the preceding can be confounded.

Fissurella (?) Scrobiculata—N. S., Pl. XVII, Fig. 15.

T. parva, depressa, fere regulariter ovalis, lateraliter prope medium paululum angustata, antice ac postice rotundata, alba, fasciis radiantibus haud distinctis fulvescentibus notata; superficie omnina supra minute scrobiculata, ac striis radiantibus subobsoletis ornata; foramine late ovato, sub-postico, margine elevato circumdato; margine aperturæ attenuato, minute crenulato; superficie interna alba.

Long. 9½ *Mil.*—*Diam.* 5¾ *Mil.*—*Alt.* 2½ *Mil.*

Scarce, S. Prov. Ceylon.

The sculpture of this interesting shell is very peculiar, the surface being covered with rough, diamond-shaped scrobiculations, perhaps caused by its being covered by the mantle of the animal, in which case, this species will have to be removed to *Macrochisma.*

Fissurella canalifera—N. S., Pl. XVII, Fig. 13.

T. ovato-elongata, antice angustata et ad terminationem retrorse elevata, solidula, concentrice lamellose rugata et striis inæqualibus radiantibus ornata, rufescente pallida, nonnullis maculis elongatis obscuris radiantibus notata; foramine longo, sub-centrali, antice ac postice rotundato; superficie interna albida; margine aperturæ obtusiusculo, fere simplici, minute crenulato, antice insinuato; margine foraminis paulo incrassato, obtusiusculo.

Long. 14 *Mil.*—*Diam.* 7½ *Mil.*—*Alt.* 4¼ *Mil.*

S. Prov. Ceylon.

Easily distinguished from any other species of *Fissurella*, by the curious way in which the shell, at the anterior end is turned up and contracted, thus forming interiorly a sort of canal; the black stripes in position, also, seem tolerably constant, there being two broad ones radiating from the posterior end of the foramen and the same number, but narrower and more indistinct, from the anterior end.

Macrochisma scutiformis—N. S., Pl. XVII, Fig. 14.

T. ovato-elongata, lateraliter compressiuscula et paulo insinuata, moderate elevata, solidula, striis radiantibus ac concentricis minutis ornata, sordide albida, fasciis nonnullis radiantibus fuscis notata; foramine longo, excentrico fere tertiam partem diametri longitudinalis occupanti, postice angustato; margine aperturæ obtusiusculo, simplici; margine foraminis intus incrassato.

Long. 12¾ *Mil.*—6½ *Mil.*—*Alt.* 2 *Mil.*

Rare,—S. Prov. Ceylon.

We know of no other species of the genus with a similarly formed foramen; it differs from *M. hiantula*, Swains., not only in the above respect, but also in colour and in being laterally more compressed.

Rocellaria cordiformis—N. S., Pl. XVII, Fig. 18.

T. parva, fragilis, longitudinaliter oblonga, albida, antice obtuse acuminata, postice producta, sub-rotundata; umbonibus tumescentibus, paulo prominentibus, incurvatis; hiatu cordiformi, parvo, vix dimidiam partem testæ occupante; superficie striis subtilibus, antice fortioribus, undique acutis ac confertis ornata, et sulca lævi ab umbone utriusque valvulæ oblique ad marginem ventralem medianum decurrente notata.

Long. 6½ *Mil.*—*Diam.* 3½ *Mil.*

S. Prov. Ceylon. In coral.

The smallness of size and the peculiar heart-shaped form of the hiatus, easily distinguish this species from others.

Ornithological Notes, chiefly on some birds of Central, Western and Southern India; by William T. Blanford, F.G.S., C.M.Z.S., &c.

[Read and received 3rd March, 1869.]

The following are a few notes on collections of birds made 1st, in Nágpúr, Chanda, and on the upper Godávery; 2nd, at and near Khandalla on the Western Ghats near Bombay; 3rd, on the Nilgiri hills in Southern India. The first alone was large, and was made during the cold and hot seasons of 1866-67; the other two during short visits to the places named. By far the greater portion of the ensuing pages refer to the first collection alone. Several of the birds observed and collected are very rare: one, *Salpornis spilonotus*, Franklin, had only been previously procured by the describer and by Mr. Hodgson, and no specimen of the bird was ever seen by Mr. Blyth or by Dr. Jerdon, until very recently. *Hirundo fluvicola* had not, so far as I am aware, ever been found again in Central India, since Dr. Jerdon first described it, and *Cyornis Tickelliæ*, Blyth, has equally escaped observation since first collected by the excellent ornithologist after whose wife it was named, while the range of several species noted below, was not previously known to extend into the countries mentioned.

I have, in every case, given the number of the species in Jerdon's work, but I have preferred following a somewhat different classification. Although deficient in some respects, as for instance in associating *Saxicola* and *Muscicapa* in one instance, and *Phylloscopus* and *Tyrannus* in another in the same sub-family. Mr. Blyth's classification in the catalogue of the birds, belonging to the Museum of the Asiatic Society of Bengal, published as long ago as 1849, is, in many respects, more in accordance with our present knowledge of the affinities of birds, than that adopted in Gray's and Horsfield's catalogues. The classification, I have followed is, in the main, identical with that of Prof. A. Newton, as employed in the Zoological Record, but I have followed Jerdon in classing together the bulbuls and orioles, and have followed neither Jerdon nor Newton with regard to the *Sylviidæ.*

In the present notes, I have not attempted to mention all the birds met with. I have merely noticed those concerning which I have observed some interesting particulars connected with their distribution, habits, nidification, &c. The natural history of the common Indian species is pretty well known, though there is still something to be learned very often concerning the range of allied forms, as for instance amongst the *Motacillæ.*

I believe the most interesting part of my observations is, that which relates to the relative distribution of some of the migratory birds. It has been for some time known that Eastern and Western forms of these meet in India in several cases, and in the following pages some additional instances will be found.

Order RAPTORES.

Tribe DIURNÆ.

Family VULTURIDÆ.

Sub-family *Neophroninæ.*

6. **Neophron Ginginianus,** Daud. (*N. percnopterus,* L. apud Jerdon). Jerdon does not mention the breeding season, which varies much. I found a nest with two young ones considerably grown and probably a month old on April 14th. The nest was on a cliff at the side of the river Warda. Later than this, on May 2nd, I found another nest containing a single egg, well incubated with a fully formed chick inside. This was on a tree.

The relative ranges of *Neophron percnopterus* and *N. Ginginianus* require to be ascertained. Specimens from Western India should be carefully examined.

Family FALCONIDÆ.

Sub-family *Falconinæ.*

18 ? **Tinnunculus Cenchris ?** Naum. I shot a female Kestril on the Pem Gunga river, west of Chanda, differing from the common species in size, being smaller than the male of *T. alaudarius*, and having dull yellow legs instead of the usual pale clear yellow. The wing measures 9.75, tail 6.5, tarsus 1.7 inches. The tail is much more richly barred than in *T. alaudarius*, and the bars extend completely across the feathers. The back is much browner and less rufous. I am inclined to think this possibly a young *T. cenchris*, a bird never before recorded from Central India. It differs, however, in having much coarser legs, as coarse as in *T. alaudarius*, and in the colour being much duller and browner than in the specimens in the Indian Museum.

Sub-family *Aquilinæ.*

29. **Aquila fulvescens,** Gray. The most abundant eagle in the Nágpúr and Chanda country. I have lately obtained several specimens of the nearly allied *A. nævioides*, Cuv., from Abyssinia, which fully bear out the distinctions pointed out by Mr. Blyth and Dr. Jerdon. The bill and legs are constantly larger in the African species. The plumage is very similar.

The only other Eagles of which I obtained specimens in the neighbourhood of Chanda were *Spilornis cheela* and *Pandion haliætus.*

Sub-family *Buteoninæ (?)*

50. **Circus cyaneus,** L. I obtained a fine female and a young male of this species near Chanda, on the 1st and 13th of March respectively. I do not think there can be any reasonable doubt of the identification, as I noted that the birds agreed with the description of *C. cyaneus* at the time, and I subsequently compared them with European specimens in the Museum at Calcutta. This is the first instance, I believe in which the occurrence of this bird so far south as the Central Provinces has been noticed, specimens, if seen, having not probably been distinguished from *C. cineraceus.* I see,

however, that Dr. King has obtained it from Goona,—J. A. S. B., 1868, Part II, p. 213. Dr. Jerdon was not aware of its occurrence south of the Punjab.

53. **Circus melanoleucos,** Gmel. I certainly did not once see this bird in the Central Provinces, and I never remember having met with it in Western India. It has been found by Radde breeding on the Amoor, and may very possibly be one of those Eastern Asiatic species, the range of which only extends partly across Hindustan, like *Motacilla luzoniensis.* It is not included in Sykes's Deccan list.

Sub-family *Milvinæ.*

Milvus sp. I shot near Woon, North West of Chanda, a kite considerably exceeding the common *M. Govinda* in size, but otherwise undistinguishable. It is a male, and measures—closed wing 20 inches, bill from the gape 1.7, tarsus 2.5, tail 13. The bird is evidently young, but the inner portions of the feathers are rich brown; for the feathers of the head and neck are rich brown with dark centres, not whitish as usually in a young *Milvus Govinda*, and the abdomen and lower tail coverts are pale rufous.

I obtained also near Chanda *Pernis cristata* and *Elanus melanopterus,* both assigned to the subfamily of the kites by Dr. Jerdon, though their position is somewhat doubtful. Blyth makes each the type of a distinct subfamily.

Tribe Nocturnæ.

Family Strigidæ.

65. **Syrnium ocellatum,** Less. (*S. sinense*, Lath., apud Jerdon). This bird appears not to be rare south of Nágpúr, inhabiting mangoe topes. I see also that Dr. King mentions it in his Goona list. Owls, and indeed all the larger raptores, require to be watched for, and they are not generally obtained by any one passing through a district and unacquainted with their local haunts, so easily as the *Insessores.* The only other owls I obtained in the Central Provinces were the common species *Urrua Bengalensis*, *Ketupa Ceylonensis* and *Athene Brama.*

Order ALTRICES.

Family Psittacidæ.

148. **Palæornis torquatus,** Bodd. I have lately shot the

African race (*P. cubicularis*, Hasselquist) in Northern Abyssinia. The only distinction I can detect from the common Indian *P. torquatus* is, that the former bird has a larger bill.

I thought, I saw *P. Alexandri* once or twice in the great forests south east of Chanda, but I am not sure. It is certainly rare in Central India.

Order INSESSORES.

Suborder Picæ.

Family Picidæ.

160. **Picus Mahrattensis,** Latham. Chanda jungles, local. The closely allied race which Mr. Blyth did me the honor to name after me, was found, not abundantly, at Thayet Myo, and again above Ava. It probably is peculiar to the dry country of upper Burma.

164. **P. (Yungipicus) Hardwickii,** Jerdon; not rare in the Chanda jungles. It usually occurs in small companies of 3 or 4, hunting about the upper branches of trees. My specimens were rather smaller than the dimensions given by Dr. Jerdon.

166. **Chrysocolaptes festivus,** Bodd. I shot one specimen near Chanda, the wing measures only 6 inches.

The only other woodpecker killed in the Central provinces was the very common *Brachypternus aurantius*.

Family Cuculidæ.

199. **Cuculus canorus,** L. I killed a male on the 24th April on the Pranhita river north of Sironcha. On the 4th May, near Sironcha, I shot another, and heard others calling then and on subsequent days. I did not observe any females, but I had no time to look for them.

212. **Conystes melanoleucos,** Gmel., shot at Khandalla on the western ghats near Bombay. I obtained a bird in Abyssinia which I cannot distinguish from this species.

222. **Tacconia affinis,** Blyth. Two or three specimens from the neighbourhood of Nágpúr agree best with this race in dimensions, but one of them has rather the colouring of *T. Leschenaultii*, Lesson. I much doubt if these races should be distinguished. *T. Sirkee*, Gray, appears rather more distinct.

Family Caprimulgidæ.

The only species met with in the Nágpúr country were *C. asiaticus* and *C. monticolus*. In the great forests about Sironcha, in the beginning of May, the noise made towards morning, just before day-break, by the nightjars, was incessant. The cry is most singular, and is well described by Jerdon as resembling that made by a stone bounding over ice and gradually striking at shorter intervals than at first. I am not quite certain which species it was which made the noise, but I suspect *C. monticolus*, which appears to be more common in those forests than any other species.

Family Cypselidæ.

100. **Cypselus Abyssinicus,** Ehr., of which I obtained several specimens in Abyssinia, is unquestionably identical with the Indian species, and Ehrenberg's name is said by Tristram to have priority. Blyth, Ibis, II. 339, places *C. abyssinicus*, Streubel, as a synonym of *C. affinis*, but I am inclined to believe Mr. Tristram is right.

104. **Dendrochelidon coronata,** Tickell. This fine swift is far from rare about Chanda, and I can fully confirm Jerdon's excellent account of its habits. Though it has a rapid flight, it is not by any means equal in this respect to the Alpine swift, much less to the *Acanthylis* group; I almost doubt if it equals *Cypselus apus*. Indeed it always appeared to me to afford an easy shot *for a swift*.

95. **Acanthylis sylvatica,** Tickell. Although I was on the look out for this rare swift, I never had the good fortune to secure a specimen, and I doubt if its range extends to Nágpúr or Chanda. I once saw a small swift flying past a hill near Ahiri on the Pranhita which may have been this species, but it did not come within shot.

In the Ibis for 1866, Vol. II. p. 78—Mr. Tristram seems to doubt Dr. Jerdon's assertion that the flight of *Cypselus melba*, though elegant and rapid, is not nearly so powerful as that of the two spine-tailed species. "If so," says Mr. Tristram "the speed of the latter must be a considerable improvement on the greased lightning of American imagination." On the latter point I cannot pronounce an opinion, as I never saw any greased lightning, but it is equally certain that Mr. Tristram never saw the flight of *Acanthylis*. It is some years now since I made their acquaintance in Pegu. I cannot say to which species the birds belonged, for I could never get a gun to my shoulder before they were out of shot, but the impression remaining upon my mind is, that their speed exceeded that of *C. melba*, which I shot in 1867 at Coimbatore, just as the Alpine swift excels the common swallow.

Suborder PASSERES.

Family PITTIDÆ.

345. **Pitta Bengalensis.** In the forests around Chanda and on the Pranhita, I did not once see this species; near Sironcha I seemed to come suddenly into its range, and found it abundant there and on the Godavery. One specimen which I shot had been feeding partly on the common large black ant of the Indian jungles, but the principal food appeared to have been termites with a few *coleoptera.*

Family MELLIPHAGIDÆ.

631. **Zosterops palpebrosus,** Temm. Rare in the Central Provinces. I only came across 3 or 4 specimens. The Nilgiri race is a little larger and appears to be a little darker in colour. I have only one specimen to compare, in that the beak is 0.4 in., wing 2.2, tail 1.75, tarsus 0.7 in. In a specimen from Manbhúm, the beak is 0.35, wing 2.15, tail 1.55, tarsus 0.6. The bill appears a little variable. The black lores appear rather more developed in the Nilgiri bird. I doubt whether it is wise to propose a distinctive name upon such slight differences, as intermediate forms may be found.

Family NECTARINIDÆ.

234. **Arachnechthra Asiatica,** Lath. I can quite confirm Jerdon's account of the female of this bird retaining her dull colours in the breeding season.

Family CERTHIIDÆ.

246. **Salpornis spilonota,** Franklin. Ibis, 1867, p. 461, and Gould's birds of Asia, Part XX.

This very rare bird appears also to have been noticed lately by other observers and ranges as far as Oude. My specimens were obtained in the great forests on the Pranhita south of Chanda, where I used to see the bird nearly every day.

The following is a complete description taken from a comparison of freshly killed specimens.

Colour above brownish black, spotted with white, feathers of the crown with a more or less narrow central white stripe, supercilium white and beneath it a dark stripe passing through each eye to the nape. The sides of the neck chiefly white, with slight dusky marks, while the back of the neck has only very few and small white spots. Two central tail feathers dull grey brown in the centre, edged with alternating dusky and white spots, the former larger ; outer tail feathers dusky, each with 4 more or less interrupted white bands and tipped with white. Throat white, occasionally with a few dusky marks, remainder of lower plumage mixed white and dusky, darker on the sides and lighter on the breast. Beak blackish above, flesh-coloured below, legs dark horny inclining to plumbeous, irides brown. Sexes alike. Measurements, taken before skinning ;—Length $5\frac{1}{4}$ to $5\frac{3}{4}$, extent $9\frac{1}{2}$, closed wing $3\frac{1}{4}$ to $3\frac{1}{2}$, tail $2\frac{1}{8}$, beak at front $\frac{3}{4}$ to 1, tarsus $\frac{5}{8}$, foot $1\frac{5}{8}$. The bill in the male is shorter than in the female, in the former it is generally $\frac{3}{4}$ inch, in the latter $\frac{7}{8}$ to 1 inch.

The birds keep to the largest trees, running round the stems in all directions, and flying with a steady flight, not unlike that of a woodpecker, but swifter and more elegant. They have a whistling note. They evidently breed about the end of April, as birds killed at that time had the generative organs greatly enlarged, and I constantly saw them in pairs. On one occasion I came upon two pairs together. I found *Coleoptera* in the stomachs of those I examined.

Family HIRUNDINIDÆ.

84. **Hirundo ruficeps,** Licht. (*H. filifera* Stephens apud Jerdon). In November, December and January these birds are in small flocks generally, not exceeding 15 to 20, and have a particular fancy for perching on telegraph wires, on which all establish themselves close together, a few flying off and playing about, chasing insects, &c. I fancy they keep to one spot very much, and do not move about greatly. They build in February and March, and perhaps also later, always, so far as I have seen, near water, and very frequently on the banks of rivers. I found several nests on the Warda river, near Chanda, invariably beneath overhanging ledges of rock; 3 eggs ap-

pear to be the regular number. There is a peculiarity in all the nests I examined which I do not think has been noticed. They all are formed of mud and shaped like a saucer, open above. In the centre of the bottom there is invariably a small hole left. What is the object of this ? Can it be cleanliness ?

During the breeding season, these birds hunt up and down the stream keeping over the water or in its immediate neighbourhood.

85. **H. erythropygia,** Sykes. (*H. daurica*, L. apud Jerdon). On February 23rd, close to Wún, in southeast Berar, I saw an immense flock of these swallows flying about one spot on the ground and constantly alighting. There was no flight of winged ants or termites to attract them, and they might have been preparing to migrate or resting during migration. I frequently met with this species near Nágpúr.

86. **H. fluvicola,** Jerdon. I met with this bird 1st, at the marble rocks near Jabalpúr, 2nd, on the banks of the Kolar, at Saonair, a few miles north-west of Nágpúr, 3rd, close to the village of Gúgús, west of Chanda, on the river Warda. I gave an account of the nests, eggs and habits, in the Ibis for 1867, Vol. III. p. 462, and as this has since been copied by Mr. Gould in his " Birds of Asia," it is scarcely necessary to repeat it. The most curious point is, that the birds evidently return to the same spot every year to build, and this place is invariably beneath an overhanging bank over deep water. Mr. Gould represents them as breeding against a high cliff. This may occasionally happen, but is unusual.

I found in one place on the Pem Gunga a deserted colony. Several nests had been half built and abandoned. The cause was evident, the place which in former years had been a deep pool had partially silted up, and the nests were accessible, and doubtless no longer secure from predaceous animals. Nevertheless a pair of *Cotyle concolor* had bred in one of the deserted nests, which contained two of their young.

90. **Cotyle (Ptionoprogne) concolor,** Sykes. I have just mentioned this bird breeding in a deserted nest of *Hirundo fluvicola.* The shape of the nest was unmistakable, it was only half finished and open above. I obtained the eggs on two or three occasions. They were more oval and more closely spotted than those of *H. fluvicola* and *H. ruficeps.*

The nests were so precisely similar to those just described, made by *H. ruficeps*, that as they are in exactly the same situation, it is possible they might have been built by that bird, and only occupied by the *Cotyle*. They had the usual hole at the base. It would be interesting to know if anybody else has observed parasitic nidification in this bird.

91. **Cotyle (Ptionoprogne) rupestris,** Scop.

On the 4th of February I saw two distinct species of crag martin flying about the lofty cliffs around a hill near Perzágad, about half way between Chanda and Nágpúr. One was *C. concolor*, the other conspicuously larger. The next day I saw the latter again, consorting with *Hirundo erythropygia*, and succeeded in shooting a specimen which proved to be *C. rupestris*. I again found this bird far from rare at Khandala, Karli, and the neighbourhood between Poona and Bombay, at the end of October. It is evident, therefore, that its range in the peninsula of India is not confined to the higher hills.

This species abounds in Abyssinia, and I have seen it as low down as about 2000 feet above the sea, much as in India. It always keeps very much to craggy hill sides.

Family MUSCICAPIDÆ.

293. **Leucocerca leucogaster,** Cuv. (*L. pectoralis*, Jerdon). I shot this bird near Chanda in forest. It appears in Dr. King's Goona list, while the much more widely distributed *L. aureola*, Vieill., (*L. albofrontata*, Frankl.) does not. My specimens are dusky on the back and rather rufous on the abdomen.

295. **Cryptolopha cinereocapilla,** Vieill., common in every mango tope and grove of large trees about Nágpúr.

297. **Alseonax latirostris,** Raffles. Specimens from near Chanda appear to agree but with this race. It is scarce. I cannot see the smallest difference between the specimens collected by me and one sent from Amoy by Mr. Swinhoe as *Muscicapa cinereo-alba*, Temm.

306. **Cyornis Tickelliæ,** Blyth. I obtained 2 specimens of this rare bird, one at Seoni between Jabalpúr and Nágpúr, the other

near Chanda. The first was a female,* but the plumage was precisely similar to that of the male.

310. **Muscicapula superciliaris,** Jerdon. A solitary specimen was shot by the Museum Collector who was with me about half way between Nágpúr and Chanda.

311. **Erythrosterna acornaus,** Hodgson. I obtained a solitary specimen of this bird also. It has not, I believe, before been recorded from the plains. My specimen, a female, was killed at Seoni on the road from Jabalpúr to Nágpúr in a mango tope. It is identical with the type specimens received from Mr. Hodgson in the Indian Museum, but it does not agree well with Jerdon's description, the back being bluish cinereous, sides of breast cinereous grey, middle of breast, throat, and belly white with a pale rufous tinge. The head and neck are dark ashy, forehead rufous close to the bill, wing $2\frac{1}{2}$ inches, tail $1\frac{9}{10}$.

323. **Erythrosterna parva,** Bechst. Common about Nágpúr. I did not obtain a single specimen of *E. leucura*, which is probably only found in Bengal and Orissa, like some other migratory birds. In *E. parva* the buff feathers round the orbits are peculiarly conspicuous.

Males shot as early as the end of November had the red breast, so that except in birds of the year, I doubt if the male ever has the plumage of the female.

Family Campephagidæ.

268. **Volvocivora Sykesii,** Strickland. Not rare in some of the woods near Sironcha, but I saw it nowhere else. The clear whistle mentioned by Jerdon is most peculiar. I heard it several times in the beginning of May.

277. **Pericrocotus erythropygius,** Jerdon. Not very rare in the open country about Nágpúr.

The representation of this bird by *P. albifrons*, Jerdon, in Upper Burma, is a parallel case to the replacement of the *Malacocerci* by *Chattarhœa gularis* and of *Francolinus vulgaris* and *F. pictus* by

* I did not unfortunately myself examine the specimen, and its sex was determined by the native skinner who was with me, but as I repeatedly tested his determinations, and always found them correct, I see no reason to doubt its accuracy.

Drawn and lith. by J. G. Keulemans.

TROCHALOPTERON FAIRBANKI.

Printed and Coloured by P. W. M. Trap Leyden.

F. Phayrei. There are other cases of the representation in Upper Burma alone of Hindustan species, not found in the intervening country.

Family Dicruridæ.

281. **Dicrurus cærulescens,** L. This bird is not rare about Nágpúr.

Family Laniadæ.

257. **Lanius erythronotus,** Vigors. This bird varies greatly in size and somewhat in plumage within the same district, and at one time I thought I had two distinct races, but I subsequently shot intermediate forms. In some the black frontal band is as broad as in Himalayan specimens, in others it is completely wanting. The wing varies from 3.4 to 3.7, tail from 4 inches to 5, and the amount of rufous on the lower back is scarcely the same in any 2 specimens.

Family Crateropidæ *(Timaliidæ.)*

Subfamily *Timaliinæ.*

Unquestionably Jerdon is correct in raising *Timalia* and its allies to the rank of a family, but I confess that I cannot see why the very closely allied *Drymoicinæ* should not be included, as has been done by Blyth. Jerdon's main objection,—their less social habits—is not by any means a universal criterion. *Megalurus palustris*, for instance, is a solitary bird, and so, very often, is *Timalia pileata*, while I found *Prinia gracilis* in small families just like *Malacocerci* and a small *Drymoica* which I shot on the coast of the Red Sea occurred in precisely the same manner. I cannot understand why *Crateropus* is removed from this family by Newton.

397. **Dumetia hyperythra,** Franklin. Shot near Chanda in bushes beside a river.

423. **Trochalopteron cachinnans,** Jerdon. By some mistake, Jerdon has assigned white lores and chin to this bird; they should be black. It is extremely common on the Nilgiri hills.

423*a*. **T. Fairbanki,** n. sp.* *Persimile* T. Jerdoni, *sed capite insuper fusco, haud cœrulescente coloris margine distincto ; dorso olivaceo, mento, gula, collo, pectore griseis, lateribus colli cinereis, medii pectoris*

* The author has arranged, at his own expense, for a coloured drawing of this interesting species, to be executed at home, and it is to be hoped that the plate can be issued with the next number of this year's Journal, should it not arrive in time for issue with the present number. [Ed.]

pennis fusco centratis, abdomine subcaudalibusque ferrugineis. Statura ab illâ T. Jerdoni *non discrepante.*

Habitat in montibus Pulney, Indiæ meridionalis. Detexit S. Fairbank.

Head above dark brown, the margin of the colour distinct and not passing into anything else on the nape, but distinctly contrasting with the olive colouring of the back; lores, which are small, and a narrow streak running back from the eye dusky; supercilia and orbital feathers white; back olive, rather lighter towards the rump, wings and tail rather darker. Beneath the chin and throat with the sides of the head below the eyes rather pale grey, the feathers of middle of the breast the same but with dark stripes in the centre; sides of the neck ashy, this colour passing far back close to the dark brown of the head; whole abdomen and lower tail coverts ferruginous, flanks and thigh coverts olivaceous.

Beak dusky, legs dark plumbeous. Dimensions the same as those of *T. Jerdoni*, wing 3.4, tail 3.7, bill at front 0.7 inch.

In Proc. Z. S. for 1867, p. 834, I mentioned my impression that the grey-breasted *Trochalopteron* of the Pulney hills collected by Mr. Fairbank was distinct from *T. Jerdoni* from the Wynaad. This impression was due to some slight differences from the description in Jerdon's Birds of India, and also to the *a priori* probability that two birds living on isolated hill ranges would prove distinct, since the intervening range of the Nilgiris in which neither are found, is inhabited by the very different *T. cachinnans*. Unfortunately the specimen of *T. Jerdoni* which formerly existed in the Asiatic Society's Museum has disappeared, and I am unable to make a direct comparison, but in a drawing which Dr. Jerdon shewed me the other day, *T. Jerdoni* is represented with a distinct black chin like *cachinnans*, of which there is not a trace in *T. Fairbanki*. The other differences to which I alluded are the head being dusky above instead of bluish, and distinctly separated from the olivaceous back instead of passing into dull ashy on the nape; the centre of the breast being paler in the Pulney species, and the rufous colouring of the parts extending to the under tail coverts, which, in *T. Jerdoni*, are olivaceous like the flanks. Another distinction appears to be indicated by the drawing, *viz.* that in *T. Jerdoni*, the grey extends much further down the breast, and the rufous colour of the abdomen is paler. In *T. Fairbanki* the latter is of the same colour as in *T. Cachinnans*, but such differences as these might be due to bad stuffing or incorrect drawing. No native artist, however, would have put in a black chin.

The habits are doubtless precisely similar to those of *T. Cachinnans*. I learn from Mr. Fairbank that the bird abounds on the Pulney hills. I suspect the Anamullay and Travancore ranges may yet yield several interesting novelties when closely searched. They are at present less known than any other part of the Indian peninsula, and judging from the comparatively large number of animals already known to be peculiar to them and to the Malabar coast, they are well deserving of close examination.

435. **Malacocircus Somervillei,** Sykes. Abundant at Khandalla on the top of the Bhore Ghat, and therefore at the edge of the Deccan. Further inland it is replaced by *M. Malabaricus*, Jerd.

In the course of 1867, I shot every species of *Malacocircus* known; *M. terricolor* in Calcutta, *M. griseus* at Coimbatoor, *M. Malabaricus* and *M. Malacolmi* about Nágpúr and Chanda, and *M. Somervillei* at Khandalla.

Sub-family *Drymoicinæ*.

530. **Orthotomus longicauda,** Gm. I shot a specimen of this tailor bird, with a paler grey breast, in Chanda forest. It does not appear to differ from the common form in any other respect, and may, therefore, not improbably be an individual peculiarity.

533. **Prinia Adamsi,** Jerd. Mr. Fairbank informs me that he has procured this species near Ahmednuggur in the Deccan.

534. **Prinia sonalis,** Sykes. Pem Ganga valley near Chanda. I believe it was this race which I killed, it seems a little larger than *P. Stewarti*, but the two forms are not easy to distinguish. This species and the next are included in Dr. King's list of Goona birds.

536. **P. gracilis,** Franklin. Forest close to Chanda. I found this bird in small flocks of 5 or 6, like *Malacocirci*, hunting about amongst the branches of trees, and flying consecutively from tree to tree, just as the restricted *Timaliinæ* do. I see Captain Beavan, Ibis for 1867, p. 454, has also noticed the occurrence of this bird in flocks and its habits.

Family Brachypodidæ.

In the classification I have mainly followed that of Newton, the *Oriolidæ* are classed as a distinct family, while the bulbuls are associated with the true thrushes. As *Phyllornis* is unquestionably a link between the bulbuls and orioles, while there does not appear to be any equivalent link between them and the thrushes, I believe that, with respect to the birds of India at all events, Dr. Jerdon's classification is as sound as it is convenient.

452. **Ixos luteolus,** Less. Occasionally seen, and one or two specimens obtained near Chanda.

460. **Otocampsa fuscicaudata,** Gould. This race extends northwards along the Western Ghats, like many other Malabar forms, and I shot it at Khandalla. I never saw an *Otocampsa* in Central India.

One of the forms with yellow lower tail coverts, perhaps *Ixos xanthopygius* H. and Ehr., occurs at Lahej near Aden.

467. **Iora zeylanica,** Gm. I found this common bird near Chanda. Between Chanda and Nágpúr I killed a specimen perfectly intermediate between *I. zeylanica* and *I. typhia.*

470. **Oriolus Kundoo,** Sykes. I obtained a nest from the topmost branches of a banyan on the 29th April, with some fragments of egg shells in it, the eggs had been broken in securing the nest. It was a very neat cup-shaped structure, almost entirely formed of hairy sheep's wool, but with a snake's cast-skin interwoven, as is so commonly the case in *Thamnobia* nests.

473. **Oriolus Ceylonensis,** Bon. A specimen of this bird was obtained by my friend, Dr. Bühler, at Nasik, and I have quite recently heard from Mr. Fairbank, that he has shot it a few miles northwest of Ahmednuggur in the Deccan. Like other Malabar forms, it doubtless ranges for a considerable distance to the northward along the Western Ghats, and thence occasionally wanders into the Western part of the Deccan.

Family Turdidæ.

I include the *Saxicolinæ* and *Ruticillinæ* in this family, as some of the older writers did and as was done by Mr. Blyth. It appears to me that woodland forms, like *Janthia*, come very close to *Callene*

Brachypteryx, &c. The African *Thamnolæa* is quite as much like a thrush as a *Saxicola*, while on the other hand there is a complete break between both the subfamilies mentioned and the typical *Sylviadæ*. If *Grandala* is not a thrush, it should be put with the Starlings as the very closely allied *Lamprotornis leucogaster* of Africa is.

353. **Oreocætes cinclorhynchus,** Vigors. I saw this bird for two consecutive days, 4th and 5th April in high forest about 20 miles south-east of Chanda, and I shot one specimen. I suppose all that I saw were migrating, as I met with none afterwards. Jerdon says it feeds on fruits and berries. The bird shot by me had *coleoptera* and large black ants in its stomach.

354. **Geocichla cyanotus,** J. and S. This bird is occasionally met with in the forests around Chanda. At Khandalla between Bombay and Poona, I shot a speciman with an olive green back. In the Indian Museum I find specimens of *G. citrina* similarly coloured. Jerdon says, the female of *cyanotus* is less purely coloured than the male, and that of *Citrina* is olivaceous. The olive green colour is certainly not sexual in the former and I doubt its being so in the latter. I am inclined to think that the olive coloured birds are young. I did not meet with *G. citrina* in the Central Provinces.

356. **Geocichla unicolor,** Tickell. I shot this species also at Khandalla, but did not meet with it in Central India.

342. **Myiophonus Horsfieldii,** Vigors. Not rare on the crest of the Western Ghats as far north as Bombay. I shot only one specimen, but I saw others at Khandalla. Mr. Fairbank told me that he had obtained the nest on the Pulney hills close beside a deep pool in a stream, just like the one described by Jerdon.

It is rather surprising that this bird does not occur in Sykes's list which, however, is far from complete.

342*a*. **Callene albiventris,** Fairbank, Pulney hills figured in P. Z. S. for 1867, p. 832, Pl. XXXIX. and again by Gould, Birds of Asia, Pt. XX. The egg evidently resembles that of *C. frontalis* described by Blyth from Hodgson's drawings. Ibis for 1866 II. 373.

Blyth describes the females of both, *Callene rufiventris* and *C. frontalis*, as dull coloured. The specimen of the female of *C. albiventris* was so little paler than the male that I was inclined to consider the difference due merely to the state of the plumage. The sex had been ascertained by Mr. Fairbank by dissection.

488. **Saxicola opistholeuca,** Strickland (*S. leucuroides,* Guer. apud Jerdon.) I shot a single male bird close to Nágpúr. It has not I believe previously been found south of the Nerbudda. The same remark applies to the next species.

492. **Saxicola atrogularis,** Blyth. Of this bird I killed 3 specimens, 2 males and a female within a few miles of Nágpúr on open waste ground.

Saxicola, sp. I shot a female *Saxicola* close to Nágpúr which I could not identify with any known Indian species. It was much less rufous than *S. atragularis.* I cannot find the specimen now.

479. **Thamnobia fulicata,** L. I found a curious nest made by this bird, and in a singular position, *viz.*, inside the bamboo of a dhooly in the veranda of Captain Glasfurd's house at Sironcha. The principal material of which the nest had been composed, was a number of short fragments of string, with these were grass, horse-hair and a snake's skin. The nest contained 3 eggs as usual.

Saxicola melæna of Rüppell has very much the appearance and habits of the Indian *Thamnobia,* and has precisely the same trick of jerking its tail.

Family Sylviadæ.

After separating from this group the *Drymoicinæ* which I believe should be placed in the *Timalidæ*, and removing the *Saxicolinæ* and *Ruticillinæ* to the *Turdidæ* there still remain the *Motacillinæ* which have even less affinity with the true Sylvians than the wren warblers and stone chats shew, and which are classed separately by most ornithologists. The *Calamoherpinæ*, *Sylviinæ* and *Phylloscopinæ* form a thoroughly natural family, similar both in form and habits.

515. **Acrocephalus brunnescens,** Jerd. This prince of skulkers is as difficult a bird to secure as any I know of. One when badly wounded got away from me in a small open bush on the banks of a river, where, so far as I could see, its only possible plan of disappearing was by diving amongst the roots. I only obtained one specimen in the Central Provinces, though I frequently heard the sharp single call from bushes beside water,—a favorite resort.

The specimen I obtained, a female, has the first long primary only $\frac{1}{16}$ inch shorter than the second, otherwise it agrees pretty well with Jerdon's description. It, however, differs from the Calcutta specimens in the Asiatic Society's Museum, not only in the proportions of the wing, but also in being much whiter below, and in having a distinctly defined whitish eyebrow, with a strong white line extending to the base of the upper mandible. The rump too in the Chanda specimen is distinctly paler than the back, not so in those from Bengal.*

516. **Acrocephalus dumetorum,** Blyth. Not very rare about Chanda, in bushes. I also shot it at Khandalla on the top of the Western Ghats. I never saw it near water.

568. **Phylloscopus indicus,** Jerdon. I obtained two or three specimens of this bird, and saw it frequently in the low scattered jungle between Nágpúr and Chanda, but not in the forests south and east of the latter place. It is a most active little bird, clinging to stems, and running up and down them in all directions like a *Sitta.*

The other *Phylloscopinæ* which I obtained about Nágpúr and Chanda were *Phyllopneuste rama, Phylloscopus viridanus, P. nitidus, P. lugubris?* and *Reguloides superciliosus.* Of *Sylviinæ* I shot *Sylvia orphea* and *S. curruca.*

Family Paridæ.

645. **Parus cinereus,** Vieillot. The specimens of this bird which I shot in Central India differed so much from Jerdon's measurements and description that I could not but believe, that they belonged to a distinct species. On comparing them, however, with Himalayan specimens, I found them perfectly identical, and there was no perceptible difference between them, and Gould's figures in the Birds of Asia. It struck me, as this bird is very abundant on the Nilgiris, that Jerdon might have taken his measurements from the race occurring there, which would consequently be much larger than the plains species, and on obtaining the Nilgiri form, I found that this was the case, except that the lengths given for the beak and tarsus must be misprints.

* Other specimens from the neighbourhood of Calcutta, which I have seen since this was written, exactly resemble that from the Central Provinces, and I find that in that specimen, the proportions of the primaries in one wing differ slightly from those in the other.

Jerdon omits to mention the white nuchal spot and the white on the outer tail feathers. The black line below is continuous throughout from the beak to the point of the tail. I append the measurements of the two races.

	Chanda.	Nilgiri.
Whole length, ...	Barely 5 inches.	Nearly 6 inches.
Wing, ...	$2\frac{1}{2}$	$2\frac{8}{10}$
Bill at point,....................	$\frac{1}{3}$	0.37
Tarsus, ...	$\frac{7}{10}$	$\frac{7}{10}$
Tail, ...	$2\frac{1}{4}$	$2\frac{3}{4}$

The size of the Nilgiri race, however, is somewhat variable, some specimens are smaller and appear to form a passage into the plains race, so I can see no need for proposing a new name, although the difference appears quite as great as in the case of *Pratincola caprata* and *P. atrata.* The bill especially in the Nilgiri variety appears to vary in size.

P. cinereus is not very rare in the forests on the Pranhita and around Chanda, I found insects in their stomachs. In April the sexes were in pairs, playing about on the trees with a peculiar low whistling note. They could scarcely have been breeding, for many of them, although paired, were moulting, but doubtless they do breed in the plains. I saw them, still in pairs, as late as the middle of May.

648. **Machlolophus Jerdoni,** Blyth. I shot this bird at Jabalpúr, and again near Nágpúr, and saw it at rare intervals on the Pranhita and Godavery, everywhere very rare.

Family Alaudidæ.

I cannot see why the *Motacillinæ* should form a distinct family, unless the pipits be excluded, for which there is no good reason. In form, plumage and habits there is less difference between *Alauda* and *Corydalla* or *Agrodroma* than between *Saxicola* and *Pratincola*, or *Falco* and *Accipiter.* The bill is extremely variable amongst the typical *Alaudidæ*, varying from the finch-like form of *Pyrrhulauda* to the long bill of *Certhilauda*, and in flight these two forms differ more from each other than do the skylarks and titlarks. The long hind claw of *Budytes* can scarcely be an adaptive modification, for the species in which it is most developed is less similar in its habits to the larks than other species which have shorter hind claws.

591. **Motacilla personata,** Gould and **M. dukhunensis,** *vera* Sykes (not of Jerdon). I obtained both these races in the Central Provinces. The former I only shot, at and near Nágpúr, in December and January, the latter both near Nágpúr and also near Chanda in March. As I was then on the look out for specimens in breeding plumage, and shot those with most black about the head, I should not, I think, have overlooked *M. personata*, had it occurred. The two are not very difficult to distinguish even in winter plumage.

In Bombay and at Khandalla, in October and November, I only met with *M. dukhunensis*. In this race, the black cap in the male is persistent.

I am unable to distinguish birds shot in Abyssinia from *M. dukhunensis.*

Captain Beavan's Umballa and Simla *Motacilla luzoniensis*, Ibis, 1868, pp. 76, 77, is probably *M. personata.*

The distribution of these races of *Motacilla* is very singular and deserves most careful observation. In some cases the migratory forms of Bengal are the same as those of Burmah and China, and distinct from those of Western and Southern India, as in the two forms of *Erythrosterna* and probably in some other instances, but here is the apparent case of a third race intervening, for hitherto *Motacilla personata* does not appear to have been detected either in Bengal or Bombay.

602. **Agrodroma campestris,** L.

604. **A. sordida,** Rüppell.

I obtained both of these large pipits near Nágpúr. The last named appeared to be the commoner, and I frequently saw it in stubble fields of "Thúr" or "arhar" (*Cajanus indicus*) and similar places.

768. **Alauda Malabarica?** Scop. This bird is very imperfectly described. I found a crested lark abundant at Khandalla, which I at first thought was *Galerida Boysii* of Blyth, as the measurements agreed, although the coloration is different from that of *G. cristata.* But I find the type of *G. Boysii* is still in the Asiatic Society's collection, and that it has precisely the plumage and bill of *G. cristata.*

On shewing the Khandalla lark to Dr. Jerdon, he immediately recognised it as the bird he had identified with Sonnerat's *alonette* *huppée de la côte de Malabar* (*A. Malabarica* of Scopoli). On turning to Sonnerat's Voyage, pl. 111 (not 113 as quoted in Jerdon's Birds of India) I find the chief peculiarity of the lark there figured, is the very broad pale edges to all the feathers, and in the accompanying description, it is stated that the crest is tipped white, and the feathers of the back and wing coverts are broadly tipped with rufous. I cannot find a copy of Scopoli's work: Latham merely copied from Sonnerat, even translating *cinq pouces, neuf lignes* by 5¾ inches which, considering that the French *pouce* is not the English inch, is of course not quite accurate.

Now the Khandalla bird has neither white tips to the crest feathers nor broad rufous edges on the back and wing coverts. In size, bill and colouring it closely resembles *A. gulgula*, the principal differences being that it has a pointed erectile crest on the top of the head as in *Galerida*, and that it has precisely the proportions of the wing primaries of that genus. The plumage above is scarcely distinguishable from that of *A. gulgula*, below the breast spots are larger and more numerous and the abdomen is paler. Jerdon says *Alauda Malabarica* is somewhat smaller than *A. gulgula*, and the general tone of colouring much more rufous. Now the Khandalla bird is, if anything, less rufous, certainly less so than the Nilgiri race of *A. gulgula.*

Again Mr. Blyth in his commentary on Dr. Jerdon's birds of India in the Ibis for 1867 says that *Alauda cœlivox* of Swinhoe is nearer to *A. Malabarica* than to *A. gulgula.* There is a specimen of *A. cœlivox* in the Indian Museum sent, I believe, by Mr. Swinhoe himself, and whilst it so clearly resembles *A. gulgula* that I am unable to appreciate the difference, it is not in the least like the Khandalla lark.

The very imperfect specimen in the Indian Museum, labelled *A. Malabarica* by Mr. Blyth and presented by Dr. Jerdon, is in so bad condition that I can only say, it is not the Khandalla bird. It may be *A. gulgula*, the Nilgiri variety.

I have in one or two cases shewn that Malabar birds range north along the Western Ghats, so that it is by no means improbable that this lark also inhabits Malabar. If we suppose, which is probable, that Sonnerat's figure is simply a caricature, as the adjoining print on the same page of *Pyrrhulauda grisea* most certainly is, and that the description was taken from the picture, and not from the bird, (the only difficulty concerning which is the measurements,) it appears highly probable that Dr. Jerdon was perfectly right, and that this bird is really the Malabar lark. I think this is a more satisfactory view than to propose a new name for the Khandalla bird on the chance of its being distinct, though I fear the latter is the usual practice with some ornithologists. I grant that Sonnerat's figure resembles *Spizalauda deva* and the Nilgiri variety of *Alauda gulgula* quite as much as it does the present species, but until it has been clearly proved which of the three is the common crested lark of Malabar, it is best not to alter the existing nomenclature on the chance of its being wrong. I accordingly give a description of the Khandalla bird, which may stand as *A. Malabarica,* until it is proved that that bird is a distinct species.

Top of head with lengthened pointed crest very dark brown, the feathers very narrowly edged but not tipped with fulvous. Sides of head and back of neck much lighter in colour than the cap, rather pale fulvous supercilium, lores rather darker, and ear coverts also. Back and sides of neck rufescent fulvous with rather broad median dusky streaks, and the feathers not broader near the base than towards the point. Back and wing coverts deep brown with very narrow greyish edgings, some of the greater coverts more broadly margined. Quills dusky brown, primaries and secondaries rufous on the inner edge and more narrowly externally, under wing coverts also rufous. Tail middle feathers dusky with pale margins, the remainder deep blackish brown, all narrowly tipped fulvous, the outermost but one with a broad fulvous margin and the outermost almost entirely fulvous. Beneath, chin and upper throat dirty white, breast pale fulvous with broadish dusky streaks forming the centre of each feather, a dark patch on each side of the neck just where the streaks begin; abdomen and under tail coverts fulvescent.

Length (taken in the flesh) 6 $\frac{1}{4}$ inches, wing 3 $\frac{3}{4}$, tail 2, tarsus $\frac{7}{8}$, bill at front $\frac{9}{16}$, hind toe 0.3, claw 0.4. In other specimens the wing is only 3 $\frac{1}{2}$ to 3 $\frac{5}{8}$.

765. **Spizalauda deva,** Sykes. This bird must be rare about Nágpúr and Chanda, for I only once obtained a specimen which was shot near Edlábád, west of Chanda.

756. **Mirafra erythroptera,** Jerdon. I met with this bird not unfrequently in low jungle and on the skirts of the forest

country near Chanda. Jerdon's description of its habits, as usual, is excellent.

757. **M. cantillans,** Jerdon. I only came upon this bird once in a wild tract of grass with scattered bushes, about 50 miles west of Chanda. Over a small tract of country extending for a few miles along the road it abounded, but no where else. I did not observe any other *Mirafra* besides these two.

758. **Ammomanes phœnicura,** Franklin. Extremely abundant in the open country about Nágpúr and Chanda. I have occasionally seen it perch.

Family PLOCEIDÆ.

Dr. Jerdon refers to the occurrence of *Ploceus hypoxanthus* at Rangoon and Thayet Myo. I also shot it at Mandelay (Ava).

765. **Estrelda formosa,** Lath. I met with this rather scarce bird in the Chanda forest and again on the Pranhita near Ahiri, always in or near forest.

The only other *Estreldinæ* collected in Central India were the common *E. amandava*, *Munia undulata* and *M. Malabarica*.

Family FRINGILLIDÆ.

716. **Emberiza Huttoni,** Blyth. I obtained this bird both at Chanda and Nágpúr, and Mr. Fairbank informs me that it is common on rocky hill sides near Ahmednuggur. It is highly probable that it has been mistaken for *E. hortulana*.

Dr. Jerdon, Birds of India, p. 380, mentions my having shot *Emberiza rutila*, Pallas, in Upper Burma. This is a mistake. I shot the only specimen obtained in Pegu at the base of the Arracan hills, west of Henzada.

721. **Euspiza melanocephala,** Gm. I found this bird much less common about Nágpúr than the next species. Jerdon does not describe the female. It has the head above including the ear-coverts and back brownish grey with dark mesial streaks to the feathers, very faint on the head; rump grey, mixed with yellow, wing-coverts, quills and tail feathers dusky, edged with fawn colour, the tertiaries and greater coverts very broadly so; chin, throat and breast pale fawn colour, abdomen yellowish white, under tail coverts bright yellow. Bill horny, paler beneath, feet brown.

722. **Euspiza luteola,** Sparrman. Very common about Nágpúr, less so further south. The female is dull coloured, like that of *E. melanocephala.*

711. **Passer (Gymnoris) flavicollis,** Franklin. About small villages in the jungle this species very often entirely replaces the common sparrow, but it is also found in the wildest jungles far from any human habitation. I entirely fail to see any good grounds for its separation as a distinct genus from *Passer.*

Family Corvidæ.

660. **Corvus culminatus,** Sykes. This bird is said frequently to point out where tigers and leopards are lying by perching on the trees over them, and cawing. I have never seen an instance myself, except when the tiger has killed an animal, and the crows are attracted by the carrion. The birds are, however, very watchful and often perch above men; and I have been annoyed by them when trying to shoot birds, so they may very possibly follow tigers at times, somewhat as the *Presbytis* monkeys do.

Order GEMITORES.

Family Treronidæ.

772. **Crocopus phœnicopterus,** Lath.

773. **C. chlorigaster,** Blyth.

Birds shot at Nágpúr were perfectly intermediate between these two races; one has the green forehead and the green of the tail of *C. phœnicopterus,* another the green forehead only and both have the yellowish green belly of *chlorigaster.* There are also intermediate forms, killed by Captain Beavan in Manbhúm, in the Indian Museum. Birds procured at Chanda were pure *chlorigaster.*

I am inclined to look upon Dr. Jerdon as right in considering all these intermediate forms as fertile hybrids; they are always found where the two races meet, and where the two differ so little as in the green pigeons, the rollers and Kallij pheasants, they doubtless breed together freely.

I found the nest and two very young birds of *Crocopus chlorigaster* near Sironcha on May 11th. The nest was exceedingly small, a little platform, of sticks very loosely put together on the branch of a perfectly bare tree.

780. **Carpophaga sylvatica,** Tickell. I am obliged to dissent from Dr. Jerdon's account of the distribution of this bird. He says—it inhabits the whole of India in forest countries. Now this is constantly asserted of Malay forms, and I am persuaded that in many cases it is a mistake. I have been all through the immense forests of the lower Nerbudda and Taptee valleys, and I never saw an imperial pigeon in them, nor did I ever meet with the bird near Chanda. I first came upon it near Sironcha and thence it occurred down the Godávery, and I have shot it in Orissa. My belief is, that its range is rigidly restricted to the great forest country inhabited by *Gallus ferrugineus* and *Rucervus Duvaucelii*, and that it does not occur in the woods of Central* or Western India. This makes it the more probable that Mr. Blyth's *C. pusilla* is a really distinct race, confined to Malabar, or perhaps like other Malabar forms ranging northwards along the Western Ghats. It may also occur on the hill plateaus about Salem and Trichinopoly. In the same manner I have scarcely a doubt but that Jerdon's *C. cuprea* will prove, when compared, distinct from *C. insignis*, Hodgson.

I also never yet saw an *Osmotreron* nor a *Chalcophaps* in the country west of Nágpúr, or in the Nerbudda valley. I much regret now that I did not collect birds in the Nerbudda and Taptee valleys, as I might have noted several interesting points regarding their distribution.

Order RASORES.

Family Pteroclidæ.

803. **Pterocles fasciatus,** Scopoli. I can confirm Dr. Jerdon's account of the crepuscular habits of this bird. For two or three years I noticed occasionally, when camped beside streams in jungle, that some bird frequently flew along the course of the stream with a most peculiar tri-syllabic cry, after dark in the evening, or before it was light in the morning. At last I caught sight of the bird one morning, and recognised it by its flight as a *Pterocles*, and as *Pt. exustus* is never found in forest, it must have been *Pt. fasciatus.* The closely allied *Pt. Lichtensteini* occurs in immense numbers near the Abyssinian coast, and this also flies to water in the dusk of the morning and even-

* When Jerdon speaks of this bird's breeding in Central India, I believe he means Bastá, not Nágpúr, and still less Málwa.

ing, not in the day, as other sand-grouse invariably do, though I did not notice it as early in the morning, as I did *Pt. fasciatus.*

I occasionally met with *Pt. fasciatus* about Nágpúr and Chanda, but it is much less common there than in Guzerat.

802. **Pterocles exustus,** Temm. I obtained the eggs close to Nágpúr on December 27th, and again not far from Woon, north-west of Chanda on February 21st, 3 in each case. Jerdon says the central rectrices in the female are not elongated. It should be, are less elongated than in the male. The whole description of the female must have been taken from some other bird by mistake. The abdomen is quite different from that in the male being closely barred, the chin and throat are orange buff, breast isabelline with black spots, an imperfect blackish gorget, then a broad unspotted space, and then the closely barred abdomen.

Family PHASIANIDÆ.

803. **Pavo cristatus,** L. The train is rarely full grown before April. Peacocks not unfrequently shew the presence of a tiger by flying up one after the other from a particular spot in the jungle. In the hot part of the day, both animals resort greatly to the thickets of *jhow* or "bastard cypress" (*Tamarix indica*) in the beds of rivers.

812. **Gallus ferrugineus,** Gm.

813. **G. Sonneratii,** Temm.

For the relative distribution of these birds see J. A. S. B. for 1867, Vol. XXXVI. p. 199.

Family TETRAONIDÆ.

814. **Galloperdix spadicea,** Gm.

Common in the Taptee and Lower Nerbudda valleys, and in the jungles around Chota Oodipúr.

815. **G. lunulosa,** Valenc.

I have shot this bird a little west of Nágpúr near Ellichpúr, but I never noticed it further west.

Precisely on the same grounds as Jerdon, *viz.* Geographical distribution, I come to exactly the reverse conclusion, *viz.* that *Galloperdix* is *a form with African affinities* allied to *Pternistes*, but it would take too long to give all my reasons here.

818. **Francolinus vulgaris,** Steph.

819. **F. pictus,** Jard. and Selby.

For relative geographical distribution, see J. A. S. B. for 1867, p. 200. I have since been assured by Captain St. John, that he has shot *F. vulgaris* close to Khandalla. I cannot help thinking he must be mistaken, though I believe he knows the two forms well.

In the Transactions of the Literary Society of Bombay, Vol. II, p. 216, Captain McMurdo asserts that there is a third partridge inhabiting the Wagur district of Cutch, distinct from both the painted and black partridges, but resembling the former. What can this be? Dr. Adams says the bird in the hills below Kashmir, differs from that in the plains. Lieutenant St. John assures me, that the Persian black partridge differs from the Indian. Are the two species confused under *F. vulgaris?*

828. **Perdicula erythrorhyncha,** Sykes. This bird has the habits of a *Perdicula* and not of a quail. Its range is wider than stated by Jerdon, I shot it to my surprise in high jungle between Chanda and Sironcha. I also obtained it at Khandalla close to Col. Sykes's locality.

Family Turnicidæ.

I only shot one species near Chanda and Nágpúr, *Turnix taigoor,* Sykes.

Order GRALLATORES.

Family Charadriidæ.

841. **Rhinoptilus bitorquatus,** Jerdon. I mentioned my having seen this bird near Sironcha in the Ibis for 1867, p. 462. I did not obtain a specimen. The locality was in very wild open forest jungle about 15 miles east of Sironcha.

852. **Chettusia gregaria,** Pallas. I killed a specimen about 40 miles south of Nágpúr. I also saw this bird, or another species of *Chettusia,* near Nágpúr.

859. **Œdicnemus crepitans,** Temm. I have seen this bird in considerable numbers in Upper Burma, near Pagan. Jerdon does not mention its occurrence east of the Bay of Bengal. I think there must be a Burmese specimen in the British Museum from my collections, but I am not sure. It probably does not occur in Lower Pegu, in Arracan, or in the Malay peninsula.

Family SCOLAPACIDÆ.

870. **Gallinago stenura,** Temm. I have never met with this bird in Western or Central India, though for two or three years I examined every bird I shot, and I doubt if it occurs there. It is not in Sykes's list nor in that of Dr. King. Beavan, Ibis 1868, noticed the early arrival of the snipe in Burma which I can confirm from my own knowledge. At Poona it never appears before the middle of October, and then the birds are all *G. scolapacina* so far as I know. I believe it will be found that the birds are almost as late on the Western coast about Bombay, at all events sportsmen do not go out to shoot them before October, and generally not before November, whilst around Calcutta very fair sport may be had in September. This is strongly in favour of *G. stenura* not occurring in Western India, for it certainly is the earliest to arrive in any numbers in Bengal. About Calcutta, *G. stenura* seems to disappear in December and January, doubtless migrating further to the south-east: I have lately in those months examined bags of 30 to 50 birds, without finding one specimen. It abounds again, I believe, in February and March.

Family RALLIDÆ.

Podica personata, Gray. I suspect I saw this bird on the river at Beypúr. It is likely enough that this Malay form might occur in Malabar, and unless this were the bird, I cannot conceive what it could have been. It swam and looked something like a grebe, but flew away when approached. It was certainly neither grebe nor duck, and I suspect it was a *Podica*.

Descriptions of two new species, belonging to the genera VARANUS, *and* FERANIOIDES *respectively, from near Agra;* by A. C. L. CARLLEYLE, ESQ., *Curator, Riddell Museum at Agra.*

[Received 22nd February, read 3rd March, 1869.]

Order.—SAURIA.

Family.—VARANIDÆ.

Genus.—VARANUS.

Species.—**T. ornatus,** *Carlleyle.** (vide p. 196).

Habitat.—Neighbourhood of Sikandra, near Agra.

Specific character.—Ventral shields, from gular fold to loin, in 116 transverse series. Total length of specimen, 29½ inches. Length of body alone, from end of snout to root of tail, 14¼ inches. Length of tail 15¼ inches. Length of head, from end of snout to nape, 2 inches. Breadth of head above, from ear to ear, 2 inches. Circumference of body, at thickest part, 6¾ inches. Length of fore leg 3½ inches. Length of middle toe with claw ⅞th of an inch. Length of hind leg 4 inches. Length of second posterior toe with claw, (which is the longest,) 1 inch. The body of this specimen is longer, in proportion, than in either *V. dracœna* or *V. lunatus.*

Description.—Scales of the greater portion of the back oval and slightly, or obtusely, keeled. Scales on the rear of the neck round, very prominent—almost tubercular, pretty sharply keeled, and raised, in their centres, almost to a point. Scales of back between the shoulders. also pretty sharply keeled. The small shields of the abdomen and under side of tail, are of an oblong oval shape, with a slightly raised, gently rounded, boss, or convexity, in the centre of each, surrounded by a narrow depressed border. These convexities are

* Mr. Carlleyle suggests that a new generic name be introduced for the land-*Varani* with a round tail. These have been already called by Fitzinger *Psammosaurus*, but the distinctions, as likewise those pointed out in some other forms of *Varani*, have not been by other naturalists considered sufficient to justify a generic separation. A thorough review of all the various species from different parts of the world would, no doubt, be very desirable, for it is at present difficult to accept several of the numerous generic names suggested, because they are generally adapted to certain type species only, and a discrimination between what is to be called a variation of a genus, or a section, or a sub-genus &c. is by no means easy. It seems rather certain that these limits vary in different species, and that they have to be determined in each instance according to the characters of the group of animals to which they refer. (ED.)

easily depressed by force, so as to form little shallow hollows instead; but the narrow border, surrounding each of them, still remains marked and unmistakable. Small shields of the breast and throat hexagonal, also with a central convexity and narrow depressed border. Shields of under side of hind legs, pentagonal, in other respects similar to the last. Shields of under side of fore legs the same, but much smaller than the scutes of the under sides of the hind legs.

Anterior frontal scales of head slightly keeled, transversely. Posterior frontal scales larger, but not keeled. Vertical scales,—a small circle of eight scales, with one in the middle of the circle,—in the centre of the vertex. Superciliary scales small and granular.

Scales in centre of chin long-shaped, but very small and granular, and arranged in regular longitudinal series, anteriorly converging.

There is a slight shallow, longitudinal groove in the centre of the upper surface of the snout,—which mesial, supra-rostral groove, though common to and peculiarly characteristic of all the *Varani*, is not noticed at all by Günther, in any of his descriptions, although it appears plainly enough in his plate showing an upper view of the heads of *V. dracæna*, *V. lunatus* and *V. nebulosus.*

The nostrils, in the present species, form an elongated, curved, and rather narrow slit, situated, on either side, about $\frac{1}{4}$ of an inch in front of the eyes, and a little over $\frac{1}{2}$ an inch from the end of the snout; or much nearer to the eye, than to the end of the snout.

The eyes are situated further forward, or nearer to the snout, than in either *V. lunatus*, or *V. dracæna.*

The ears are situated about $\frac{3}{4}$ of an inch behind the eye.

Coloration and *markings.*—These are very peculiar, and the colours very bright and beautiful, when the animal is alive, or only recently dead; but the bright colours fade away very much, after the skin is stuffed and dried,—a change which gradually took place in the stuffed skin of the present specimen, little remaining but the black markings, the original yellow ground colour much faded, and some slight traces of the formerly existing orange tints, which *tout ensemble* of conspicuous hues, gave the animal quite a gaudy appearance, when it came first into my possession, quite fresh, or, indeed, then still half alive.

The upper surface of the snout is marked with some black dashes. Vertex and occiput of head black. Another line runs from below the eye to the ear. Another black line, or stripe runs from behind each eye, on either side, to a point above the ear, and then continues backwards, on each side of the nape, to the middle of the back of the neck, where it stops. These two lines, or stripes, thus converge, and nearly meet on the back of the neck. The ground colour on either side of the black stripe which runs from behind the eye is of a bright gamboge yellow, forming two longitudinal bands of yellow behind the eye, with the black stripe in the midst. A black stripe also runs, on either side, from the back of the ear to a point between the shoulders, where these two lines unite, forming an acute angle of which the apex is directed posteriorly. A single black stripe runs from the centre of the occiput backwards, to the centre of the angle formed by junction of the two black stripes which run from the ear to a point between the shoulders, and unites with these lines there, dividing the receding angle in the midst. Rudiments of smaller black lines, converging towards the same point, and pale inky, or ashy-black, shadings, appear between the larger converging stripes. From the apex of this posteriorly directed angle of black, between the shoulders, a norrow longitudinal black stripe runs backwards along the centre of the back, to near the root of the tail—but not quite reaching it,—tapering off more and more finely in a posterior direction, until it disappears above the lumbar region. Ground colour of the back of the neck, between the black stripes, a bright orange, when the animal is living, or but recently killed, (fading after the skin is stuffed). The sides of the neck and shoulders gamboge yellow, and marked with several round, blackish ashy coloured blotches, or *ocelli*,—two on the shoulders being the most conspicuous. Sides of body, and sides of back, marked with round gamboge yellow spots, or blotches, with ashy coloured cloudings between them. General ground colour of back, pale greenish ashy, mixed with bright yellow. No rings, or marks, on the under side of the throat, which is of a dirty white colour. Belly white.

Tail round, with not the slightest sign of any longitudinal ridge, keel, or crest,—and more thin and tapering than in either *V. dracæna* or *V. lunatus*.

Legs short; toes rather slender, and shorter, in proportion, than those of *V. lunatus*.

Head much flattened, or depressed.*

Teeth 10 in upper, and 10 in lower jaw, short, conical, and slightly recurved.

This is a true dry-land *Varanus:* the only two individuals of this species which I have seen, having been found in the most dry, and dusty places possible, far removed from water; and both were found in the neighbourhood of Sikandra, not far from the high road from Agra to that place.

I would here take the opportunity of observing, with regard to *Varanus dracæna*, and *V. lunatus*, that I cannot imagine why Günther has called them "Water Lizards," as they have nothing to do with water, and are always found in the *driest* places!

I would also remark that *Varanus flavescens* has nothing in common with the above species, and should, I think, form the type of a separate genus, or sub-genus, as a link between the true land *Varani*, and the *Hydro-sauri*. For, being a decidedly aquatic species, *Varanus flavescens* has a strong and deep longitudinal ridge or "crest," on the upper side of the tail, almost like that of a *Hydro-saurus*. The head also is higher and more triangular than that of the true land *Varani;* and the scales of the body are larger, and so strongly and sharply keeled and pointed, as to form a most marked distinction. The dentition also is different.

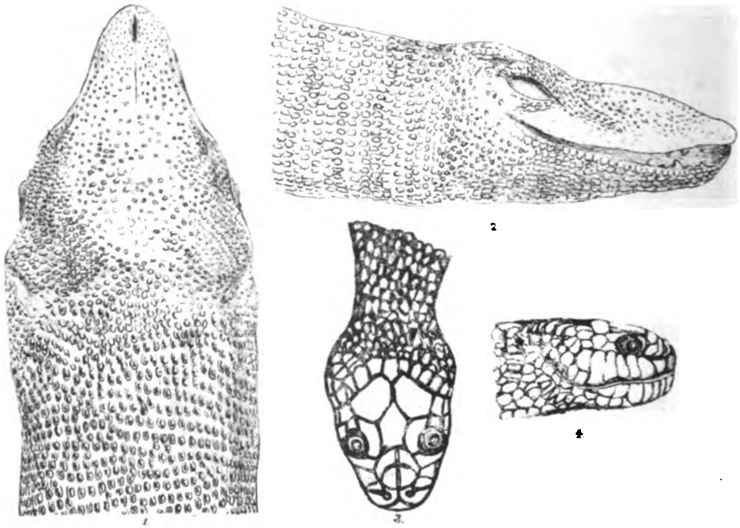
And *V. flavescens*, besides, has *not* the "central—supra-rostral groove," which I before mentioned as distinguishing the true dry-land *Varani*. Both *Varanus dracæna* and *V. lunatus* are very *common* about *Agra;* I have, therefore, had full opportunity of comparing my new *Varanus* with numerous specimens of those two common species. *V. nebulosus* is not found here.

I think Günther is mistaken in ascribing only "ninety" transverse series of scutes, from the gular fold to the loin, to *V. dracæna;* for all the specimens of that species which I have obtained here, have not

* The photograph from which the sketch on p. 196 is taken shews the head to be remarkably broad and the snout short, what principally distinguishes this species when compared with *V. lunatus*, and other known Indian forms. Unfortunately the photograph is not clear and is was impossible to give much more than a correct outline of the head. (Ed.)

less than 95 transverse series! While in a specimen of *Varanus flavescens*, in my possession, on the other hand, I find only 67 transverse series (at *most*) instead of "70," as given by Günther! I find, also, that *V. lunatus* has, more commonly, less than "105" series; or, generally, about 103. The longest specimen of *Varanus lunatus* in my possession, measures 2 feet, 9 inches; and the longest specimen of *V. dracæna*, 3 feet 6 inches.

It appears to be a law of nature, that the more terrestrial any species of *Varanus* is, the greater in number, and the smaller in size, are the transverse series of scutes, on the under side of the body; and the more aquatic any species of *Varanus* is, the lesser in number and larger in size these series of scutes are.



Figs 1-2 Varanus ornatus. Figs. 3-4 Feranioides Jamnaetica

Order.—OPHIDIA.

Sub-Order.—COLUBRINI INNOCUI.

Family.—HOMALOPSIDÆ.

Genus.—FERANIOIDES (*Gen. Nov.*)

Species.—**F. Jamnætica,** *Carlleyle.*

Habitat.—River Jamna, near Agra.

Date of capture.—March, 1868.

Specific character.—Scales in 29 series. Entire length of snake, from snout to end of tail, 2 feet, 1 inch. Length of tail $3\frac{1}{4}$ inches. Circumference of body, at thickest part, $2\frac{1}{2}$ inches. Length of head, from end of snout to nape, $\frac{5}{8}$th of an inch. Greatest breadth of head across, $\frac{4}{7}$th of an inch.

*Description.**—Body thick, for the size of the snake. Head thick, broad, somewhat *Cerberine* in appearance, and distinct from the neck. Tail short, rather quickly but evenly tapering, and slightly compressed laterally, so as to form a sort of ridge on the back of that part.

Plates on top of head (posterior to nasals, and above eye) large posteriorly, and small anteriorly,

2 | |
2 | |
and arranged as 3 or | | | . Anterior frontal plates 2, triangular,
2 | |

with the two outer sides rounded. Posterior-frontal plates of a curved, diagonally elongated, or oblong, irregular pentagonal shape, situated (with regard to their greater axis) in a somewhat diagonal position to the central longitudinal line that divides the frontal plates in the midst. The anterior side of these post-frontal plates is concave. Vertical plate pentagonal, longer than broad, shaped like an elongated heraldic shield of which the lower point of the shield runs posteriorly, for about one quarter distance, between the two occipitals. Supraciliary plates (one over each eye) smaller than the vertical, of a sub-conic form, or semi-elliptical shape, curved over the eye, and truncated posteriorly, of which the broad base abuts posteriorly, against the advance of the two large occipital plates. These are very large, each an irregular sided hexagon (the two posterior sides of the irregular hexagon being very small, the other sides long,—especially the outer). No plates towards the nape; the nape being covered with multi-angular, pentagonal, quadri-

* This interesting new species was pointed out to the author of this paper by Dr. T. C. Jerdon who, as stated in the Proceedings of this Society for March, p. 105, contemplated to describe the same in his forthcoming work on the "Reptiles of India," but who was so courteous as to disclaim the priority of publication, when requested for his opinion on the matter.—The snake principally differs from *Ferania* by its round pupil, and is in this respect one of the rare instances recorded among the HOMALOPSIDÆ, most of which have a narrow vertical pupil of the eye. The dentition would also appear to be peculiar, but on this point our information is as yet very deficient regarding a large number of our Indian snakes. (ED.)

lateral, and ovoid scales, of which the three most anterior and central ones are the largest and most conspicuous; the first central scale of the nape of the neck, which fits in at the posterior angle of the junction of the two occipitals, is pentagonal, and the largest. In reality, the occipital plates do not cover the whole of the back of the occiput proper, or do not reach to the nape; so that, the first dorsal (or rather cervical) scales are, in fact, situated on the occiput: and hence the head of this snake looks as if only the anterior half of its upper surface, were covered with plates, and the posterior half with scales. This is a strongly marked peculiarity which at once serves to distinguish this snake.

Nasal orifices narrow-shaped and curved, partially covered with a valve (capable of being closed over the orifice, when the snake is under water), the nasal slit being situated, in part, between two plates, *i. e.* the præ-nasal, and post-nasal; the præ-nasal plates (one on each side) being large, situated straight in front of the anterior frontals, and are shaped somewhat like an uneven disc of which a portion, posteriorly, has been cut out, leaving a sort of receding angle in the posterior margin of the plate. And each præ-nasal plate is also cleft posteriorly, from near its centre, by the nasal slit, thence making a short curve backwards to the line which separates the præ-nasals from the post-nasals. The latter are situated rather laterally, being small and oblong shaped. The rostral plate is pentagonal, shaped like a triangle rising from a parallelogramic base of equal breadth with the base of the triangle, and the apex of the triangle extends nearly half way back between the two præ-nasals. Upper labials, on right side 6, on left side 5; the third labial entering the orbit. The most posterior upper labial plates (the 6th labial plate on one side, the 5th on the other) very large. Posterior to the proper lateral upper labial plates on each side there is a largish sub-temporal plate placed above two small plates. Temporal plates, proper 4, small. Post-ocular plates 2, situated one above the other. Ante-ocular 1, curved, long transversely. Loreal 1, smaller, of an irregular shaped, quadrilateral figure. Median lower labials 2, very small, and situated one behind the other. Lateral lower labials 6, on each side, the two anterior lateral lower labials, on each side of the median lower labials, very long. Chin shields 2, very large.

Eyes, rather small, round; dark ash coloured, with a round white pupil.

Scales, smooth, not keeled, generally oval-shaped, and in 29 series.

Ventral plates proper, (from the throat to the anals and including throat plates,) 153. Præ-nasal plates 4, in pairs,—or in other words, two bifid plates. Post-nasal plates 7, in a transverse series of 4 and 3. Sub-caudal plates proper 100, in pairs. Total lower plates of under-part of body, 264.

Colouring and markings.—Markings on plates on the top of the head of a sort of puce, or olivaceous mouse-brown, or a muddy olive chocolate colour. A narrow yellowish white curved line runs longitudinally along the centre of each of the occipital plates, and extends to the nape. Anterior upper labials marked with dark blotches. A broad, dark olivaceous brown, narrowly-black-edged, stripe, runs along the cheeks, from the posterior upper labials, to beyond the gape, backwards, as far as the side of the neck. A yellowish-white stripe runs from the back of the eye to beyond the occipitals, as far as the back of the neck, on each side, posteriorly, and is again produced anteriorly as a narrow streak in front of the eye, then running round across the præ-frontals, (just behind the nasals) to meet the corresponding line on the other side; the angular curve of the streak as it crosses the front of the head, becoming lineally attenuated. There is a muddy olive chocolate coloured, longitudinal stripe on each side of the nape of the neck, on the scales which lie immediately at the back of each of the occipital plates, which unites anteriorly with the dark colouring of the head plates. A longitudinal broad stripe of the same dark colour, occupies the centre of the nape, which unites anteriorly with the dark colouring of the central head plates, and blends posteriorly with a large broad, oblong shaped, centrically narrowed, muddy olive-brown coloured, and narrowly black-edged blotch, occupying the whole of the back of the neck. A transverse, irregularly shaped, narrow, yellowish space, or band, runs off transversely, laterally on the neck, from each side of the dark nape mark, and divides the large dark blotch on the back of the neck,—on each side,—from the dark cheek stripe, and unites below with the yellow of the sides of the neck. A dark line runs longitudinally through the præ-oculars and nasals. Vertical shield of the same dark colour. The whole of the dark markings on the top of the head, and centre of the nape, form a united figure resembling a barbed arrow-head, of which the shaft is broken off a little behind the posterior ends of the barb; the point of the arrow-head being directed forwards, and terminating on the præ-frontals.

Whole of back marked with large, broad, round, or oval-shaped, olivaceous mouse-brown or dark schistaceous olivaceous blotches, edged with black; these blotches are sometimes separate, or distinct from one another, and sometimes confluent,—and in the latter case they resemble some kinds of chintz pattern. The dorsal blotches become much darker towards the tail,—and, at length, become quite black cross-bands on the tail itself. Between each of these broad dark coloured blotches, there is a narrowish, greenish-yellow transverse band, which unites below with the bright yellow colour of the sides. Ground colour of sides, bright yellow, but marked with a double line of lateral dark, lozenge-shaped and irregular shaped spots, large and small, of the same colour as the transverse blotches of the back. The larger of the lateral lozenge-shaped spots sometimes alternate with the lateral extensions of the dorsal blotches,—being sometimes situated in the midst of the yellow lateral interspaces. Ground colour of ventral plates yellow, marked, in irregular alternation, with square-shaped black spots, which generally go in pairs, or alternately 1 and 2, and sometimes singly, with alternate yellow interspaces.

Teeth very small, apparently 22, in upper maxillary: 5th tooth, on each side bifid:—hindmost tooth broad, short and thick, or tubercular. There appear to be (as far as I can see) either 14, or 16 teeth in the lower maxillary: hindmost tooth longer than the others, sharp and recurved: second hind tooth also sharp and recurved.

While at Allahabad, the year before last, I bought four living snakes from a snake-catcher, which I think I might find reason to class in my new Genus *Feranioides*,—if not actually identical as to species with the individual above described.

In colouring, they somewhat resembled certain snakes which I remember seeing in the Calcutta Museum collection, named by Blyth "*Pythonella*," and by Günther "*Homalopsis*," the *Homalopsidæ* being the family to which the Genus *Ferania* and *Feranioides* belong.

? monthly qu
, in charge

...	October.	
...ge	Inches	Avera...
	4·68	
	7·52	
	0·59	
	1·81	
	3·16	
...9	17·76	3·5...
	3·96	
	2·16	
	4·99	
	5·86	
	10·76	
...1	27·73	5·5...
	5·86	
	5·41	
	4·03	
	3·61	
	16·25	
...0	35·16	7·0...

Monthly Means of the principal Meteorological Elements and actual Rain fall recorded at the Calcutta Observatory for twelve years, from 1856 to 1867; by GOPEENAUTH SEN, *in charge of the Observatory.*

January.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	1.06	30.049	68.6	63.1	0.76	S W & W
57	..	30.022	68.0	61.9	.72	N W & N
58	0.07	29.994	68.1	61.4	.70	N W, S W & W
59	...	30.002	69.1	63.3	.75	W, N & N W
60	...	30.017	66.3	60.2	.72	N & N W
61	0.56	29.976	68.1	61.8	.72	N, W & S
62	1.03	30.009	67.0	61.8	.76	N
63	...	30.043	67.3	61.2	.69	N
64	...	29.992	65.0	58.0	.66	N, N W & W
65	0.48	30.066	69.5	62.7	.67	N & N W
66	1.91	30.041	69.0	63.4	.72	N, W & S
67	0.55	30.048	69.0	63.1	.70	N W & N by W

February.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	...	29.963	72.7	65.5	0.70	N W & W
57	...	29.887	75.0	67.3	.68	S & W
58	0.54	29.978	71.0	63.0	.67	N W, S W & W
59	0.66	29.980	74.6	67.6	.71	S, W & N
60	0.09	29.913	75.8	68.4	.70	S & S W
61	...	29.914	72.6	63.4	.63	W, S & S W
62	...	29.925	73.4	66.3	.71	S & W
63	1.20	29.940	71.6	64.0	.64	W, N & E
64	0.47	29.939	72.7	65.8	.67	S & W
65	1.86	29.972	73.7	66.5	.67	N W & W
66	3.74	29.956	70.3	64.0	.69	E, N & W
67	0.82	29.966	73.1	65.9	.65	N N W & N E

March.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	2.23	29.860	80.2	74.9	0.77	S E, S & S W
57	0.96	29.835	80.5	72.7	.69	S & S W
58	0.22	29.849	81.3	72.7	.66	S & S W
59	4.23	29.878	78.7	72.1	.73	S, S W & W
60	...	29.807	82.6	73.8	.66	S & S W
61	0.88	29.853	80.8	72.7	.68	S & S W
62	1.69	29.900	78.4	69.8	.66	S, N & S W
63	...	29.826	82.9	73.1	.58	S & S W
64	1.84	29.878	79.1	70.8	.63	S & S W
65	1.96	29.920	79.4	70.7	.62	S, W & N W
66	...	29.811	83.9	75.1	.62	S, W & S W
67	1.57	29.894	80.1	72.7	.67	S & S S W

April.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	0.62	29.726	85.8	79.3	0.73	S & S E
57	1.80	29.760	83.2	76.2	.71	S
58	0.97	29 772	86.2	77.8	.67	S
59	1.29	29.809	84.5	76.8	.69	S, S E & S W
60	2.47	29.759	84.9	78.2	.73	S & S E
61	0.31	29.711	85.6	78.2	.70	S
62	2.53	29.752	84.6	76.9	.69	S & S W
63	2.43	29.705	84.4	77.4	.68	S
64	1.11	29.741	85.6	76.2	.60	S
65	4.28	29.795	84.5	77.7	.69	S & S W
66	1.81	29.779	84.1	76.9	.68	S, S S W & W S W
67	0.27	29.793	84.9	76.0	.62	S W & S S W

Annual.

Years.	Total fall of Rain.	Means of Barometer.	Means of Thermometers. Dry Bulb.	Means of Thermometers. Wet Bulb.	Means of Humidity.
	Inches.	Inches.	o	o	
1856	64.23	29.782	79.1	74.4	0.80
57	68.97	29.773	78.9	73.2	.76
58	59.76	29.784	79.4	73.6	.76
59	68.66	29.795	79.5	74.2	.78
60	52.61	29.767	79.9	74.2	.76
61	89.19	29.764	78.9	73.6	.77
62	73.48	29.770	78.7	73.2	.77
63	61.15	29.763	79.0	73.4	.73
64	84.22	29.798	79.1	73.1	.72
65	61.58	29.805	80.1	74.4	.73
66	65.74	29.791	79.7	74.2	.74
67	72.73	29.808	79.4	74.0	.74

May.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	8.18	29.650	85.0	79.6	0.77	S & S E
57	9.33	29.600	86.0	79.9	.75	S & S E
58	3.28	29.586	86 0	80.0	.75	S & S E
59	3.18	29.699	86 1	79.2	.72	S, S E & E
60	2.21	29.613	88.7	81.4	.71	S & S E
61	9.07	29.610	85 9	79.6	.74	S & E
62	3.80	29.684	85.4	79.0	.74	S
63	4.20	29.625	85.8	72.3	.70	S & S E
64	10.36	29.729	84.6	77.5	.68	S & S E
65	15.94	29.651	83.4	78.9	.78	S & S E
66	2.56	29.646	87.0	80.7	.73	S, S S W & S S E
67	2.46	29.639	87.7	80.4	.69	S, S S E & S S W

June.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	12.67	29.545	83.3	80.2	0.86	S & S W
57	10.30	29.528	85.3	80.3	.79	S
58	8.22	29.530	86.9	81.2	.76	S & S E
59	12.48	29.532	84.4	80.4	.83	S & S W
60	6.46	29.544	84.9	80.6	.81	S & E
61	26.44	29 572	83.3	79 4	.83	S & S W
62	13.63	29.550	84.5	80.1	.81	S & S E
63	12.93	29.507	84.4	80.0	.79	S & S E
64	18.73	29.548	85.5	80.8	78	S & S E
65	8.63	29.550	86.1	82.1	.81	S & S W
66	7.02	29.518	86.4	81.4	.76	S S E, S & W S W
67	6.12	29.576	84.9	80.7	.80	S E, S S W & S

July.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	10.94	29.492	83.2	80.2	0.87	S & S E
57	12.98	29.547	82.2	79.5	.88	S
58	17.96	29.566	83.8	80.4	.85	S, E & S E
59	9.09	29.530	85.4	81.4	.83	S & S E
60	17.92	29.532	83.9	80.7	.86	S & S E
61	10.93	29.534	83.1	79.8	.85	S, E & S W
62	13 31	29.515	83.2	80.2	.87	S & S E
63	11.22	29.519	83.4	79.8	.82	S, S E & E
64	13.09	29.505	83.4	79.9	.83	S
65	12.19	29.575	83.9	80.8	.85	S & S E
66	13.42	29.587	83.1	80.1	.85	S, S S E & S E
67	15.44	29.557	83.7	80.7	.85	S S W, S W & S

August.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	10.30	29.642	82.4	79.7	0.88	S & S E
57	18.70	29.520	82.0	79.2	.88	S
58	14.65	29.558	83.6	80.3	.86	S & S E
59	21.24	29.652	82.6	79.7	.87	S & S W
60	14.65	29.605	83.6	80.5	.86	S & E
61	16.12	29.597	83.0	79.7	.85	S, E & S E
62	12.03	29.539	83.0	80.0	.87	S & S E
63	14.10	29.555	82.8	79.7	.85	S, S E & E
64	16.64	29.621	83.3	79.8	.83	S & S W
65	5.99	29.623	84.5	31.3	.84	S & S E
66	11.48	29.584	82.9	80.2	.86	SSE, ES E & S by E
67	18.50	29.607	82.8	80.1	.86	S S E, S & S S W

First heavy or continuous falls of Rain from and after the

1856	1st June	1862	24th May
57	7th June	63	7th May
58	15th May	64	16th June
59	6th May	65	22nd May
60	16th June	66	9th June
61	3rd June	67	20th May

September.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	9.02	29.673	83.4	80.3	0.86	S & E
57	13 30	29.705	82.5	79.0	.85	E & S E
58	4.74	29.689	83.9	80.5	.85	S, S E & N E
59	11.55	29.699	83.5	80.4	.86	S & S W
60	7.13	29.667	83.4	80.4	.87	S, E & S E
61	12.48	29.665	83.7	80.1	.84	S
62	10.86	29.704	82.8	79.6	.86	S, & S E
63	10.33	29.643	82.7	79.6	.85	S, S E & E
64	12.59	29.684	83.8	80.1	.82	S & S E
65	10.25	29.676	84.2	80.7	.83	E, N & S
66	15.97	29.666	84.3	81.0	.84	S S E & S
67	13.70	29.645	83.1	80.3	.86	S W & S S E

October.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	9.21	29.793	81.0	77.2	0.83	N W & S
57	1.60	29.870	81.6	75.9	.76	N & N W
58	8.03	29.829	81.3	75.9	.77	N W, W & N
59	4.96	29.796	81.5	77.2	.81	W, N & N W
60	1.68	29 810	[illegible]	76.9	.79	S & N
61	7.75	29.802	81.2	77.3	.83	N & S
62	14.40	29.767	80.9	77.2	.84	S
63	3.48	29.814	81.3	76.5	.77	N & S
64	6.50	29.866	80.3	75.0	.75	N & E
65	...	29.848	84.4	77.4	.68	W & S
66	7.83	29.838	81.9	77.7	.80	N N W & N E
67	8.45	29.880	81.2	76.9	.79	N E & E N E

November.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	...	29.969	75.2	69.7	0.76	N W & N
57	...	29.963	73.0	65.9	.70	N W & N
58	...	30.017	73.8	67.8	.75	W, N W & N
59	...	29.955	74.3	68.4	.75	N, N W & S W
60	...	29.930	75.5	68.5	.71	N & N W
61	4.39	29.921	73.5	68.9	.80	N & N W
62	...	29.925	74.1	67.7	.73	S, N W & W
63	1.26	29.948	75.2	68.9	.71	N
64	2.89	30.033	75.6	69.3	.71	N & N W
65	...	29.950	76.4	69.1	.67	N & N W
66	...	29.988	76.1	69.5	.70	N W, N N W & N
67	4.85	30.018	74.1	69.0	.75	N & N N E

December.

Years.	Rain fall in Inches.	Barometer Mean.	Thermometers. Dry Bulb, Mean.	Thermometers. Wet Bulb, Mean.	Humidity.	Prevailing direction of Wind.
		Inches.	o	o		
1856	...	30.025	68.5	62.8	0.75	N W & N
57	...	30.041	67.4	61.1	.71	N W & N
58	1.08	30.034	66.7	61.9	.78	N, N W & W
59	...	30.010	68.7	63.3	.77	N, N W & W
60	...	30.012	67.2	60.8	.71	N & N W
61	0.26	30.008	66.5	61.7	.77	N & W
62	0.20	29.964	66.5	60.2	.72	N & N W
63	...	30.032	66.7	60.7	.70	N & N W
64	...	30.036	70.3	63.4	.66	N & N W
65	...	30.034	71.0	64.7	.69	N, W & S
66	...	30.079	67.1	60.7	.68	N, N N W & N W
67	...	30.077	67.9	61.7	.69	N & N N W

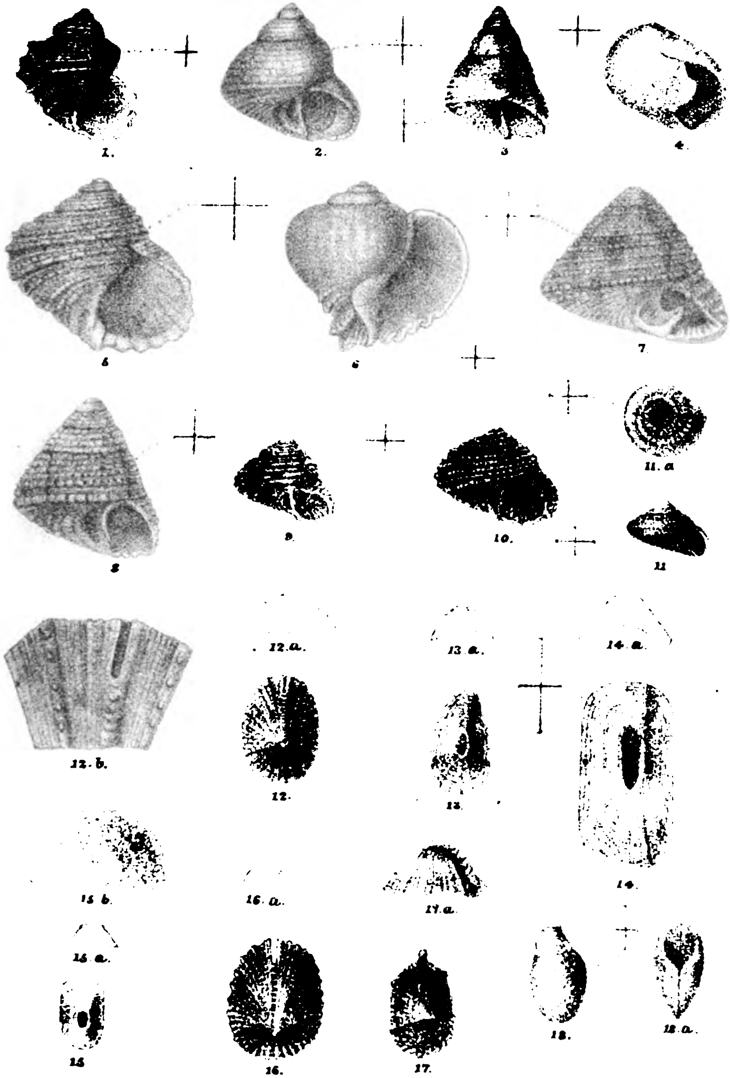
No continuous or heavy falls of Rain after the

1856	13th Oct.	Gale May 14th and Sept. 3rd
57	11th Oct.	Gale May 7th
58	28th Oct.	
59	10th Oct.	Gale July 27th
60	10th Oct.	
61	23rd Oct.	
62	24th Oct.	
63	7th Oct.	
64	22nd Oct.	Cyclone October 5th
65	25th Sept.	
66	25th Oct.	
67	1st Oct.	Gale Nov. 1st, Cyclone Nov. 2nd

TABULAR STATEMENT shewing the monthly Rain fall from January, 1837, to November, 1868, and the monthly quinquennial average for each month during that period, as taken at the Surveyor General's Office, Calcutta; by GOPEENAUTH SEN, *in charge of the Observatory.*

Years.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Total for year.	Remarks.
	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	Average	Inches	
1837	...		0·96		0·22		0·98		3·07		5·73		7·93		10·12		9·82		4·68		0·03		0·07		43·61	
1838	...		0·12		0·36		1·43		2·13		11·76		10·43		11·08		8 16		7·52		...		...		52·99	
1839	1·34		0·23		0·31		1·31		7·84		9·12		14·77		9·45		18·95		0·59		1·06		...		64·97	
1840	...		...		0·44		0·80		8·05		13·05		9·01		21·31		4·94		1·81		...		...		59·41	
1841	0·85		0·24		0·76		3·26		5·31		7·03		14·09		13·96		11·59		3·16		...		...		60·25	56·25 average for 5 years.
Sum.	2·19	0·44	1·55	0·31	2·09	0·42	7·78	1·56	26·40	5·28	46·69	9·34	56·23	11·25	65·92	13·18	53·46	10·69	17·76	3·55	1·09	0·22	0·07	0·01		
1842	...		...		3·76		3·73		1·82		26·24		9 61		21·97		4·08		3·96		0.19		0·76		76·12	Cyclone June 3rd.
1843	1·67		0·64		1·20		2·42		5·33		8·64		10·18		20·05		11·19		2·16		...		0·86		64·34	
1844	0·22		0·08		0·22		3·13		7·44		12·13		13·72		26·91		5·02		4·99		...		...		73·86	
1845	1·10		0·64		0·17		7·30		1·42		10 66		12·80		15·36		4·80		5·86		...		0·81		60·92	
1846	0·82		1·80		2·30		0·57		2·49		12·14		20·07		13·26		9·97		10·76		0·74		1·52		76·44	70·34 average for 5 years.
Sum.	3·81	0·76	3·16	0·63	7·65	1·53	17·15	3·43	18·50	3·70	69·81	13·96	66·38	13·28	97·55	19·51	35·06	7·01	27·73	5·55	0·93	0·19	3·95	0·79		
1847	...		...		...		2·33		4·79		12·01		15·69		15·09		10·95		5·86		5·59		0·05		72·36	
1848			...		0·41		1·31		6·22		13·52		17·50		9·22		4·74		5·41		0·20		0·16		58·69	
1849	2·44		1·67		2·16		0·32		7·44		14·40		12·24		10 11		14·71		4·03		...		0·99		70·51	
1850	...		2·00		1·52		1·28		3·30		11·99		15·34		14·88		20·59		3·61		1·77		...		76·28	
1851	0·07		2·41		1.05		3·75		0·08		8·39		12·89		10·78		8·49		16·25		...		...		64·16	68·40 average for 5 years.
Sum.	2·51	0·50	6·08	1·22	5·14	1·03	8·99	1·80	21·83	4·37	60·31	12·06	73·66	14·73	30·08	12·02	59·48	11·90	35·16	7·03	7·56	1·51	1·20	0·24		
1852	1·58		...		6·08		1·84		11·89		8·59		17·98		9·95		‡		2·59		...		0·50		61·00	
1853	0·10		...		...		1·00		2·42		8·27		12·76		13·44		9·15		4·94		...		...		52·08	
1854	...		1·01		1·28		7·25		3·75		16·82		10·60		11·59		9·26		4·01		0·90		...		66·47	
1855	0·46		1·11		0·14		3.83		5·97		5·84		19·18		11·07		19·39		3·38		...		...		70·36	{ 62·83 average for 5 years.
1856	1·06		...		2·23		0·62		8·18		12·67		10 94		10·30		9·02		9·21		...		...		64·23	{ Gale May 14th & Sept. 3rd.
Sum.	3·20	0.64	2·12	0·42	9·73	1·95	14·54	2·91	32·21	6 44	52·19	10·44	71·46	14·29	56·35	11·27	46·82	*11·71	24·13	4·83	0·90	0·18	0·50	0·10		
1857			...		0·96		1·80		9·33		10·30		12·98		18 70		13·30		1·60		...		...		68·97	Gale May 7th.
1858	0·07		0·54		0·22		0·97		3·28		8·22		17·96		14·65		4·74		8·03		...		1·08		59·76	
1859	...		0·66		4·23		1·29		3·18		12·48		9·09		21·22		11·55		4·96		...		...		68·66	Gale July 27th.
1860	...		0·09		...		2·47		2·21		6·46		17·92		14·65		7·13		1·68		...		...		52·61	
1861	0·56		...		0·88		0·31		9·07		26·44		10·93		16·12		12·48		7·75		4·39		0·26		89·19	67·84 average for 5 years.
Sum.	0·63	0·13	1·29	0·26	6.29	1·26	6·84	1·37	27·07	5·41	63·90	12·78	68·88	13·78	85·34	17·07	49·20	9·84	24·02	4·80	4·39	0·88	1·34	0·27		
1862	1·03		...		1·69		2·53		3·80		13·63		13·31		12·03		10·86		14·40		...		0·20		73·48	
1863	...		1·20		...		2·43		4·20		12·93		11·22		14·10		10·33		3·48		1·26		...		61·15	
1864	...		0·47		1·84		1·11		10·36		18·73		13·09		16·64		12·59		6·50		2·89		...		84·22	Cyclone October 5th.
1865	0·48		1·86		1·96		4·28		15·94		8·63		12·19		5 99		10·25		...		...		...		61·58	
1866	1·91		3·74		...		1·81		2·56		7·02		13·42		11·48		15·97		7·83		...		...		65·74	69·23 average for 5 years.
Sum.	3·42	0·68	7·27	1·45	5·49	1·10	12·16	2·43	36·86	7·37	60·94	12·19	63·23	12·65	60·24	12·05	60·00	12·00	32·21	6·44	4·15	0·83	0·20	0·04		
1867	0·55		0·82		1·57		0·27		2·46		6·12		15·44		18·50		13·70		8·45		4·85		...		72·73	{ Gale November 1st. { Cyclone November 2nd
1868	0·05		0·18		0·16		5·47		5·80		26·61		11·17		24·83		15·69		1·53		...				91·49	up to 30th November, 1868.
Sum.	0·60	0·30	1·00	0·50	1·73	0·87	5·74	2·87	8·26	4·13	32·73	16 37	26 61	13·31	43·33	21·67	29·39	14·70	9·98	4·99	4·85	2·43				
Average for whole Period.		0·49		0·68		1·17		2·34		5·24		12·45		13·33		15·25		11·12		5·31		0·89		† 0·24		

* Average of 4 years only. ‡ Not forthcoming.
† Average of 30 years.



1. Gibbula (?) sub-plicata
2-3. — Stoliczkana
4. Pisulina Adamsiana
5. Tallorbis roseola
6. Rapana bella
7. Clanculus Ceylanicus
8. Gibbula Dupontiana
9. — Blanfordiana
10. Euchelus Seychellarum
11. Solarium impressum
12. Emarginula papilionacea
13. Fissurella canalifera
14. Macroch. scutiformis
15. Fissurella (?) scrobiculata
16. — capuloidea
17. Sub-emarg. Oldhamiana
18. Recellaria cordiformis

// JOURNAL

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Contribution towards the knowledge of Indian Arachnoidea;

by F. Stoliczka, Esq., Ph. D., F. G. S. &c.

(With plates XVIII—XX.)

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With the exception of the Cœlenterata, and probably the Crustacea, few other branches of Indian Zoology have received so little attention as the Arachnoidea. It is really surprising to see, how very few species of Indian Arachnoids there are recorded in the leading works on the subject by Walkenaer (Aptères) and Koch (Die Arachniden &c.), when compared with the great number from other foreign countries, which one would suppose to be in this respect much less known than India. Walkenaer's descriptions of the Indian new species are, besides, often insufficient, to be of much use; they are generally too short for the purpose of specific identification. A good number of Ceylon and some Indian Arachnoidea have been, however, carefully described by Koch. Those of the Indian Dutch possessions were, to a large extent, worked out by Dr. Doleschall, and the Mauritius and Madagascar species have been monographed by Vinson. Several additions to this fauna were also lately made by Count Keyserling, Blackwall, and others.

One of the most important works for the study of Indian Arachnoidea is Savigny's excellent figures in the "Descript. Scient. de l' Egypte," although his number of new species will have to be greatly reduced, if Walkenaer's identifications prove to be correct. With the very wide geographical range, which many species of spiders are known to possess, I expect Western India will have a great number of identical species with Arabia and Egypt, the Southern portions of the Peninsula with Ceylon and partially also with Mauritius, the Southern Burmese and Malacca country with the Philippine and other islands of the Indian Archipelago. There are undoubtedly some Western Indian species the same as the Arabian, and probably European, but I have as yet so very few materials from that part of the country, that I abstain at present from quoting specific names; a list of them will be given in due time. Of the Arachnoid fauna of Bengal and the North Eastern provinces we scarcely know anything, for only very few species appear to have as yet found access into European collections. I may here remark that the distinction of the faunas which have been pointed out in the verbebrate animals between Western and Eastern India,—the one with an admixture of African, the other with that of Malayan types,—appears to be fully confirmed through the study of the ARACHNOIDEA. It is really remarkable that in examining a collection of spiders from our Eastern frontier, together with another made in Western India, often scarcely a single species will be found to be identical to both parts. Bengal has a strong admixture of Malayan types, and several species are common to it and Assam and Burma. The Western Hymalaya mountains possess in the Arachnoid fauna a prominently European character, as their general climate would lead us to expect, the Eastern Hymalaya probably contain some Chinese or Malayan types, but of this we know exceedingly little.

It is strange that not only dislike, but a real enmity and ill-feeling against Arachnoids, seems to have taken hold of men's minds. "Unheeded, or regarded with repulsive loathing by the '*cui bono*' people of the present generation" says an able writer* who *did* observe many a magnificent tropical Arachnoid! No doubt, the few species which secrete a poisonous fluid in special glands, and through

* Dr. A. Adams, in Ann. and Mag. Nat. Hist., 1847, XX, p. 289.

its use occasionally become dangerous, are the source of all this ill-feeling which has been extended to the most useful animals. Harmless they are certainly on the whole, and as regards usefulness scarcely surpassed by any other class of animals. They wholly live on insects and destroy a very large number of those which often create great damage to either animal and vegetable life. Thus they are important agents in sustaining a proper balance in the economy of nature, and their usefulness actually increases, by their not being dangerous in such a way, as insects often are.

These are, however, not the only reasons which entitle the ARACHNOIDEA to a fair share of attention on the part of every observer of nature. Their instinct is often higher developed, than we find it in insects. This instinct not only shews itself in the way in which they obtain their living, but also in the art of weaving in which they may be said to have been the teachers of man. Actually almost their whole life is nothing but a carrying out of clever arrangements, resulting from a certain amount of thought and deliberation. The beauties of colour, the curiosities of form, &c. which they exhibit, are equally remarkable and interesting. It is, therefore, only natural that some of our oldest classic writers have expressed their admiration of the works and the talent, exhibited by Arachnoids, in the most inspiring language, and many a beautiful idea in the mythology of the Greeks and Romans is interwoven with their manners and their mode of life.

It is unnecessary for me to go here into those historical and other accounts, to excite interest and attention to the study of the Arachnoids,—they speak for themselves. At the same time, I believe, I am justified in saying that there are very few branches of zoology, which would reward the zeal of the student with greater success, as regards new forms of animals, than the Arachnoids. Almost everything that we see and observe about us is a novelty to science; for if it is not actually so as to mere form, it is pretty certain to be so as to the real value in the study of geographical distribution, &c.

Several years elapsed since that I began to collect materials for a Monograph of the Indian SCORPIONIDÆ, having in view to initiate the study of the Arachnoids in this country by the description of a group, the animals of which are more generally and better known than common spiders. I found, however, that it would be probably many years, before I should be able to go on with this work; but meanwhile I have collected a large number of species from various orders of the class, and out of these I have on this occasion selected a few characteristic species of each family. I have only omitted the aquatic (PYCNOGONIDÆ and COLOPODA) and the parasitic forms (ACARINA). They are too minute to be observed with ease, though of the ACARINA some such species, for instance as those which in very large quantities destroy the leaves of the tea plant, will be worthy of examination. Of the other orders, the PEDIPALPI, (including PSEUDOSCORPIONES) SOLIFUGÆ, PHALANGIDEA and ARANEIDEA, I shall of each describe one or more species. One of the chief objects of this selection of various species, of all of which illustrations* are here given is, as I said, to attract the attention and at the same time also to facilitate the study of the Indian ARACHNOIDEA. I hope that, with the assistance of friends, who will collect those species which they find in their neighbourhood, we may obtain the materials for a work which may form a parallel to that magnificent publication of the Ray Society, " the English spiders" by Mr. Blackwall. The Indian Museum is a safe custody for all these objects, and I shall have already to mention in the present paper a few species, for which I am indebted to Dr. J. Anderson, the Curator of the Indian Museum; they are species collected by Messrs. Peel, Gregory and Haughton in Assam and adjoining districts. Central India is also very rich and will, I hope, furnish many species of spiders and scorpions.

Order, PEDIPALPI.

This order includes those ARACHNOIDEA in which the palpi are prolonged, often strongly thickened, and terminating with moveable claws or cheliceres. The scorpions may be called the typical forms of the order. One of the most important recent essays on the classification of *Pedipalpi* is by Dr. Peters, printed in the *Monathsberichte* of the Berlin Academy for 1861.

TELYPHONUS, *Latr.*

The *Telyphoni* externally very much resemble the scorpions, but they have, in place of a segmented tail with a sting at end, a simple

* The measurements are always given in millimeters, so as to avoid differences which may result from the use of a geographical and an English inch.

multi-articulated seta, and are therefore harmless. They also have the feet much longer than the palpi, while in the scorpions the contrary is the case. Lucas published, 1835, a monograph of the genus in Guerins "Magasin de Zoologie," which is simply copied by Gervais in Walkenaer's "Aptères," vol. iii. Koch "Die Arachniden" &c. vol. x, and other authors, have since described several other species. The North American SCORPIONIDÆ have been monographed in 1863 by Mr. Wood (see Journ. Acad. Nat. Sc., Phil., 2nd ser., vol. ii, p. 358).

The species of *Telyphoni* are all remarkably like each other, and it is very difficult to find any striking distinctions between them. In habits they are quite similar to the scorpions, living in damp places under stones &c.; not unusually they are met with in houses.

Telyphonus Assamensis, *Stol.* Pl. XIX, Fig. 1.

Body depressed, all over finely granulated; general colour above dark brown, blackish on the thorax and palpi, paler on the abdomen and feet; below, the same parts respectively still paler and more distinctly reddish.

The thorax is much longer than broad, surrounded with a thin, raised margin; its front part is sub-triangular, somewhat higher than the rest. The anterior angle, near which the two central eyes are situated is obtuse; the central eyes themselves are slightly prominent and separated from each other by a round smooth tubercle. The region of the lateral eyes is also slightly prominent, two eyes, of which the lower is much the larger, being contiguous, and situated on the front side of the prominence, while the third is the smallest and somewhat more distant. The posterior part of the thorax which is nearly double as long as the anterior has, on the surface, numerous depressions of which a central longitudinal groove is the most conspicuous.

The palpi are about as long as the abdomen, they are very stout. The first moveable segment has 4 spines on the upper inner edge, the last two have a common base and the outer one is the stronger; the upper anterior edge has only one spine, and the lower two subequal ones on a common base. The second segment which is very obliquely articulated to the first has one small spine on the lower front edge; the third has anteriorly one inner long process, and the fourth a smaller internal one, but a much larger external, articulated and slightly curved.

The maxillæ are very short, pointed, horizontal. The feet of the first pair are the thinnest and longest, the metatarsi, [or should these be considered as the tibiæ ?] are one long segment, the tarsi are made up of 8 short points and terminate without claws. The other feet are much more robust, the fourth is longer than the third and the third longer than the second, the last two being sub-equal. Each of the feet has only a very short thick metatarsus, and the tarsi consist of four joints, the last of which terminates with two strong claws; on the fourth pair of feet there is usually a fifth segment well defined.

Below, the front part is occupied by the immoveable base or the basal segment of the palpi which forms a broad triangle, separated longitudinally by a groove next to which in front there is a very strong slightly curved spine. The coxæ of the three last pair of feet, (the first being articulated much higher) are broad, almost contiguous, leaving behind the last only a small triangle as the rudiment of the sternum.

The abdomen is much elongated with sub-parallel sides; it consists of a minute first and 8 other larger segments, each of which has about the centre a pair of rounded depressions. Below, the first segment is the longest and the two subsequent ones, are very short; in the centre of the first the sexual opening is situated.

The seta is very slender, longer than the abdomen, attenuated towards the end, and consists of from 35 to 40 short segments, gradually becoming smaller toward, the tip; occasionally some of the middle ones are a little longer than others. The base of the seta is formed of three segments, the last being the longest and cylindrical, the two previous more flattened and very short.

The size of this species varies very much. Young specimens are often found scarcely half an inch long, and others more fully grown which exceed two inches; the last are the largest I have observed; the former also differ in colour, being usually more reddish brown, while older ones are dark or blackish brown.

*Length of the thorax 16·4 m.m.; its width about the middle 10 m.m.
———————— abdomen 22 m.m.; ——————————— 11 m.m.

* The nomenclature of the different parts of the body will be fully understood by a reference to the explanation accompanying the plates.

Length of the abdominal seta (including the base)		31.5 m.m.
„ of the cheliceres,	....	29.0 „ „
„ of one foot of the first pair,	....	57.0 „ „
——————— 2nd ——	....	30.5 „ „
——————— 3rd ——	....	34.0 „ „
——————— 4th ——	....	46.0 „ „

What distinguishes the present species in particular are the various depressions on the thorax, the entirely vertical position of the posterior lateral eyes, the thin raised margin which surrounds the thorax and abdomen, and the long seta with very numerous small segments. *Telyph. spinimanus*, Lucas, of unknown habitat, is very closely allied to our species, but the feet and palpi are in proportion to those of ours shorter, and the tarsi of the first pair of feet not so numerous. Another still more closely allied species is described by Mr. H. C. Wood from China as *Telyph. Stimpsonii* (Proc. Acad. Nat. Sci., Phil., 1861, p. 312); however the palpi, or cheliceres, of this species are described as somewhat different, the denticulation of the first moveable segment being very similar, but the third is larger than the others, which is not exactly the case in our species. The third segment has in *T. Stimpsonii* two minute spines above and the terminal internal process is bifid, and the processes of the fourth point are strongly serrated, while in the Assam species the process is not divided, and the upper spines on the third, as well as the strong serration of the fourth are absent.

Loc. Assam. A large number of specimens of this species has been sent by Messrs. Peel, Haughton and Gregory. These specimens vary in size from half an inch to two inches, but they evidently are only different stages of age of one and the same species. The young specimens are sometimes of a quite uniform reddish brown colour and have comparatively a longer tail than the old ones, while the spines on the second (externally the 1st) segment of the palpi are not perfectly developed. The species lives in damp places under stones, and is also often met with in bath-rooms of houses, in company with true scorpions. My colleague Mr. V. Ball informs me that he also procured a species of a *Telyphonus* in Western Bengal, it may be the same as the present, but more likely another species which Koch describes from the East Indies. Several specimens of this species also exist in the old collection of the Asiatic Society, but no record of localities exists.

Order, SOLIFUGÆ.

Family, *GALEODIDÆ*.

The animals, forming this division of the *Arachnoidea*, have the general form of true spiders, the abdomen being distinct from the thorax, it is, however, distinctly annulated and not provided at its end with any kind of spinners; the palpi are of a somewhat similar form and length, as the feet. The peculiarity of the abdomen and the palpi has caused the separation of this single family of the GALEODIDÆ into a separate order. The animals are, besides, characterised by the horizontal form of the falces, terminating with an upper fixed and a lower immoveable claw; they only have two eyes, like the *Phalangia*, placed on a common tubercle on the thorax; all of them also appear to have a number of wing-like appendages on the lower side of the anterior portion of the last pair of feet; the physiological functions of these appendages is however, I believe, still unknown; they only live in warm climates.

Koch published a monograph of the family in vol. viii of the "Archiv für Naturgeschichte" 1842, p. 350. The author suggests a division, according to the number of segments of the tarsi, in *Solpuga*, Lichtenstein, *Galeodes*, Olivier, *Aellopus*, Koch, *Rhax*, Hermann and *Gluvia*, Koch. A few additional species are recorded by Gervais in Walkenaer's "Aptères," vol iii, p. 90, but very few other species appear to have been described since. The Indian species mostly seem to belong to the genus

GALEODES, *Oliv.*

These have the tarsi of the 2nd and 3rd pair of feet with 2, and those of the 4th with 3 segments. There have been, I think, three species named from India. The most common, said to have been already known to Aristoteles, is the Bengal species *Gal. fatalis*, Herbst. (Ungeflügelte Jns. p. 32, pl. I, fig. 1), which has the cephalothorax nearly triangular, considerably depressed and channeled in front, the appendages of the fourth feet nearly sessile, and these last more hairy than the others. A second species was named by Gervais, *G. brevipes*, and is said to be from Nepaul (Walkenaer, Aptères, vol. iii, p. 87). It is stated to have a short and stout body, a thin lamina in front of the head (cephalothorax) which is nearly smooth and brownish, the abdomen elongated oval, the feet short and pale reddish, the tarsi brown, and the falces strongly denticulated, blackish. With neither of the species can the one here described from Western Bengal be identified, but a fourth species, apparently, from Central and Northern India, was named by Capt. Hutton, *Gal. (vorax ?)* (see Journal Asiatic Society Beng., vol. xi, pt. II, 1842, p. 857). Capt. Hutton gives there a very full and interesting account of the habits and manners of a large species of *Galeodes*. It is said to occur in Northern India, the Punjab and Afghanistan. The usual size is 2½—2¾ inch., and the abdomen is equal to a thrush's egg. Capt. Hutton's description is in other respects so general, that it would be impossible to identify any species with it; I can only say that neither the form nor the size of the body of the new species, here described, appear to coincide with the account given of *G. (vorax ?)*, while the common Indian species, *Gal. fatalis*, is often said to reach the same size as the last, and I rather think it doubtful if they are distinct species.

The *Galeodes* appear to be common all over India, but especially in the South. Mr. H. F. Blanford tells me that he observed them in large numbers and of great size in the Trichinopoly and Arcot districts. It would be especially interesting to observe these, and also those occurring in Western India, and to compare them with the Persian, Arabian, and Egyptain species, from which countries many are known.

Galeodes orientalis, *Stol.* Pl. XVIII, Figs. 4—5.

♀. General colour above yellowish brown; the terminations of the falces dark brown; eyes black; abdomen blackish grey, pale at the sides; feet yellowish, brown in the middle; the last ante-terminal segments of the palpi brown; below, uniform whitish or yellowish.

The cephalothorax is sub-quadrangular, broader in front than behind, the anterior part is considerably higher than the posterior, sloping in front towards a sharpened, dark brown edge, deeply indented just before the projecting corners; along the whole of the posterior (and partially lateral) edge there is a very deep groove present; the surface is finely granular, and like the median segments covered with longish hairs, those of the abdomen being, however, much more numerous and shorter than others. The falces are a little longer than the thorax, the two segments being strongly inflated, thickly set with moderately long stiff hairs; and two dark brown longitudinal stripes on the upper side of each are distinct. Their claws are attenuated, slightly incurved; the upper is finely serrated inside, the lower moveable joint being the stronger one; they are unequal, the left pair of the falces being distinctly longer than the right one, and each of them has, above near the claws, one long horny appendage, something of the form of a plume. The palpi are much longer than the entire body from the tip of the falces to the anus, they are very stout; the last or terminal joint is the shortest, inflated at the end, internally supplied with a brownish lamina, which has on the inner side a circular rather prominent field, and next to it on the outer side are two small tubercles, one below the other.

The three segments forming the thorax are distinctly separated and become gradually smaller towards the abdomen; the last pair of feet is by far the longest, then come the third and the first which are nearly of the same size, each of them being about equal to the length of the whole body. The first pair is without claws, the other pairs each possess two slender claws. All the feet are covered with numerous long and very thin hairs, unequal in size; on the first pair and on the palpi some of them are particularly elongated.

The abdomen is eliptical, composed of 9 segments, thickly covered with short hairs, equally narrow in front and behind, where it is slightly raised; in fresh specimens it is somewhat inflated, but in dried ones it becomes more flattened; the ventral side, at the beginning of which the stigmata and the genital opening are situated, has centrally a deep longitudinal groove; the anus is terminal, situated in an almost perpendicular slit; the abdomen is, as stated before, blackish grey above, yellowish on the sides and below.

♂. The male is perfectly similar to the female in form and colouration, but very much smaller; it has the left falces also a little longer than the right ones, and both with similar plume-like appendages; the palpi appear to be in proportion a little longer than they are in the female, (though not so well expressed in the figure, the body having been made a little too long); the penultimate segment is dark brown, the last one has at the end a white skin, slightly emarginated and folded at the terminal edge.

	♀	♂
Length of the cephalothorax, ...	6 m.m.	4 m.m.
Width in front, ...	7 „ „	4.5 „ „
Length of the three thoracic segments, ...	5 „ „	3.5 „ „
Length of the abdomen, ...	12 „ „	8.5 „ „
Width „ „ „ in the middle,......	8 „ „	5 „ „
Length of the palpi, ...	43 „ „	30 „ „
Length of one of the first pair of feet,	33 „ „	18.5 „ „
——————— 2nd	27 „ „	17 „ „
——————— 3rd	32 „ „	23 „ „
——————— 4th	50 „ „	33 „ „

This species most closely resembles the one figured by Savigny (in the Exped. de l'Egypt, &c.) as *G. arenoides*. Koch (Archiv für Naturgeschichte, viii, 1842, p. 353) considers it distinct from the European *G. arenoides* of Pallas, and names it *G. Arabs*. This species is, according to Koch, pale yellowish, with two brown stripes on the falces, two large spots on the cephalothorax, and a longitudinal stripe on the body. The present species differs from it by the want of any spots on the cephalothorax and by having in both sexes the palpi much longer in proportion to the body.

Loc. The two figured specimens were obtained by Mr. T. H. Hughes in the Birbhúm district of Western Bengal; I have also obtained lately some specimens from the neighbourhood of Delhi through Mr. R. Mitchell; the species appears to be common there.

Order, PHALANGIDEA.

Family, PHALANGIDÆ.

The Phalangidæ belong to a small division of *Arachnoidea*, which have the cephalothorax not distinctly separated from the abdomen, but, in other respects, greatly approach true spiders; they have the feet usually very long and slender in proportion to the body, and the thorax bears on a prominence two large eyes; in some species two other small accessory eyes are said to exist; the falces consist of two segments the second of which is didactylous at the end, possessing a moveable short claw.

The vitality of the feet of the *Phalangia* has been often noticed, and I would call the attention of any one interested in the subject to a very interesting paper of Mr. Lindemann in the Bull. Soc. Moscau vol. xxxvii, pt. II, (p. 537). The author describes here the muscular system with some detail, and points out how the *Phalangia* use their two alternate pairs of feet when moving about. The paper is important because this mode of muscular actions as well applies to the largest number of other *Arachnoidea.*

Koch in his "Uebersicht des Arachnidensystems," Nürnberg, 1839, pt. II, referred the GALEODIDÆ and PHALANGIDÆ to the order SOLIFUGÆ, and the genera allied to the PHALANGIDÆ he separated into 5 families TROGULIDÆ, SIRONIDÆ, GONYLEPTIDÆ, COSMETIDÆ and OPILIONIDÆ, the last named being equivalent to the present family PHALANGIDÆ, which have the last pair of feet similar to the others, the cheliceres or palpi without spines, &c.

The distinction of genera in this family is now principally based upon the form of the thorax and the spines surrounding the eyes. Strictly speaking they are to a great extent merely convenient sections, for those characters pass so gradually one into the other, that a strict generic definition, in the manner proposed by Koch, is quite impossible. Koch's previous divisions of 12 genera is on the contrary based upon the number of tarsal segments, and seems in some respects preferable; but it is scarcely necessary to say that no single characters alone ought to be taken as leading in such cases.

The English species of this family were monographed by Mr. R. H. Meade (Ann. Mag. Nat. Hist., 1855, vol. xv, p. 393, with additions in vol. vii, 1861, of the same Annals). Koch (Arachniden, vols. ii and viii) described a large number of European and foreign species, but only very few Asiatic, and hardly any Indian ones.

GAGRELLA, *Nov. gen.*

Koch has proposed the genus LEIOBUNUM to include those species which have the edges of the eyes smooth, no processes on the palpi and a short body with very long legs. To some other, apparently Asiatic species with one horn on the abdomen and 25 segments of the 1st, 3rd and 4th pair of feet, Koch gave (Arachniden vol. xvi) the name *Acanthonotus,* (see Koch's Uebers. d. Arach., pt. II, 1839), but this name has already been applied in 1835 by Owen to an Amphipoden Crustacean. It seems to me, however, that there is sufficient ground for a new generic separation of the species with a spiny abdomen from *Leiobunum,* for in this genus the segments of the body are distinctly traceable above, while in *Gagrella* the upper surface is almost uniformly coriaceous, only the terminal portion consisting of distinct segments. As regards the position of the eyes with their smooth margins, and also as regards the form of the palpi, falces, feet, &c., both genera are much alike. In *Gagrella* the metatarsal and tarsal segments are very numerous, differing with the length of the feet; the former vary from 5-8 on the 1st and 3rd pair of feet, and from 7-15 on the 2nd and 4th pair, the latter vary from 20-30 on the 1st and 3rd and from 30 to about 100 on the others; all the joints of the tarsi become very gradually shorter towards their terminations, and each of the tarsal and metatarsal parts is provided at its end with a minute spine. Herbst described from the East Indies a brown *Phalangium monocanthum* which has the thorax posteriorly truncated. Koch described from Bombay an *Acanthonotus niger* (Arach. xvi, p. 61, p. 159, p. 1541) which also differs from the next species in the form of the body.

Gagrella atrata, *Stol.* Pl. XVIII, Fig. 2, Pl. XX, Fig. 11.*

The whole body is finely granular, above entirely black, below ashy or brownish; the falces or cheliceres, the two terminal segments of the palpi, the anterior small portions of the femora and the tarsi yellowish or pale brown, the rest of the feet, &c. blackish brown.

The cephalothorax is somewhat semilunar, convex, in front provided with two short spines, at the lateral edges emarginated opposite each coxa; posteriorly it is concave, with a double raised margin; the tubercle, bearing the eyes laterally, is situated somewhat below the middle: it is narrow at the base and furrowed along the middle. In front and at the sides of the ocular tubercle there are, besides, some indistinct depressions on the surface of the thorax observable.

The falces are thin, equal to about two-thirds of the length of the palpi, with the terminal claws brown. The palpi are also slender and a little shorter than the body, terminating with a single strong claw.— The lip is very small, the so-called maxillæ rather long, and in common with the projecting bases of the palpi provided with short soft papillæ. The sternum is long, broader posteriorly, slightly concave at the sides and with the front edge, under which the sexual opening is situated, somewhat raised. The coxæ are long, depressed,

* This represents a more common variety with a shorter body, than the one shewn in Fig. 2, Pl. XVIII.

with serrated edges; the feet are long and slender, the second is the longest, a little more than ten times as long as the body, then come the 4th, 3rd, and 1st, the last two being subequal, and a little more than half the length of the first. The single claws are distinct only on the two last pairs of feet. The abdomen is about one-third longer than the thorax, with subparallel sides, and very obtusely pointed posteriorly; the surface is slightly convex, coriaceous, with the segments,—except the last three which are situated low down,—very indistinctly marked; a little before the centre it has a solid almost perpendicular spine. On the lower side there are only five segments very distinctly marked; below the base of the sternum there is on each side a small trachean opening.

Length of the thorax	$2\text{-}2\frac{1}{2}$ m.m.;	its width	4.5—5 m.m.,
———— abdomen	4.7 – 5.3 m.m.;	————	4.5—5 „ „
———— one foot of the first pair,		....	22 m.m.
———————— 2nd ———		....	37 „ „
———————— 3rd ———		....	20 „ „
———————— 4th ———		....	32 „ „

Loc. Neighbourhood of Calcutta; I obtained a few specimens in an old native hut, and some others among old branches of wood. The animals are very quick in their movements.

Gagrella signata, *Stol.* Pl. XX, Fig. 10.

The entire body is finely granular, a yellow line begins at the front end of the thorax, divides just before the ocular tubercle, each branch becoming widened and extending along the lateral margins of the abdomen posteriorly; the middle part of the abdomen is purely black, the rest of the thorax and the feet brown with the joints darker, the palpi and falces on the lower surface rather pale, the sternum and abdomen partially ashy.

This species which in general form resembles the former, differs considerably in colouring. The body is rather short, or broadly oval; the cephalothorax has no spines in front, it has, however, a double ridge posteriorly, but the margin is moderately concave. The abdomen has one high and nearly perpendicular spine placed before the centre. The under surface is also quite similar to that of the last species, the coxæ being flattened and serrated on the edges &c., (see fig. 10 a). The most important distinction consists in the length of the feet; those of the second pair being the longest, nearly 18 times longer than the body, the tarsi are equal in length to the each preceding segment respectively; the first pair of feet is scarcely longer than one half of the second, and is the strongest; the 4th comes next to the second but is much shorter, while the 3rd is only little shorter than the first.

Length of the thorax 2.7 m.m.; its width posteriorly 6 m.m.
———— abdomen 5.2 m.m.; ———————— 5.5 „ „
————one of the first pair of feet .... 50 m. m.
———————— 2nd ———— .... 95 „ „
———————— 3rd ———— .... 41 „ „
———————— 4th ———— .... 63 „ „

Loc. This species was sent by Mr. Peel to the Indian Museum, from Sibsaugur in Assam; it appears to be very rare; I have not observed it anywhere about Calcutta.

Order, ARANACEA.

Family, LINYPHIIDÆ.

HERSILIA, *Savigny.*

This genus was established for a species, *H. caudata*, from Egypt, collected during Napoleon's expedition to that country. Lucas published in 1836 in Guerins "Magasin de Zoologie" some valuable notes on the genus, pointing out its peculiarities as regards the position of the eyes, the great length of the slender feet and that of the two posterior appendages of the spinners. Lucas also described two species from the Malabar coast, *H. indica* and *Savignyi*, but Walkenaer (Aptères, I, p. 372,) considers the latter to be a young specimen of the former, though (l. cit., vol. iii, p. 433) he again does not seem to be certain of his former suggestion. The same author separates here *Hersilia* into two groups which he calls "Heteropodes" and "Orthopodes," in the former the third pair of feet being very short, in the latter subequal to the others. The species which I shall here describe belongs to the former group; it is quite distinct from either of the two forms noticed by Lucas, but it is rather similar to a species described by Blackwall from one of the Cape de Verde Islands (St. Jago); I shall, however, point out the distinction of both (see Ann. and Mag. Nat. Hist., 1863, 3rd ser., vol. xvi, p. 80).

It is difficult to find an appropriate position for the genus, but from the general appearance of the body and the distribution of the eyes, it seems to me that *Hersilia* has a great relation to *Linyphia*. Its habits are, however, very similar to those of *Philodromus*, and the same is the case as regards the proportionate length of the feet; it may, therefore, be also correctly placed near, or in, the family THOMISIDÆ.

There are several species found all through India, Burma and the Malacca straits. I have observed them mostly on palm-trees, the bark of which they much resemble in colouring; they are sometimes also called mangoe spiders.

Hersilia Calcuttensis, *Stol.* Pl. XX., Fig. 9.

♀. Cephalothorax scarcely broader than long, the ocular region narrow and strongly elevated, the posterior region with the lateral margins strongly curved, with one longitudinal central and two transverse fine grooves; the anterior part is the smaller. The grooves and the margins are partially dark brownish, the rest is yellowish, thickly covered with short white hairs.

The eyes are in exactly the same position as in the type species; the two anterior on each side form with the posterior laterals an ascending triangle, and the anterior laterals are very small, situated in front and below the posterior laterals; of all the eyes the anterior centrals are the largest. The immediate region round each eye is dark brown.

The falces are shorter than the sternum, sub-cylindrical, at the base rather contracted, pale brown with moderate dark brown claws.

The lip is broadly semicircular, short; the maxillæ somewhat higher, thick at the base, attenuated towards their ends and strongly converging. The palpi are thin, more than double the length of the falces; they are yellowish with black tips; the lip and maxillæ are a little darker than the other organs.

The sternum is almost broader than long, flat, greyish brown, thickly set with hairs, anteriorly emarginated, posteriorly obtuse. The feet are slender and very long, the first being the longest, then the second, which is only a little shorter than the fourth, and then comes the third which is about equal to one-half of one of the second pair. The colour is pale yellowish with dark terminations to the joint. No bands are traceable.

The abdomen is oval, posteriorly broader and more inflated, obtusely pointed at the extreme end; the anterior edge slightly covers the thorax. The general colour is a fawn or pale brown, with very numerous equally distributed white dots; a dark brown band extends from the anterior edge to about the middle of the abdomen, or more than half of its length, and at the end it is provided with short processes. Laterally, from the anterior edge, a thin zigzag brownish stripe with one blackish dot at each angle runs to the anus. The lower side is of a uniform greyish fawn colour, and thickly covered with whitish hairs. The epiginium is slightly prominent, brownish, with a thickened white posterior margin. The outer appendages of the spinners equal in length to the body; they consist of three joints, the first being very small, the second about three times as long as the former and the third somewhat more than three times as long as the second, gradually attenuating into a point. The middle pairs of spinners extend only to half the length of the second joint.

Length of thorax	3 m.m.;	its width in the middle	3 m.m.
——— — abdomen	6 " " ;	———————	4.5 " "
——— of one foot of the first pair, ...	22 m.m.		
——————— 2nd —— ...	20.5 " "		
——————— 3rd —— ...	8.5-9 " "		
——————— 4th —— ...	19 " "		

From Blackwall's *H. versicolor* this species differs by having the second pair of feet almost quite as long as the first, by the want of whitish bands on the feet and the different markings of the thorax and abdomen, the latter possessing a number of dark spots extending from the posterior end of the dark longitudinal band to the spinners.

Loc. Neighbourhood of Calcutta; apparently very rare, only one full grown specimen having been met with during a period of two years collecting of *Arachnoidea* in this vicinity; it was caught on the wall of a house. I subsequently observed another young specimen in my own house; it moved about either forward or sideward, flatly pressed to the wall, exactly like a *Philodromus*, and appeared to be very shy. Like the young of *Philodromus*, this young *Hersilia* was more hairy than the full grown animals are.

Family, LYCOSIDÆ.

DOLOMEDES, Latreille.

The species of this genus are chiefly characterised by the arrangement of their eyes, of which the four anterior are small and in one line, while the four posterior form a trapezoid, narrower in front than behind. Some of the species have short feet and in general character resemble the *Lycosæ*, with which the disposition of the eyes mostly agrees; other species have long feet and resemble the *Philodromi* of the THOMISIDÆ, or the *Nephilæ* of the EPEIRIDÆ. I rather think that a few good generic, or subgeneric, types will have to be distinguished among the forms now referred to *Dolomedes*, but my present very scanty materials do not permit me to enter into the details of this question. I shall note only one species which appears to be particularly interesting.

Dolomedes longimanus, *Stol.* Pl. XX, Fig. 3.

♀. The cephalothorax is large, more than half the length of the abdomen, roundish oval, slightly convex, narrowly truncated, and sloping in front and behind; yellowish brown with dark brown margins, and a pair of rather broad longitudinal bands of the same colour in the middle.

The cephalic region is very little elevated, and not distinctly separated from the posterior, which has a short groove in the centre. The four small anterior eyes are on the front side, they are grouped in two pairs though not well defined; the four posterior, much larger eyes form, as usually, a trapezoid, the anteriors being the smaller ones, and placed nearer to each other than the posteriors.

The falces are cylindrical, little shorter than the sternum; with small claws; they are yellowish with a longitudinal broad streak of a brown colour.

The lip is subquadrate, broader than long, sub-truncate in front; the maxillæ are longer than broad, about double the length of the lip, very little broader at their terminations; the palpi are inserted at their upper bases, they are thin, the 2nd segment being the longest, and next comes the 5th; all these organs are pale yellowish, covered like the rest of the body with short hairs, only a few of them being blackish.

The sternum is oval, truncate in front, obtusely pointed behind, hairy, yellowish with a brown, partially interrupted streak near the margin, opposite the thickened coxæ of each of the three first pair of feet. All these are remarkably slender, and as regards proportioned length rather different from those usually met with in other species of *Dolomedes.* The first pair is by far the longest, the 2nd and 4th are subequal, and the third is a little longer than one half of the 4th.

The abdomen is sub-cylindrical, about half as long again as the thorax, but narrow, truncate, and slightly covering the base of the former with its anterior edge which is provided with a number of stiff short hairs. The centre is occupied by a brown streak attenuating posteriorly into a point; the remaining portion of the upper surface has also a brownish tinge but there are numerous greenish white shining dots on it; the sides possess a few darker oblique transverse blotches and are bounded above by an undulating whitish margin; below, the surface is pale yellowish brown with two narrow, whitish, somewhat raised lines, beginning at the sexual opening and converging towards the spinners which are terminal.

Length of cephalothorax 4 m.m.; its width in the middle 4 m.m.

———— abdomen ..... 7 „ „; ———————— 3 „ „

——— one foot of the 1st pair .... 35 m.m.

——————— 2nd —— .... 25 „ „

——————— 3rd —— .... 15 „ „

——————— 4th —— .... 28 „ „

This is a very peculiar species of *Dolomedes;* it entirely agrees with this genus in the disposition of the eyes, the general form of the body, the length of the falces, the form of the lip and maxillæ &c., all characters upon which genera of Arachnoids are almost solely based; but the feet are those of a *Nephila,* very slender, the first pair being the longest, while in *Dolomedes* the fourth is usually the longest, or at least sub-equal to the first. The shortness of the feet of the 3rd pair is also remarkable, but as there are several species of *Dolomedes* known with equally long feet, I rather prefer placing the species in this genus than proposing a new one, especially as I am at present only in possession of a single specimen.

Loc. Neighbourhood of Calcutta, apparently a very rare form; I obtained it a few years ago in the botanic garden on the leaf of a tree, but never met again with a second specimen.

Family SALTICIDÆ.

SPHASUS, *Walck.*

Blackwall classifies the species of this genus in the family LYCOSIDÆ, but the short truncate form of the cephalothorax, with the unequal eyes disposed in front of it, seems to me to indicate a much greater relation to the SALTICIDÆ than to the last named family. I have observed several species in various parts of India; they generally hunt after insects among grasses between which they jump about exactly like do the species of *Salticus* on walls, they sometimes also form a small loose snare; some of them defend themselves furiously when caught with the hand, and if released they drop supporting themselves by a single thread. Walckenaer in his work (Insect. Aptères, vol. i, p. 376), characterizes a species *S. indicus*, which was sent to him from Bengal with the following words "abdomen ferrugineux, bordé de noir; corselet et pattes ferrugineux." It is impossible to identify a species from such a description, for the colour of specimens, when not well preserved, very much changes in spirit. I have not seen any species of that colouration, and very likely the specimen from which the above description was taken, was first dried and afterwards put in spirit, in which case a reference to general colouration is as good as worthless. The green colours of the *Sphasi*, and also of the *Thomisi*, very rapidly fade away in spirit, changing to pale or greyish brown.

Sphasus viridanus, *Stol.*, Pl. XX, Fig. 1.

♀ Cephalothorax oval with the cephalic part high, convex, narrower anteriorly than posteriorly; the thoracic part is much broader, with convex sides and with a deep groove in the middle, in continuation of the two grooves which separate it from the former; both parts are uniform pale green, with two small, brown, lateral spots about the middle of the upper surface, and some other equally small dark green dots, irregularly distributed over the surface; hairs very few and short. On the front side a broadish, dark green line runs down perpendicularly from each of the first pair of eyes to the base of the falces and one similar line is seen laterally; the lower corners at the base of the falces are purplish.

The eyes are situated close together on a roundish, upper anterior protuberance of the thorax which is reddish, or rather violet brown, and thickly covered with short, depressed, gray hairs. The two anterior eyes which are situated on the front surface are very small, those of the second pair placed near the edges of the thorax are the largest, and the posterior, arranged in a curve, are of median size.

The falces are long, pyramidal, thick at their base, becoming gradually thinner towards their ends; they are of the same green colour as the thorax which has, below and externally on each side where the falces are articulated, a small brown spot at the edge; the claws of the falces are comparatively very small and pale brown.

The lip is green, long, narrow, with an attenuated and pointed termination; it is a little shorter than the maxillæ, and these again a little shorter than the mandibles. The maxillæ are dilated at the base where the palpi are inserted on the outer side, somewhat contracted in the middle and again slightly broader at their ends, which from a pale green gradually pass into a brownish hue. The palpi are thin, provided with short black hairs.

The sternum is grass green, small, depressed, somewhat heart-shaped, being anteriorly slightly indented. The legs are pale green, with numerous scattered black hairs which, as likewise those on the sternum, originate from smaller or larger blackish tubercles; they become much longer on the tibiæ and tarsi, than they are on the femora. The first pair of feet is the longest, the second comes next, but it only slightly differs in length; then comes the fourth and at last the third, which is also only a little shorter than the fourth. The inferior central portions of the femora of the first pair are distinctly carmine red, and a slight tinge of this colour is also observable on the femora of the second pair. The ends of all the tarsi become brownish and each terminate with two short black claws.

The abdomen is pyramidal, distinctly separated from the body, mostly elevated at its anterior end, and partially covering the thorax, broadest near the middle and then very gradually tapering posteriorly to a point, on which the anal appendages slightly project. It is of a uniform yellowish or sometimes bright green colour, with some lateral stripes or corrugations posteriorly, extending over the whole breadth of the abdomen. About one-fifth distant from the anterior end is a silvery white, horse shoe shaped mark, formed of four somewhat raised dots, and extending posteriorly on either side, until the white stripe gradually disappears; this abdominal white stripe is only seen in full grown specimens. The genital opening lies between two small, green tubercles, and the trachean opercula are large, oval, lateral, quite flat, posteriorly white margined.

Length of cephalothorax 6 m.m.; its width about the middle 4·5 m.m.
——— abdomen .. . 8 ,, ,, ——— anteriorly ...... 4.0 ,, ,,
——— one foot of the 1st pair .... 32 m.m.
——————— 2nd ——— .... 30 ,, ,,
——————— 3rd ——— .... 23 ,, ,,
——————— 4th ——— .... 24·6 ,, ,,

This, as likewise the next species, differs from most of the European forms of *Sphasus* by the elongated narrow lip, but the pyramidal shape of the falces, the arrangement of the eyes and the whole form of the body agree with the type of the genus.

Loc. Neighbourhood of Calcutta; appears to be rare, three specimens were found while hunting after insects between the large leaves of a low shrub. The male was not observed.

Sphasus similaris, *Stol.* Pl. XX, Fig. 2.

Cephalothorax suboval, truncate in front and behind, very high, with convex sloping sides, and slightly narrower at the ocular region; yellowish, covered with very short brownish hairs which form two parallel longitudinal lines along the centre; and two other similar ones are also partially conspicuous on the sides of the thorax.

The eyes are situated on the upper anterior part of the thorax. The four posterior ones form, as usually, a curve with the convexity directed backwards; the external ones are placed laterally in front, they are more distant than those of the previous species. The two eyes of the second row are situated in front of the curve, they are rather close together and are the largest; the four posterior ones are smaller and sub-equal; a round black spot extends from each eye into the central space surrounded by them. The two anterior eyes are closer together than those of the second row and are very small. The entire region occupied by the eyes is covered with short silvery hairs. A conspicuous but very fine dark line extends from each of the small anterior eyes towards the margin of the thorax, and is continued on the falces; there is also a minute dark spot on the external angle of the thorax where the falces articulate.

The falces are pyramidal in shape, vertical, tapering gradually towards their ends; they are greenish with a brownish tinge near the articulation of the small claws.

The maxillæ are elongated, very little broader and roundish at their terminations, somewhat shorter than the falces; the palpi are articulated at their external bases, but the maxillæ are only thicker at this place, not being dilated in front. The lip is somewhat shorter than the maxillæ, slightly wider about the middle and conspicuously contracted and produced at the end.

The sternum is rather roundish, truncated in front and somewhat pointed posteriorly; conspicuously indented at the point of articulation of each coxa. The first pair of feet is the longest, the 2nd and 4th are sometimes perfectly equal, sometimes the 2nd is a trifle longer; the 3rd pair is only little shorter, than either of the two last named ones. The sternum, lips, maxillæ and coxæ are yellowish green, the femora are purely green, and all feet are covered with very fine whitish and with larger stiff black hairs. The tibiæ and tarsi have a brownish or violet tint, and the black hairs on them are long and spiny. The terminal part of the tibiæ of the last pair of feet is almost black. Each of the femora have on the internal side two black longitudinal lines, of which the anterior one is the more conspicuous; above, there are also two or three obsolete blackish lines.

The abdomen is much elongated, thickest in front, but scarcely covering the edge of the thorax, and gradually tapering towards the oval end; it is wholly covered with very fine hairs. The front part is pure silvery white, the rest is pale brown. Two very thin conspicuous white lines, internally margined with dark brown, and forming an elongated elipse, unite in the middle and continue as a single white central line towards the end; this posterior part of the line becomes occasionally obsolete. Three white lines originate anteriorly and partially laterally, and converge together above and posteriorly, but they do not reach the centre, and are on both sides margined with dark brown. Laterally there are very numerous short white stripes which also become obsolete towards the posterior end. Below is a longitudinal central black band, accompanied on either side by a slightly narrower silvery one.

The spinners are blackish, the genital opening on an obtuse dark brown tubercle, and the tracheau opercula are large, suboval and very pale brown.

♀ Length of the thorax 4 m.m.; its width about the middle 2.5 m.m.
——— abdomen 7 „ „ ——— anteriorly ...... 3.0 „ „
——— one of the 1st pair of feet .... 15 m.m.
——— 2nd ——— .... 14·5 „ „
——— 3rd ——— .... 12 „ „
——— 4th ——— .... 12.5 „ „

♂ The male is in colouring entirely similar to the female, but is often considerably smaller. The cephalothorax is shorter and stouter in proportion, and the abdomen thinner than in the ♀. The terminal joints of the palpes are at the base strongly inflated, in young specimens greenish or brownish, in full grown ones perfectly black, below with a large opening fitted out with soft skin and a horny laterally projecting black flagellum; the whole is surrounded with various longer and shorter, black, stiff hairs (see pl. xx, fig. 2c).

Length of the thorax .. 3 m.m.; its width about the middle 2·5 m.m.
——— abdomen 6 „ „ ——— anteriorly ...... 2·5 „ „
Length of one of the 1st pair of feet, ... 13 m.m.
——— 2nd ——— ...... 12.5 „ „
——— 3rd ——— ...... 10.5 „ „
——— 4th ——— ...... 11 „ „

For some time I regarded this species as identical with *Sphasus lepidus*, Blackw. (Ann. Mag. Nat. Hist. 1864, 3rd ser., vol. xiv, p. 36), but judging from that author's description, it must be considered as distinct, differing by the markings of the cephalothorax and of the abdomen, by the elongated form of the lip, etc.

Loc. Neighbourhood of Calcutta, very common (in April and May) among grasses, hunting after insects etc.; it occasionally makes a very loose snare.

Family, THOMISIDÆ.

I hardly think a distinction necessary between *Thomisus* and *Xysticus* in the manner as proposed by Koch, and accepted by several arachnologists. The unequal size of the eyes is in no way associated with the greater length of the 3rd pair of feet, as pointed out by Prasch (see

Zool. Bot. Gesellsch., Wien, vol. xvi, p. 605). I have compared several species regarding this point, and I believe that the distinction has hardly subgeneric value; it is not at all constant, neither is the truncate form of the cephalothorax. With reference to Blackwall's new genus *Pasithea,** I may mention that this name has been used as a generic denomination already several times; once in botany and twice (by Lamouroux and Lea) in recent and fossil Zoology. The name must be replaced by a new one, though, judging from the description, it is very difficult to trace its generic distinction from *Sphasus.*

The species of this family are readily recognized by their depressed form and the feet strongly bent forward (at least the two anterior pairs). They form two natural groups, one represented by *Thomisus* which has the two last pairs of feet much shorter than the two anterior ones, and the other by *Philodromus* which has all the feet of more equal or subequal size. To this last genus belongs one of our large spiders which is very often seen on the walls of houses &c. &c.; it runs about with the greatest rapidity, and daily consumes a large number of insects, being especially active at night. There are besides a great number of other similar species which occur in our neighbourhood. Several new genera have been lately established through the examination of the Swedish and N. German species belonging to this group.

Thomisus (Xysticus) pugilis, *Stol.*, Pl. XIX, Fig. 3.

♀ Cephalothorax large, subquadrangular, somewhat narrow anteriorly, broader in the middle, with sloping sides and convex edges; uniform pale yellowish green; the front is truncated with projecting edges, above and laterally marbled with brown, and near the upper edge with some more or less confluent whitish spots. The whole of the thorax is covered with very minute pustules from which originate very short white hairs.

The eyes are disposed on the front of the coloured fore part of the thorax. The first pair is situated about the middle of the vertical front, the eyes being rather distant from each other; those of the second middle pair are still more distant than those

* Ann. Mag. Nat. Hist., 1858, 3rd ser. I., p. 427.

of the first, but nearly of equal size and situated on the upper front edge. The anterior laterals are the largest and situated before the upper lateral projections of the front part of the thorax; those constituting the posterior lateral pair are placed on the same projections near their points, behind and a little below.

The falces are short, thick, greenish, covered with black hairs, and provided with small brownish claws.

The lip is elongated, slightly narrower at the end than at the base. The mandibles are about one-third longer than the lip, narrow, slightly expanded, rounded at the terminations, and thickened at the base, where on the upper external side the thickened palpi are articulated.

The sternum is small, oval, slightly truncated in front, the coxæ of the feet strongly swollen and projecting above the surface of the sternum. The first and second pair of feet are subequal and longer than the third and fourth, being again subequal and not much above half the length of the former. They are like the sternum yellowish green, with a brownish tint towards their terminations; the end of the tibiæ and tarsi have on the inner side a number of strong short spines of a brown colour. The tarsi each have two black strong claws and two opposite smaller, pale coloured ones; on the fourth feet each tarsus, however, has 6 minute black claws.

The abdomen is roundish in front, reaching partially over the base of the thorax; it widens gradually, until in about two-thirds the distance from the front edge, it attains its greatest breadth, marked on either side by a projecting angle; from this it rapidly contracts towards the abdominal point. The colour is uniform pale greenish yellow, with two minute brown dots near each of the angles of the greatest breadth. The edge of the anterior part is finely granulated and some little distance from it runs a row of similar fine granules separated from the marginal row by a groove; in the middle of the abdomen are five minute depressions arranged in form of a triangle with the point directed towards the front. The posterior abdominal end is marked with a few transverse, slightly undulating ridges. The lower surface is on the sides finely corrugated, in the middle flattened, with two slightly converging rows of five minute impressions, situated between the genital pore and the spinners. The trachean opercula are lateral, small, having posteriorly a transverse slit at the end. Of the spinners the posterior pair is the larger, for the single anterior protuberance has no opening, and there are, therefore, as in the *Epeiridæ*, only two pairs of true spinners.

Length of the thorax 2.7 m.m. ; its width 4 m.m.
——— abdomen 5.5 „ „ .... 6 „ „
——— one foot of the 1st pair,... 14.5 m.m.
———————— 2nd „ ... 14 „ „
———————— 3rd „ ... 7 „ „
———————— 4th „ ... 8.5 „ „

♂ The male is extremely small, almost minute when compared with the ♀ ; it is represented on pl. xix, fig. 3*c*, in its natural size; the colour and general form does not in any particular respect differ from that of the ♀ ; the palpi are stout, short, the terminal segment being sub-globular, with a large opening below into which the rather thick flagellum is coiled (fig. 3 d) ; the hairs all round the same are blackish and short.

This belongs to the few unicoloured species of the type of *Th. calycinus*, Linn. (*citreus*, Walck.). It has the anterior pair of lateral eyes somewhat larger than the others, but this does not appear, as I have already stated, to be a sufficient reason for instituting a separate genus under the name of *Xysticus.*

Blackwall (Ann. Mag. Nat. Hist., vol. xiv, 3rd ser., p. 38) describes from India another species, *Thom. tuberosus* which is of a brownish colour.

Loc. I found four specimens of this beautiful species inside flowers in the Eden Garden at Calcutta; not only the form of the thorax but also its coloration strongly reminds one of a minute crab, the backward movements are also those of a characteristic crab-spider ; the specimens generally hide between the anthers where they watch for insects.

Thomisus (Xysticus) elongatus, *Stol.* Pl. XX, Fig. 6.

♀ Cephalothorax quadrangular, convex, the ocular portion in front truncate, a little narrowed with projecting corners, the posterior lateral margins of the thorax being slightly curved ; a broad white band runs posteriorly, from the antero-lateral corners, it occupies the whole length of the thorax, and is slightly indented with black on each side of its base ; the sloping flanks are brown, and the margins again white with a very thin brown stripe at the extreme edges. The first pair of the middle, and the corresponding pair of the lateral eyes, are placed on the perpendicular front side of the thorax; the former are on a slight protuberance close together, the latter which are a little larger near the edges below the projecting corners; on the other side, still nearer to the outer point, the posterior laterals are situated, being directed backwards; the posterior central eyes are above, near, but not quite on the front ridge, they are nearly twice as far apart from each other than the anterior centrals; in size they hardly differ.

The falces are very short, broad at the base, gradually tapering towards the tips which are furnished with small simple claws; their length is about equal to that of the sternum, the colour is pale brown.

The lip is rather elongate, broad, subtruncate in front; the maxillæ are about one-third longer than the lip, thick at the base, narrower at the tips with which they converge towards each other.

The palpi are stout, a little more than double the length of the maxillæ; both are pale yellowish brown, thickly set with short stiff hairs towards their ends.

The sternum is subtriangular, truncate in front with roundish corners, gradually becoming narrower posteriorly. The feet of the 1st and 2nd pair are among the largest, and subequal the first being very little longer; those of the 3rd and 4th are again subequal, the fourth which is about equal to only one-half the length of the second pair being slightly longer than the third. The femora are long, sub-cylindrical, very finely granulated; the terminal portions of the tibiæ, and the tarsi of the two first pairs are on the internal side provided with stiff depressed hairs of a brownish colour. Each tarsus of the four anterior feet terminates with four claws, two being stout and black and two smaller, pale brown; on the four posterior feet the claws are much more slender than on the anterior.

The abdomen is sub-cylindrical, slightly narrowed and truncate in front, where it partially covers the base of the thorax; in the middle it is somewhat inflated; pointed and slightly elevated at the posterior end. The general colour is greyish white, produced by numerous short hairs intermixed with others which are stiff and black. There is a conspicuous dark central band with a white stripe on either side; the dark band includes four pairs of indistinct blackish spots, beginning about the middle; near the end is a dark × mark, formed of minute yellowish dots surrounded with black, and a number of similar spots of yellow and black occupies the posterior end. The upper sides are marked with numerous raised lines, converging towards the terminal upper portion of the abdomen. Below there are a number of similar raised lines, separated from the former by a broad whitish band ; they begin at the side of the trachean opercula and converge towards the spinners which are short but prominent, very close together and some distance from the terminal end. Below, the median region is occupied by a similar greyish band as above ; the genital opening is very small, furnished on each side with a minute tubercle ; the trachean opercula are large, subquadrangular, brownish, with a transverse slit at the posterior end.

Length of thorax	2·5 m.m. ;	its width in the middle	2·15 m.m.
——— abdomen	6 „ „	———————	.........2· 3 „ „

Length of one of the first pair of feet,		——	10·5 m.m.
———————	2nd	———————	10 „ „
———————	3rd	———————	4·5 „ „
———————	4th	———————	5·2 „ „

Loc. Neighbourhood of Calcutta ; on trunks of trees, apparently very rare.

Thomisus Peelianus, *Stol.* Pl. XX, Fig. 4.

♀ The cephalothorax of this species is broadly oval, slightly convex, truncate in front, narrower on the sides of the ocular region, and with strongly curved lateral edges ; brown above with the margins all round pale yellowish white, and covered with very short hairs.

The anterior part of the thorax, where the eyes are situated, is not markedly raised ; the eyes are arranged in two rows, the anterior ones lie on the slope, the posterior above, near the edge. The four middle eyes are small, equal, and form a regular square ; the anterior laterals are sensibly larger than any of the middle ones ; the posterior laterals exceed the size of the latter by a mere trifle, they are directed backwards, forming with the posterior centrals an easy curve, convex in front. The falces are short, stout, sub-triangular, broad at the base, on the inner side rapidly sloping towards the end, where a large number of short thick hairs exists ; they are white, the short fangs being, however, pale brown and their joints pale whitish.

The lip is narrow, longer than broad, subtruncate at the tip ; the maxillæ are of about double the length of the lip, also narrow, converging towards their ends and roundish on the outer anterior edges; their base is slightly thickened above where the palpi are inserted. The latter are short and thick; their second joint is the longest, and next to it in length comes the fifth. The lip, maxillæ, and three first joints of the palpi are pure white, the two last joints brownish and thickly set with stiff, dark hairs.

The sternum is almost regularly oval, slightly truncate in front, flat, white. The coxæ are short and thick; the feet of the two first pairs are almost perfectly equal, the femora are stout and in front granulated. The tarsi have only two joints of which the terminal is much the shorter one. The feet of the two posterior pairs are subequal among themselves, the third being the shorter and not much more than equal to one half the length of one anterior foot. The joints of the tarsi of the two posterior pairs are subequal, the terminal being little shorter than the other. All the feet are white, the anterior halves of the tibiæ (proper) and the tarsi of the four anterior feet are brown, and thickly set with short dark setæ. Each foot terminates with four claws, two large black ones and two smaller opposite pale brown ones; on the last pair of feet the claws become rather indistinct.

The abdomen is much depressed, narrower and truncate in front, slightly covering the base of the thorax with its edge which bears four small tubercles. Along the lateral and front margin runs a double raised, slightly undulating ridge. The postero-lateral corners are each furnished with two large white tubercles, and a similar large boss occupies the anal end below, while above between the two pairs of tubercles the surface is transversely corrugated, and furnished again with two pairs of shining brown tubercles, the anterior ones being a little more distant than the posteriors. The middle part of the abdomen is excavated, with the central portion again somewhat elevated and studded over with a few impressions for the attachment of muscles. Except the five white and four shining brown tubercles and a white longitudinal central line, the rest of the upper surface is greyish brown. The lower side of the abdomen is white, it has in the centre a few transverse curved sulci; laterally it is irregularly corrugated, supplied with a narrow prominent ridge and some posterior tubercles; the epiginium is scarcely elevated, brownish; the trachean slits transverse, very distinct and lateral to it, somewhat distant from the anterior end ; the spinners are short, situated on the lower terminal edge and surrounded with an oval raised margin.

Length of the thorax 6·5 m.m. ; its width about the middle,	6·5	m.m.
——— abdomen 7·5 „ „ ; near the posterior end,	9	„ „
——— at the anterior end, ……	3·8	„ „
——— one of the first pair of feet ………………	20	„ „
——— 2nd ——— …………………	19·5	„ „
——— 3rd ——— …………………	10·5	„ „
——— 4th ——— …………………	11	„ „

Loc. This beautiful species was sent, with a large number of other novelties, to the Indian Museum by Mr. A. C. Peel, an assiduous collector and observer of natural history objects; it was obtained at Sibsagur, Western Assam.

*Family, SCYTODIDÆ.**

SCYTODES, *Latr.*

This genus belongs to the tribe of the *Senoculina* of Blackwall, characterized by the presence of only six eyes. In *Scytodes* these eyes are distributed in pairs on the anterior part of the thorax, one pair lies in front, and one pair on either side somewhat posteriorly compared to the former.

While other *Senoculina*, like *Dysdera* and *Segestria*, are, as regards the form of the body, mostly related to the LYCOSIDÆ (especially to *Lycosa*,) and to the THOMISIDÆ, the *Scytodes* in general character seem to be closely allied to some species of the THERIDIDÆ, an opinion which, if I am not mistaken, has been advanced by Walkenaer. With reference to this point, however, and also concerning the divisions of the *Octonoculina* and *Senoculina* being natural, great doubts may be expressed. I believe that the general character of the body ought in such cases to be considered as more important in a classificatory point of view, than the single character relating to the position of the eyes. The distinction according to these is no doubt convenient, but not always natural. *Scytodes*, when observed sitting in its natural position, has like *Thomisus* the three anterior pair of feet directed forwards, and the posterior stretched obliquely from the body, but also with the intention of a forward movement. In this position the spiders greatly resemble

* Vide "SCYTODIFORMES," and genus *Scytoda* in Eu. Simon's "Hist. nat. des Araignées," Paris, 1864, p. 43.

some *Philodromi*, so much so, that they could even easily be mistaken one for the other ; they are rather sluggish in their habits, and defend themselves with the feet and falces, when disturbed in their quiet position ; they only spin a few threads but no net.

Scytodes propinqua, *Stol.* Pl. XIX., Fig. 4.

♀ The cephalothorax is regularly oval, tumid, highest near the posterior end, higher and equal to, or usually a little longer and wider than, the abdomen, except in old female specimens in which the abdomen becomes slightly larger than the thorax. The general colour is brownish yellow, with two longitudinal dark brown lines extending from each lateral pair of eyes backwards, these undulating lines being more distinct than those at the middle, and at the sides of the thorax which are generally irregularly streaked or marbled with brown. Younger specimens have a very fine, but distinct, central, longitudinal dark line, and two or three similar continuous, curved lines near and parallel to the posterior end and to the sides of the thorax.

The central pair of eyes is on a broad prominence like a rostrum, and the laterals are also placed on oblique prominences which are usually black.

The falces are short and stout, cylindrical, yellowish, with rudimentary brownish claws.

The lip is elongated, obtusely pointed at the end; the maxillæ, narrow, converging, and little shorter than the falces; they are not particularly thickened at the base where the palpi are inserted, the latter being thin and, like the former organs, yellowish with a few black hairs near their tips.

The sternum is elongated, oval, flat with minute prominences opposite each coxa, all of which are thickened. The feet are of considerable length and slender, they are yellowish, like the sternum: the femora each have, below, two longitudinal dark lines, and the tarsi possess two segments, the last being the shorter, terminating with two black thin claws. Young specimens have the joints of the various segments of the feet brown.

The abdomen is roundish oval, quite separated from the thorax and not covering its base, very obtusely pointed behind; it is yellowish white, like the rest of the body thickly covered with hairs, in the middle with a few pairs of dark dots, to each of which laterally a transverse dark line corresponds. In young specimens there are in the central region usually two single dots, one behind the other; then follow two or three pairs, the dots in each becoming gradually more distant from each other; the lateral lines are very distinct. In full grown specimens the middle dots are in pairs, the posterior very distinct, and the lateral stripes are also replaced by a few dots; only the lower side is uniform whitish; the epiginium is very small and yellowish, the trachean opercula large, brown and situated next to it, the spinners terminal and very little prominent.

Length of thorax .. 3·5 m.m. ; its width posteriorly .. 2·5 m.m.
——— abdomen, 3·8 „ „ ; ——— in the middle 2·7 „ „
——— one foot of the 1st pair .... 17 m.m.
——————— 2nd —— .... 14.5 „ „
——————— 3rd —— .... 11 „ „
——————— 4th —— .... 14 „ „

This species very much resembles in form and in the general character of colouring the European *Sc. thoracica* (Blackwall's English Spiders, pt. II, p. 380), which has, however, proportionately much longer feet, provided with brown rings, and a somewhat different arrangement of the brown marks on the thorax and on the abdomen.

Loc. Neighbourhood of Calcutta; on shady or dark places between old foliage and in houses. A similar species also occurs in Burmah and at Penang.

Family EPEIRIDÆ.

The spiders included in this family more agree with each other in their general habits, than in any particular structure of the body the form of which is extremely variable. The artful nets made by the *Epeira diadema* are so well known, that I only need to recall the name of this common European species. As a rule, the first pair of feet is the longest, the third always the smallest, the second and fourth are subequal; but in some of the forms with the abdomen hardened above, or strongly coriaceous, the fourth pair is equal to, or exceptionally even a little longer, than the first. The eight eyes are always arranged in two rows: the middle four generally form a more or less regular square, and the lateral eyes are in pairs generally close to each other; there is usually no great difference in the size of the eyes.

The last review of the genera of the EPEIRIDÆ, or ORBITELÆ, was given by Count Eug. Keyserling in 1865, (Verhandlungen der Zool. Bot. Gesellsch., Wien, vol. xv, p. 799 etc.). The author characterized eleven genera which he considered as sufficient for the classification of our then existing materials of the family, but several of the tropical forms will probably have to form generic additions. I possess from India several such species, which I hope to compare more carefully as soon as our means of reference to the literature on the *Arachnoidea* are a little more completed. The late Doleschall already added several genera from the Indian Archipelago, and the examination of the North German, Swedish and Russian spiders are rapidly increasing the number.

Argiopes may be considered only as a section, or a subgenus of *Epeira*, because the most important points of the organisation are in both almost identical. It is impossible to fix a proper limit between the elongated form of the cephalothorax of *Epeira* and the rounded one of *Argyopes*, unless we would agree to separate what is called *Epeira* by Keyserling in at least 4 or 5 other genera, and even that number would hardly be sufficient. There is one character in which most of the species classed under *Argyopes* agree, that is, the lateral eyes are contiguous and the anterior of them are very small; but there are again among the true *Epeiræ* similar and even greater variations in the position of the eyes to be met with. Further, most of the *Argiopes* have the tarsi, especially those of the front feet longer than the tibiæ, but cases of this also occur among other *Epeiræ*. Some of Koch's generic divisions should also be retained only as subgenera of *Epeira*.

I shall here give descriptions of a few species belonging to the following genera: *Epeira*, (subg. *Argyopes*), *Nephila*, *Tetragnatha*, *Meta* and *Gastracantha*. In collecting various EPEIRIDÆ I was particularly struck with the very great scarcity of male specimens; for among about 200 specimens belonging to about 30 species there were not more than 5 or 6 males.

Epeira (Argyopes) stellata, *Stol.* Pl. XVIII, Fig. 6.

♀ Cephalothorax suboval, truncate in front, posteriorly slightly emarginated; the ocular or cephalic portion is half as wide as the thoracic which is somewhat tumid, and separated from the former by oblique converging grooves nearly reaching to the centre. The sides of the thoracic portion are slightly curved, the upper surface is laterally convex and somewhat depressed in the middle; the entire surface of the cephalothorax is uniformly covered with short depressed silvery white hairs. Each pair of eyes is situated on a small, but distinct brownish prominence; those of the posterior middle pair are placed somewhat more distant than those of the anterior, and all of them are pretty nearly equal in size; the anterior laterals are very small, situated almost wholely on the under-side of the small tubercles, which bear laterally the hinder pair of the lateral eyes.

The falces are subcylindrical, brown, with short claws and very minute scattered hairs; when in a vertical position they project a trifle beyond the maxillæ, just preventing them from becoming visible in a front view. The lip is short, semicircular, with a very small protuberance in the centre of the internal front side. The maxillæ are twice the size of the lip, thick and hairy on the inner edges. The palpes are rather thickened, like the two former organs yellowish, towards the end covered with somewhat elongated black hairs, and tipped with small black claws.

The sternum is elliptical, rather wide, very slightly emarginated in front, and terminates posteriorly with a small obtuse prominence; it is pale yellowish in the middle, and brownish laterally. A small elongated tubercle is seen near the margin, opposite each of the three anterior pairs of feet.

The first pair of feet is the longest, the third the shortest, being a little longer than one half of the former; the second and fourth pairs are very nearly equal. All the feet are covered with very small silvery white hairs and with scattered shorter and longer blackish spines. The coxæ and femora are yellowish, the tibiæ and tarsi of the two first pairs are banded alternately with brown and yellow; on the third pair, however, these bands become very indistinct, and on the fourth they are replaced by a uniform dark brown hue. The two claws on each of the tarsi are very small, black.

The abdomen is oval, elongated, convex in front, covering the cephalothorax to a considerable extent. Above, the anterior portion, marked with a few minute pits, is silvery white; of the same colour is a longitudinal central band, narrowing posteriorly, and on each side there are four large subquadrangular spots on a black ground, separated by short transverse yellow bands; the last of the four spots is almost obsolete in young specimens. The sides are striped and freckled with white and yellow. The lower side is black with a yellow eliptical mark, extending from the genital opening towards the anus, and crossed in the middle by a slightly curved band; above this are a few yellow spots. The genital opening is, as usually, situated near the anterior end in a brown hard prominence; the trachean opercula are laterally placed, a little in front of it, they are large and of subtriangular shape; the spinners have five large, black appendages.

Length of the thorax 4 m.m.;	its width (posteriorly)	3.5	m.m.
——— abdomen 9.5 „ „	——— (in the middle)	6	„ „

Length of one foot of the 1st pair	23	m.m.
——— 2nd —-	20.8	„ „
——— 3rd —-	13	„ „
——— 4th —-	19.5	„ „

Loc. Two females, slightly differing in size, were found on bushes in the Sundarbans, a few miles south of Port Canning.

One of the nearest allied species of this *Argyopes* is described by Savigny in the Zoology of the Exped. d' Egypte, (Arachnides, pl. ii, fig. 5), but the abdomen of this one is marked with continuous cross bands and all the feet possess brown and pale bands.

Epeira (Argyopes) mammillaris, *Stol.* Pl. XX, Fig. 12.

♀ Cephalothorax depressed, not much longer than broad, anteriorly narrow and slightly elevated, the elevation of the occular region continuing posteriorly as a short ridge which terminates near the centre; the lateral margins are posteriorly curved, and the posterior end is broadly truncated. The whole thorax is thickly covered with very short white hairs, it is brown with a yellow spot in the middle and a smaller one in the centre of the posterior edge; the lateral margins are also yellow.

A small prominence in front bears the four central eyes, two above and two below; they form a regular square and are of equal size; the lateral eyes are a little smaller, than the centrals, they are situated on minute tubercles, and are very little more distant from the posterior centrals than these from each other.

The falces are short, stout, brown with blackish claws.

The lip is rather large, roundish at the end and with almost perpendicular sides; the maxillæ are nearly twice as long, narrow at the base, dilated and roundish towards their ends; both are brown.

The palpi are yellowish with a few blackish hairs on the two terminal joints.

The sternum is almost as broad as long, distinctly emarginated at the base of the lip, and roundish posteriorly. Opposite each coxa of the three first pairs of feet is one tubercle, the first on each side being the largest. The colour of the sternum and of the coxæ, which are strongly thickened, is a yellowish brown. The proportion in the length of the feet is as 1, 4, 2, 3, the second and fourth being nearly equal, and the third not more than half the length of the first; in all, the tarsi are longer than the respective tibial joints, they are brownish yellow with the terminal portions of all the joints dark brown.

The abdomen is nearly thrice as long as the thorax, depressed, broadly truncate in front, widest in the middle and obtusely pointed at the posterior end. The posterior halves of the lateral margins each possesses five tubercles: of the three anterior the middle one is the largest, while the two last near the posterior end are very small. The upper surface is of a uniform, dirty brown colour, thickly covered with short white hairs, and provided with a large number of minute dots of which 4 on the anterior part are especially conspicuous; all round the margins the small pits for the attachment of muscles are more numerous than in the middle. The lower side is also of the same general colour as the upper, with a broad, yellowish, longitudinal band extending from the epiginium to the spinners, and surrounding the latter. In the centre of this band is a blackish subquadrangular spot with two pairs of dots, one below the other, one single dot is placed below its lower and another above its upper margin. The trachean opercula are large, shining brown, and so is also a triangular space between them; the pulmonary slits are very narrow. The epiginium is transversely elongated, moderately prominent, brown with black margins round the two sexual pores which lie side by side. The spinners converge with their terminations, forming a broad pointed cone.

Length of thorax 6 m.m.; its width in the middle 6 m.m.
——— abdomen 12 „ „ ; ———————— 11 „ „
———— one foot of the first pair .... 25.5 m. m.
——— ———— ———— 2nd —— .... 24 „ „
——————————— 3rd —— .... 11.5 „ „
——————————— 4th —— .... 24 „ „

This species may be considered as the eastern representative of *Epeira sericea* (Walkenaer, Insect. Apt., vol. ii, p. 116), which is found in Egypt, and almost through the whole of Northern and Western Africa; the former differs from the latter by a shorter thorax and the want of numerous bands on the feet; the abdomen is also not emargined in front, and the anterior lateral edges are not serrated, what they always appear to be in the African form.

Loc. Gowalparah in Western Assam. One specimen was sent with many other interesting forms of insects by Mr. H. Haughton; the species also occurs in Burmah and all along the Malayan Peninsula.

Epeira braminica, *Stol.* Pl. XX, Fig. 8.

♀ Cephalothorax longer than broad, convex, narrowest at the ocular region, widest near the posterior end which is again somewhat contracted at its extreme termination; pale yellowish with three longitudinal brown stripes, one central and one marginal on either side.

Ocular region truncate and roundish, not elevated at all; the four central eyes form a small square in the middle, and the laterals are almost contiguous, distant, placed at the corners. The falces are somewhat elongated, thick at the base, and gradually tapering towards the ends, yellowish, laterally at the base with a short longitudinal stripe; the claws are rather long and brown. The length of the falces is nearly equal to that of the sternum.

The lip is short, semicircular, obtusely pointed in the centre; the maxillæ are much higher, broader and rounded; the palpi are inserted at their upper bases which are not specially thickened;—all these organs are pale yellowish, the last have a few black short hairs near their ends, and the former a number of similar hairs at their inner edges.

The sternum is a little longer than broad, truncate anteriorly, and rapidly terminating with a short point posteriorly, with a small tubercle opposite the insertion of each of the three anterior pairs of feet; it is black with a yellowish central longitudinal stripe. The feet are rather short and stout, furnished with very short, white hairs, and some longish black spines; the first pair is the longest, the 2nd and 4th are subequal, and the 3rd the shortest; the length of one of the third pair is equal to two thirds of one of the first; all feet are yellowish, with the terminal ends of the femora, tibiæ and tarsi blackish brown. The tarsi are thin, the claws very short and black.

The abdomen is almost regularly oviform, tumid, slightly covering the base of the thorax, nearly twice as long as the last; it is covered with numerous short, depressed, white hairs. The upper side is brown, with a central longitudinal yellowish mark, in shape very much resembling the from of a sword; about the middle there are two white dots on each side, one below the other. The sides are pale brown, and the central portion below dark brown, with two undulating longitudinal yellow marks, extending from the epiginium to the spinners. The latter have five appendages, one single largest in front and two pairs next to it posteriorly. The trachean opercula are subtriangular, large, situated near each other at the front edge. The genital opening lies some distance from this edge, on the inside of a dark brown strongly raised claw, resting on an inflated, pale coloured tubercle.

Length of the thorax 3 m.m.;	its width about the middle 2.4 m.m.		
———— abdomen 8 „ „;	———————— 5.5 „ „		
Length of one of the 1st	pair of feet	....	15 m.m.
———————— 2nd	————	....	13.8 „ „
———————— 3rd	————	....	9.5 „ „
———————— 4th	————	....	11 „ „

The species is in many respects allied to the well known *E. apoclisa*, which has a geographical distribution from North America and Sweden to Egypt; it is, however, readily distinguished from it by the shorter thorax in proportion to its length, and by its markings above and below; the colouring of the abdomen is also somewhat different.

Loc. Calcutta. The only female was found in a godown, and although I had repeatedly instituted a search after this beautiful species, I never obtained a second specimen of it.

Epeira hirsutula, *Stol.* Pl. XX, Fig. 13.

♀ Cephalothorax slightly longer than broad, rather high and convex, narrowest in front and gradually becoming wider, being widest near the posterior end which is broadly truncate;—general colour uniform brownish yellow.

Ocular region slightly elevated at the frontal superior edge. Of the central eyes those of the anterior pair are a little closer together than the posterior ones; the laterals are somewhat smaller, nearly contiguous, but distant from the former.

The falces are as compared with the size of the spider large, considerably higher than the front side of the thorax, yellowish, with brown short and thick claws

The lip is very small, semicircular; the maxillæ considerably larger, wide at the base, subtriangular, and converging with their ends; the palpi are inserted at the upper bases, they are equal to double the length of the falces. The lip is brownish, the maxillæ and palpi yellowish, the last being only at their extreme tips brown.

The sternum is sub-oval, somewhat truncate in front, very little longer than the falces, and of greyish brown colour. The feet are of moderate size, their proportionate length is as 1, 2, 4, 3, the 2nd and 4th being subequal, and the 3rd equal to two-thirds the length of the fourth; all are uniformly yellowish, brownish at the tips of the tarsi, each of which is supplied with 4 very minute claws.

Abdomen sub-pentagonal, truncate in front and slightly covering the base of the thorax, widest and subangular in the middle, obtusely pointed and somewhat raised posteriorly. The general colour is brownish, marked all over with small white specks, posteriorly with a central longitudinal somewhat branching line, and laterally with a few indistinct transverse dark spots. The lower side is brownish, with four silvery white spots, forming a quadrangle between the epiginium and the spinners; the former is very little, the latter are strongly prominent, and of considerable length. The whole of the body, including the thorax and the feet, is thickly covered with somewhat elongated white hairs.

Length of thorax 1.8 m.m.; its width posteriorly 1.6 m.m.
——— abdomen 4.5 „ „; ——— .... 4 „ „
Length of one foot of the 1st pair .... 9 m.m.
——————— 2nd —— .... 8.5 „ „
——————— 3rd —— .... 5.8 „ „
——————— 4th —— .... 7.8 „ „

Loc. Calcutta; a rare species on walls in the interior of houses; the male has not yet been observed, it seems to be very scarce.

NEPHILA, *Leach.*

The species of this genus may be considered intermediate between *Epeira* and *Tetragnatha*, as regards the form of the body as well as that of the falces, but the feet are much longer than in the former genus, the tarsi being also longer than the tibiæ, as has likewise been noticed in the subgenus *Argyopes*.

Nephila angustata, *Stol.* Pl. XX, Fig. 7.

♀ Cephalothorax longer than broad, anteriorly bluntly truncated and somewhat narrow, two converging furrows separating the ocular portion from the posterior one, which has the lateral edges curved and tinged with brown, as likewise the central region, being distinctly depressed, while the rest of the surface is pale yellowish and convex.

The eyes are placed quite near the anterior end, but not on special tubercles; of the four middle ones the anterior are situated very little closer to each other than the posterior, they are all of equal size. The laterals are smaller, almost touching each other, arranged in about the same line as the posterior middle ones, but more distant from them than these among themselves.

The falces are cylindrical, thick, not much longer than broad, yellowish with brown ends and short brown claws; their length is equal to that of the sternum; when in a vertical position they project a little beyond the maxillæ.

The lip is thick, narrow, with parallel sides, obtusely rounded in front; the maxillæ are about twice as long as the lip, somewhat narrower at their base and curved outward, being concave on the outer and convex on the inner side; both are dark brown. The palpes are thin, greenish, with long blackish hairs towards their ends.

The sternum is narrow, truncate in front and pointed behind, brown, with small tubercles opposite each of the first and the third pair of feet. All feet are remarkably slender, the first pair being longer than the second, then comes the fourth; the third being, as is usual, the shortest and about equal to one half of the second pair; all are greenish in fresh specimens, becoming yellowish after they had been for a time in spirit, with the tibial and tarsal joints brown; in some specimens the tarsi are distinctly brown even in a fresh state.

The abdomen is elongated, subcylindrical, high, anteriorly with two obtusely rounded black protuberances, strongly projecting over the end of the cephalothorax; the posterior end is obtusely pointed, elevated above the spinners and concentrically corrugated. The general colour, above, is silvery white, posteriorly with a yellowish or golden tinge. There are three parallel longitudinal black stripes, the central one connected about the middle with each lateral one by two short and diverging, dark stripes.

The sides are marked each with one long white stripe, originating anteriorly and terminating at the spinners; a second white but short stripe begins near the posterior end; the rest of the sides and the surface below is black. On the latter there are three longitudinal white stripes between the sexual opening and the spinners; the central one of these is often rather indistinct, the middle portion of the abdomen possessing a conspicuous emerald green spot, while in continuation of the lateral stripes there are two white dots on either side of the spinners. The epiginium is blackish brown, slightly prominent, posteriorly provided with two minute points.

Length of the cephalothorax 5 m.m.; its width in the middle 4 m.m.
——— ——— – abdomen 8.5 „ „ ; ——————— 4 „ „
Length of one foot of the first pair .... 24.4 m.m.
——————— 2nd —— .... 24 „ „
——————— 3rd —— .... 12.5 „ „
——————— 4th —— .... 16 „ „

Loc. Neighbourhood of Calcutta, not common on bushes or high grasses; it has also been obtained by Mr. Peel at Sibsagor in Assam. All the specimens that I have examined were females.

Epeira (Nephila?) cicatrosa, *Stol.* Pl. XX, Fig. 5.

♀ The cephalothorax is longer than broad, tumid, the ocular portion being the smaller one, oval, well margined; the posterior is somewhat depressed along the longitudinal line, and convex on either side of it; the general colour is pale greenish, with a broad brown band along the centre, and two stripes one parallel to each of the curved margins; a short streak runs from each of the posterior eyes disappearing posteriorly at the end of the ocular region of the thorax.

The central eyes are rather distant, the anterior being a little smaller than the posterior; the lateral eyes are close together, but distinctly separated, and placed on about the same line with the posterior centrals, but nearer to these than they themselves are from the anterior centrals.

The falces are cylindrical, somewhat longer than broad, pale greenish slightly narrowed towards the tips, and furnished with short brown claws.

The lip is very small, semicircular; the maxillæ much larger, subquadrangular, flattened, roundish anteriorly, slightly widened at the base where the thin palpi are inserted; the former two organs are brownish, the latter pale yellowish or greenish with a few black stiff hairs towards their tips.

The sternum is longer than broad, truncate anteriorly, pointed posteriorly, with a slight prominence opposite the base of the lip and that of each coxa of the three anterior pairs of feet; it is deep black, generally with a longitudinal central yellowish streak, and on its entire surface thickly covered with short hairs.

The feet do not vary greatly in length: the first is the longest, the second and fourth are almost perfectly equal, but not much shorter than the first, and the third is about equal to three-fifths of the first; they are greenish with minute black dots, giving origin to longer and shorter black hairs, and with a few longitudinal black lines on the femora, especially conspicuous on their upper sides.

The abdomen is somewhat longer than the thorax, the base of which it slightly covers with its truncated front edge. On the anterior upper portion it has two pairs of pointed prominences, those of the posterior pair being a little nearer to each other than the anteriors. These prominences are, at least on the inner sides, black, but the surface between and all round them is marbled and streaked with white, reddish and partially with black; the surface near the posterior end, which is raised above the spinners, is blackish brown with a few paler, very fine transverse lines. The sides of the body are finely streaked with black and white. The inferior side is blackish brown with a white streak on each side, running in a slight curve from the sexual opening to the spinners; besides these, two small distant white spots are to be observed below the epiginium, two pairs of similar spots in the middle between it and the spinners, two larger white spots on each side of the spinners and two white streaks running from the prominent spinners to the end of the body. The epiginium is very little raised and brown.

Length of thorax 2.7 m.m.; its width in the middle 1.9 m.m.
——— abdomen 4 ,, ; ——————— 2.2 ,,
——— one of the first pair of feet .... 11 m.m.

Length of one of the 2nd pair of feet, ... 10 m.m.
——————— 3rd ——————— ...... 6.8 „ „
——————— 4th ——————— ...... 10 „ „

It is difficult to place this species in either of the genera *Nephila* or *Epeira*, being intermediate between both, and showing that the distinction of the two genera is by no means so strict as would be desirable; it has the proportionate length, of the feet of an *Epeira* and the long falces of a *Nephila;* to the last genus it, however, shews in other respects a greater relation than to the former.

Loc. Found in shady places between hedges and framework about Calcutta, chiefly in gardens. I first obtained this very interesting form through my friend, Mr. H. Bennertz, who procured a large number of specimens, all of which were females and mostly full grown. It builds a large snare, and lives to a certain extent social, but it does not grow to a large size.

META, *Koch.*

The species of this genus are in external appearance perfectly similar to those of *Tetragnatha*, the principal distinction of *Meta* being the position of each of the two lateral eyes on a common tubercle. To the species quoted by Keyserling (Zool. bot. Gesellsch., Wien, 1868, XV, p. 830) as belonging to this genus I shall add presently one to all appearance new species, from the neighbourhood of Calcutta.

Meta gracilis, *Stol.* Pl. XIX, Fig. 2.

♀ Cephalothorax elongated, scarcely half as long as the greatest width at the middle; ocular portion narrow, elevated above and shorter than the thoracic portion, from which it is separated by converging grooves; the thoracic part is slightly convex, impressed in the centre, with convex sloping sides and very little curved margins.

The eyes are placed near the anterior end of the cephalothorax; of the middle pairs the two anterior eyes are smaller and closer together, than the posterior. Each two lateral eyes are nearly contiguous, situated on small prominences, the posteriors being a little larger and more distant from each other than are the anteriors. The distance between the lateral and the posterior central eyes is almost greater than that between the latter and the anterior centrals.

The falces are little shorter than the thorax, somewhat depressed, furnished with very strong, slightly curved claws lying in grooves provided with strongly serrated edges.

The lip is small, roundish at the tip; the maxillæ narrow, flattened, with their terminations curved outwards, and nearly double the length of the lip. The palpi are thin, about half as long as the falces, thickly set with blackish hairs, especially towards their ends.

The sternum is oval, somewhat elongated, sub-truncate in front and pointed behind, slightly emarginated at the places where the coxæ are inserted; the latter being rather thickened. The feet are of the usual proportionate length, the first being by far the longest (equal to double and a half the length of the abdomen and thorax together); then comes the fourth, then the second, the third being scarcely longer than the abdomen. The colour of all the parts mentioned is a pale brown, darker about the region of the eyes, on the falces, on the lip and at the terminal joints of the feet; the maxillæ are pale.

The abdomen is subcylindrical, perfectly separated from the thorax, anteriorly slightly thicker, and posteriorly curved upwards: dark brown, finely reticulated with a silvery whiteness throughout; along the centre of the sides runs a narrow thin black line, accompanied above and below by a distinctly whitish undulating line; another white line is seen along the lower margin of the abdomen, and the central portion of the latter is occupied by a black band; a very conspicuous white spot is situated laterally near the base of the spinners, which are dark brown and very little prominent; the epiginium is small, the trachean opercula large, subtriangular, rather distant from the anterior end; both are of a light brown colour.

Length of cephalothorax 2.4 m.m. ; its width 1.3 m.m.
——————— abdomen 6.7 „ ; ——— 1.5 „
————— of the first pair of feet .... 22 m.m.
——————— 2nd ————— .... 13 „
——————— 3rd ————— .... 7 „
——————— 4th ————— .... 13 „

Loc. The only specimen was found near Calcutta, in an old tree where it had formed a small loosely built snare.

TETRAGNATHA, *Walck.*

A large number of the Indian species belonging to this genus are distinguished by a long, narrow and subcylindrical body, closely resembling in this respect, as well as in the bright colouring, the European *Tetrag. extensa*, Linné. Count Keyserling gave a review of most of the known species of *Tetragnatha* (Zool. Bot. Gesellesch., Wien, 1868, XV, p. 835 etc.). He enumerates 15 species, accompanied by detailed descriptions; most of them are European or American. The review is, however, not to be considered a complete one, for there are numerous other species described by A. Adams (Ann. Mag. Nat. Hist., 2nd ser., vol. vii), by Doleschall, Blackwall, and others. The only question regarding these species to decide would be, whether they really are *Tetragnathæ*, or whether they belong to any of the allied genera. Blackwall described lately an Indian species, *Tet. decorata* in Ann. Mag. Nat. Hist., 1864, 3rd ser., vol. xiv, p. 44.

Tetragnatha irridescens, *Stol.* Pl. XVIII. Fig. 3.

♀ Cephalothorax about one-third longer than broad, having the ocular portion considerably narrowed posteriorly; the thoracic oval, with curved sides and slightly more contracted at the base, depressed about the centre towards which numerous dark brown lines converge; the general colour is light, almost fleshy brown, and the whole surface covered with very short whitish hairs.

The eyes are placed near the anterior truncate edge of the thorax in two almost parallel rows, very slightly curved forward; those of the anterior middle pair are a little more prominent than others, and the anterior lateral eyes are the smallest, the remaining being of pretty nearly equal size.

The falces are long, subcylindrical, somewhat depressed, light brown with strong dark brown claws, lying in grooves with serrated edges.

The lip is short, semicircular with the edge somewhat bent outward; the maxillæ are about three times as long as the lip, and half the length of the falces, somewhat dilated and curved outwards at their ends; the palpi are filiform inserted above at the base of the maxillæ which are, however, not thickened at this place.

The sternum is heart-shaped, elongated, posteriorly pointed, slightly convex, smooth and indented at the places of insertion of the coxæ.

The feet are very slender, clothed with thin whitish hairs, and a few longer blackish spines intermixed; their proportionate length is the same which characterizes the genus; they are like the sternum light brown with the terminations of the joints somewhat darker. The abdomen is regularly cylindrical, slightly turned upwards at the end, a little more than three times as long as broad; blackish, finely reticulated with silvery white and green dots; above, a very narrow black line runs along the centre, giving off other short oblique lines; the ventral portion is occupied by a longitudinal broad black band, which extends over the slightly prominent epiginium and the spinners.

♂ The male does not appear to differ in size from the female; it has the falces a little stronger, the cephalothorax somewhat darker brown; and on the abdomen of the specimen, examined, I did not observe any dark dorsal line. The last joint of the palpi is long, strongly thickened, and gradually attenuating towards the end; the flagellum is short, simply curved and slightly thickened terminally.

♂ Length of the cephalothorax 1.7 m.m.; its width in the middle 1 m.m.
—— abdomen .... 4·3 „ „; .... 1 „ „
—— one of the 1st pair of feet, .. 21 m.m.
—— 2nd „ .... 12 „ „
—— 3rd „ .... 6·5 „ „
—— 4th „ .... 10 „ „

This species appears to be the eastern representative of the common European *T. extensa*, which is also known from Africa and Western Asia; it can be, however, readily distinguished from the latter by the greater length of the cylindrical abdomen in proportion to that of the thorax, by the smooth sternum, less diverging falces, &c.

Loc. Neighbourhood of Calcutta; rare, on foliage.

GASTRACANTHA, *Latr.*

Subgenus, ISACANTHA, *Sim.* (Hist. nat. des Araignées, p. 286.)

Simon suggests the formation of a number of subgenera of *Gastracantha* according to the number and proportionate length of the spines of the abdomen. In the present form there is one pair of spines on either side and one pair posteriorly, all the spines being very nearly, or perfectly, equal in length.

Gastracantha (Isacantha) Canningensis, *Stol.*
Pl. XVIII., Fig. 1.

♀ Cephalothorax quadrangular, nearly twice as broad as long; above in the middle, at the anterior and posterior edges, and at the anterior corners somewhat prominent; upper surface covered with small hairs; uniform brown.

The anterior central eyes are situated in front on the median projection of the thorax, the posterior ones are somewhat higher, and very little more distant from each other, than are the former among themselves. The lateral eyes are placed together on each of the lateral projections; the anterior ones are much the largest of all, and the posterior ones so small as to be hardly conspicuous. The falces are short, very thick, inflated, vertical, with strong articulated claws, fitting into a groove with finely serrated edges; both are brown, the claws blackish. The lip is minute, semicircular, slightly angular at the tip; the maxillæ much larger, thick, roundish, bent outwards; the palpi are rather short, inserted at the upper external bases of the former, both are light brown. The sternum is subtrigonal, somewhat elongated, truncate in front and pointed behind. The feet of the fourth pair are the longest, about equal to the total length of the body, those of the first pair are somewhat shorter, the second again shorter, and the third the smallest. All the coxæ are very short and thick, the femora broadly flattened with rather sharpened anterior edges. The general colour of the feet is brown, the coxæ and the thickened ends of the joints being blackish, and covered with short hairs. The claws of the tarsi are very small and black.

The abdomen is above coriaceous, hardened, anteriorly with a convex margin, and a very small central notch; on each side are two thick protuberances, inflated and turned upwards, and terminally provided with very small dark spines, the anterior of which is slightly smaller than the posterior; the posterior margin is entire, slightly rounded, and higher than the anal end which terminates with two thick diverging almost horizontal processes, each also supplied with a small spine. The whole surface ispunctured and covered with very short hairs: along the anterior margin there are eight black oval impressions; one, the largest, is situated between each of the lateral processes, and nine are along the posterior margin, the first of them beginning on either side at the hinder portion of the posterior lateral process. In the middle of the carpace there are two rounded depressions between the two anterior lateral processes, and two between the posterior ones, somewhat more distant than the former. Above each of the lower impressions there is a large yellowish spot, and above this laterally a very small groove. In the central longitudinal line of the carpace are placed four little punctures, one below the other, and then two pairs of equally small ones, situated between the two posterior lateral processes. Beside these there are a number of other small punctures or impressions, but they do not appear to be regular and constant. The prevalent colour of the upper surface of the carpace is yellowish brown, tinged with a reddish hue, produced by short hairs; these being, however, very easily worn off.

The lower surface is strongly convex, deeply corrugated with narrow furrows; the five spinners are black surrounded by a raised roundish oval edge; a very strong vertical and pointed protuberance is situated in front of the genital opening, with the roundish trachean opercula laterally and deeply placed.

Length of cephalothorax 1·5 m.m.; its width 3·2 m.m.
——— abdomen without posterior spines 5.5 „ „
Width of the same measured between the two lateral spines 8 m.m.
Length of one of the 1st pair of feet .... 5 „ „
——— 2nd ——— .... 4·8 „ „
——— 3rd ——— .... 4·5 „ „
——— 4th ——— .... 7·5 „ „

This species appears closely to resemble *Gast. helva*, Black., (Ann. Mag. Nat. Hist., XIV, p. 42) from which it can be distinguished by the thick processes with very short spines, the want of streaks on their underside, nine equally large,-instead of ten,-posterior marginal depressions of which the two central ones are minute, by the vertical process before the genital opening, by the want of a longitudinal furrow on the thorax, etc.

Loc. A single specimen was found a few miles South of Port Canning (S. E. of Calcutta) on bushes, where it had made a small snare between the leaves.

EXPLANATION OF PLATES.

Plate XVIII.

Fig. 1.* ♀ *Gastracantha* (*Isacantha*) *Canningensis*, Stol., p. 248; 1, upper-, 1 *a*, lower view, 1 *b*, frontal view of a portion of the cephalothorax, shewing the relative position of the eyes, the size of the falces, &c.;—all figures are drawn to twice the natural size.

Fig. 2. *Gagrella atrata*, Stol., p. 213; 2, upper view in natural size; 2 *a*, and 2 *b*, upper and lower views in four times the natural size; 2 *c*, side view of the smooth ocular tubercle with one eye.

Fig. 3. ♂ *Tetragnatha iridescens*, Stol., p. 246; 3, upper view, natural size; 3 *a*, upper view of the front part of the thorax with the two rows of eyes, the falces and palpi &c., enlarged 6 times; 3 *b*, side view of the terminal joint of the left palpus with the small flagellum coiled in, enlarged 8 times.

Fig. 4-5. ♂ & ♀ *Galeodes orientalis*, Stol., p. 209; 4 and 5, upper views in natural size; 4 *a*, internal view of the metatarsal and tarsal joints of the left palpus, three times the natural size; 4 *b*, side view of the tarsal joint only; 5 *a*, side view of the body of the ♀, shewing the appendage of one of the falces and 6 appendages of the coxa and femur; 5 *b*, view of the internal side of the tarsal joint of ♀, three times natural size.

Fig. 6. ♀, *Epeira* (*Argyopes*) *stellata*, Stol., p. 234; 6, upper view, natural size; 6 *a*, frontal view of the ocular portion of the thorax, shewing the distribution of the eyes, the proportions of the falces, length of the palpi, &c.

Plate XIX.

Fig. 1. *Telyphonus Assamensis*, Stol., p. 205; 1, upper view of a full grown specimen, natural size; 1 *a*, front view of the mouth with the penultimate joints of the cheliceres; 1 *b*, upper view of the anterior portion of the thorax; 1 *c*, basal joints of the cheliceres, as seen below; 1 *d*, the three right lateral eyes in their relative position; (1 *a*—*c*, are enlarged twice the natural size); 1 *c*, a portion of the metatarsal and the tarsal segments with the terminal claws of the second left foot; 1 *f*, a portion of the metatarsal and the tarsal segments of the first right foot;—(1 *e* and 1 *f*, are enlarged four times).

Fig. 2. ♀ *Meta gracilis*, Stol., p. 244; 2, upper-, 2 *a*, lower view, twice the natural dimensions; 2 *b*, ocular portion of the thorax shewing the disposition of the eyes; 2 *c*, view of the falces and the maxillæ and also shewing the outline of the lip,—(2 *b* and 2 *c*, are enlarged four times).

Fig. 3. ♀ *Thomisus pugilis*, Stol., p. 225; 3, upper view; 3 *a*, frontal view of the ocular portion of the thorax with the falces and palpi; 3 *b*, shewing the sternum, the lip, maxillæ and the two basal joints of the palpi; all figures are enlarged three times; ♂, 3 *c*, upper view, natural size; 3 *d*, inner view of the two terminal segments of the right palpus with the long flagellum coiled in a large cavity.

Fig. 4. ♀ *Scytodes propinqua*, Stol., p. 232; 4, 4 *a*, 4 *b*, upper-, side-and lower views, twice the natural size; 4 *c*, frontal view of the ocular portion of the thorax, shewing the position of the eyes,—enlarged four times.

Plate XX.

Fig. 1. ♀ *Sphasus viridanus*, Stol., p. 220; 1, upper view, natural size; 1 *a*, relative position of the eyes; 1 *b*, front view of the head and of the falces; 1 *c*,

* In all figures the feet are drawn in their full lengths.

lower view of the lip and maxillæ ;—(1 *a*, is enlarged three times ; 1 *b* and 1 *c*, are enlarged twice).

Fig. 2. ♀ *Sphasus similaris*, Stol., p. 222 ; 2, upper view, natural size ; 2 *a*, lower view shewing the relative length of the lip, maxillæ and falces ; 2 *b*, eyes.

♂, 2 *c*, inner view of the 4 last joints of the right palpus, shewing the flagellum in the last inflated segment,—enlarged six times.

Fig. 3. ♀ *Dolomedes longimanus*, Stol., p. 218 ; 3, upper view ; 3 *a*, position of the eyes, twice the natural size ; 3 *b*, lip, maxillæ and basal joints of the palpi, enlarged three times.

Fig. 4. ♀ *Thomisus Peelianus*, Stol., p. 229 ; 4, upper view, natural size ; 4 *a*, eyes ; 4 *b*, lip, maxillæ and basal joints of palpi ; enlarged twice.

Fig. 5. ♀ *Epeira cicatrosa*, Stol., p. 242 ; 5, upper view ; 5 *a*, side view of another specimen,—both enlarged twice ; 5 *b*, eyes and 5 *c*, lip, maxillæ and basal joints of the palpi—enlarged four times the natural dimensions.

Fig. 6. ♀ *Thomisus elongatus*, Stol., p. 227 ; 6, upper view, enlarged twice ; 6 *a*, front part of the ocular portion of the thorax with the eyes ; 6 *b*, lip and maxillæ &c.,—enlarged three times.

Fig. 7. *Nephila angustata*, Stol., p. 241 ; 7, upper view, natural size ; 7 *a*, anterior part of the ocular portion of the thorax, shewing the relative position of the eyes,—enlarged ; 7 *b*, front view of the ocular portion with the falces, slightly enlarged ; 7 *c*, lip, maxillæ and basal joints of the palpi, twice the natural size.

Fig. 8. ♀ *Epeira braminica*, Stol., p. 238 ; 8, upper view, natural size ; 8 *a*, relative position of the eyes ; 8 *b*, lip and maxillæ ; 8 *c*, front and side views of the epiginium,—all enlarged.

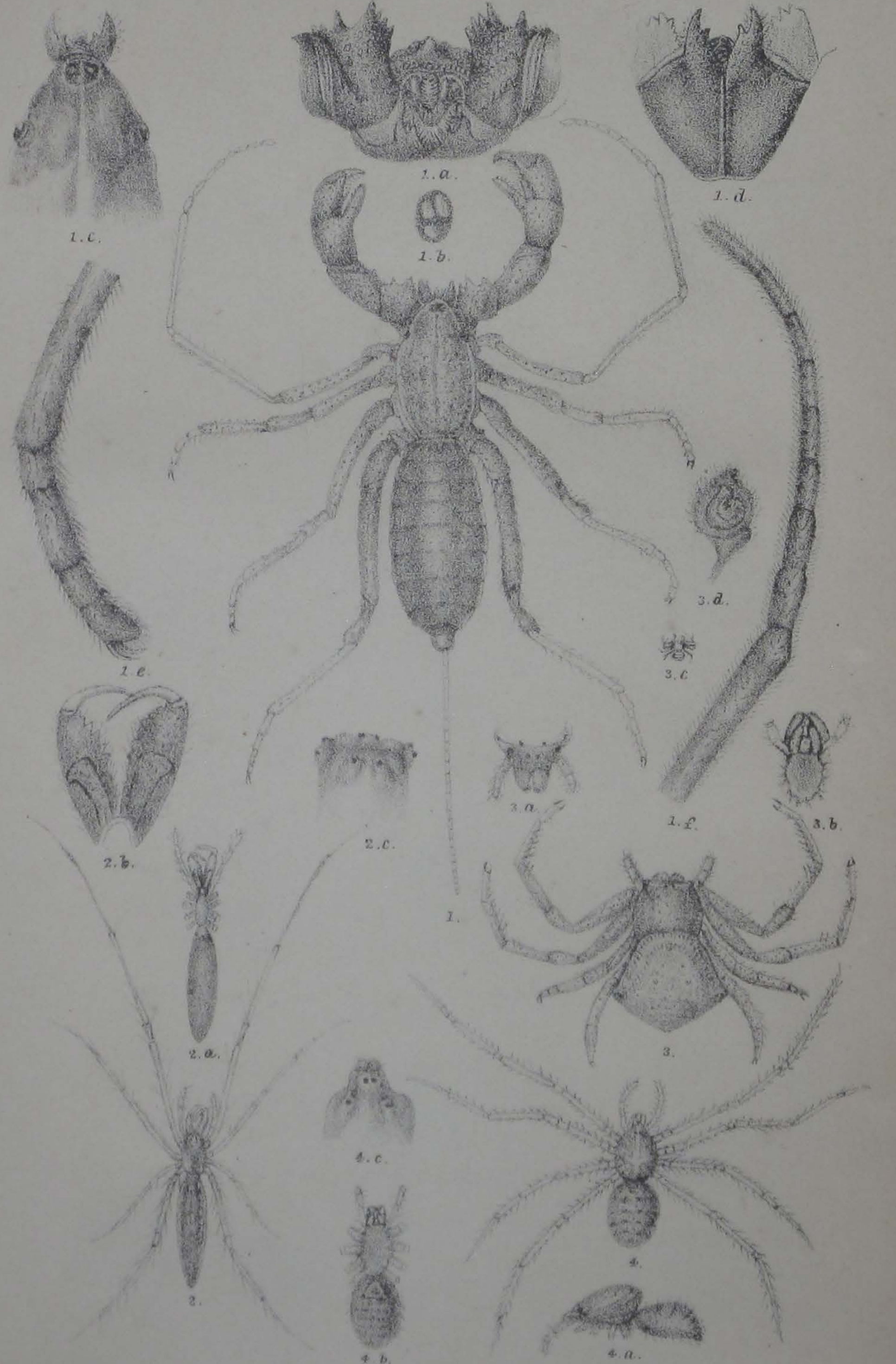
Fig. 9. *Hersilia Calcuttensis*, Stol., p. 216 ; 9, upper view, natural size ; 9 *a*, eyes ; 9 *b*, front view of the ocular portion of the thorax with the full length of the falces ; 9 *c*, lip, maxillæ and basal joints of the palpi ;—all enlarged.

Fig. 10. *Gagrella signata*, Stol., p. 214 ; 10, upper view of the body, shewing the cheliceres, palpi and the coxæ, enlarged three times ; 10 *a*, side view of the body, and 10 *b*, the left second foot,—both in natural size.

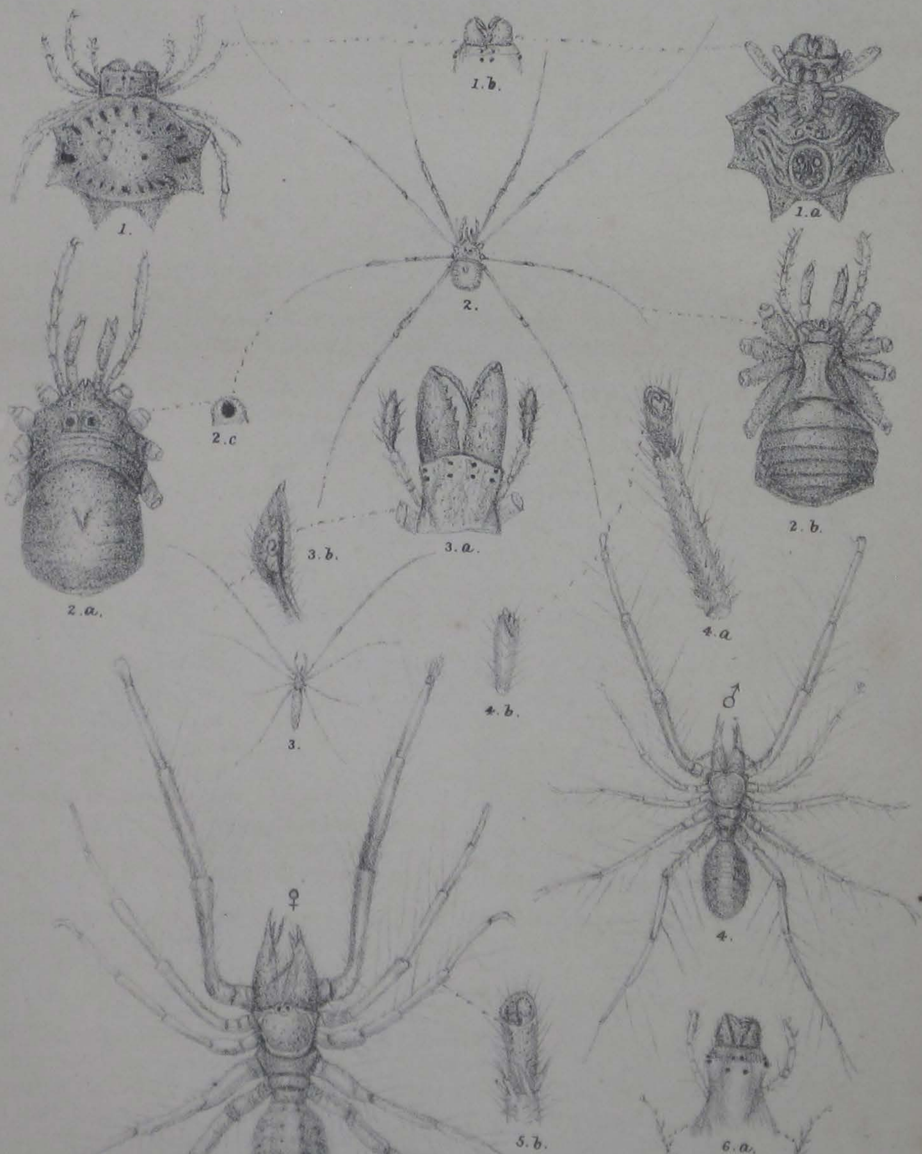
Fig. 11. *Gagrella atrata*, Stol., p. 213 ; upper view of a short, but most common variety, enlarged three times.

Fig. 12. *Epeira* (*Argyopes*,) *mammillaris*, Stol., p. 236 ; 12, upper view, natural size ; 12 *a*, eyes ; 12 *b*, front view of the ocular portion of the cephalothorax ; 12 *c*, lip, maxillæ and basal joints of the palpi,—all enlarged.

Fig. 13. *Epeira hirsutula*, Stol., p. 239 ; 13, upper view, three times natural size ; 13 *a*, eyes ; 13 *b*, front view of the ocular portion of the thorax and the falces,—enlarged.



1. Telyphonus Assamensis.
2. Meta gracilis.
3. Thomisus pugilis
4. Scytodes propinquus.



1. *Gastracantha Canningensis.*
2. *Gagrella atrata.*
3. *Tetragnatha iridescens.*
4. *Galeodes orientalis.* ♂
5. " " ♀
6. *Epeira (Argyopes) stellata.*

Calcutta.

Analysis of the Khettree Meteorite with an account of its fall, *by* D. Waldie, Esq., F. C. S.

[Read and received 2nd June, 1869.]

The Meteoric stone of which the analysis is given in the following pages, fell near Khettree, Rajputana, and the sample was supplied to me by Mr. W. Stotesbury of the Topographical Survey, who at the same time communicated an interesting account of the circumstances of the fall, of which he was to some extent personally cognisant. The account I shall give in his own words from his letter to me.

"Whilst employed in making a Topographical Survey of a portion of Shekawattie in Rajputana in February 1867, (I forget the exact date)* I was out at work one morning at about 9 o'clock ; I was suddenly startled by a loud report resembling that of a cannon at Khettree, the seat of a petty prince, about 11 miles distant to the south of the place where I was then working. The first report was followed by two more, louder than the first, but a little to the east of the place where I imagined I heard the first report ; these three were succeeded by a regular roll, resembling musketry heard at a short distance. The day being a beautiful bright one, and no clouds to be seen anywhere, and also seeing no stones falling, I did not know what to make of this, to me, strange atmospheric phenomenon. I immediately communicated the above facts to the Editor of the *Delhi Gazette*, asking to know what these strange reports in the air meant and the cause thereof. The day after I had posted the letter, I was informed by some villagers that the day before, they heard the reports, and that a shower of Aerolites had fallen, and that the stones had been seen by them. Mr. Robert Todd, a friend of mine, and in the same survey party as myself, seeing my query in the *Delhi Gazette*, regarding these reports, wrote to the Editor of the above paper informing him that they were caused by a fall of Aerolites ; he was at that time working about ten miles to the east of me, and describes the reports, &c., the same as I have mentioned already. The showers of stones, as I learned afterwards from the villagers, amounted to about 40, which fell chiefly near a village called "Saonlod," 3 miles to the north of

* Mr. Stotesbury has since found from an entry in one of his books that the date was 19th January, 1867.

Khettree in Shekawattie, Rajputana, Lat. 28° 9′ 45″ N., Long. 75° 51′ 20″ E., and about 90 miles S. W. of Goorgaon near Delhi."

"The natives, not knowing what to make of these stones, and being just as superstitious, if not more, than all natives of India, put it down to the vengeance of some offended deity: they, therefore, set about gathering all the stones that they could find; these, they afterwards pounded down to powder and scattered this to the breeze, &c., so as not to let the vengeance of the offended god redound on them. No sooner did I hear of the fall of the stones, and ascertained the exact locality, I sent all the sowars attached to my camp, to scour the country round about the place, with the intention of procuring as many of the stones as possible. I was very nearly too late, as between them all, they only managed to get the piece I sent down to you, and that by a promise of a large reward. I cannot fully describe to you the fear of the inhabitants of the villages adjacent to where the stones fell, and their amusing and queer descriptions as to their ideas of the cause, and nature of the Aerolites."

"I am sorry I had not an opportunity of viewing one of the stones before they had been broken by the foolish villagers, as I should have then been able to give you the real size, &c., of them; but from descriptions given me by the more respectable class of natives, I should say the stones were about the size of a 24-pounder shot, quite round, with a blackish appearance on the outside, and impregnated with a sulphurous smell. They fell with such velocity that they sank two or three feet into the ground, a sandy soil. The men who gave me these descriptions, I summoned and questioned them myself; of course as is natural with natives, I received all sorts of communications regarding the fall of the stones, but they are not only as foolish as they are untruthful, so it is no use my giving them you. The descriptions I have now given you, may be relied on, as they are collected by myself, from personal interviews with the more informed and respectable class of natives, such as Mahajans, Pataels and the Raj officials; and I only kept those descriptions that tallied with others I had previously received from others."

The stone is partly of a light bluish grey colour, partly of a much darker grey, in some places the two portions lying in contact like two strata, in others nodules of the one imbedded in the other. The broken surface is studded over with metallic particles, many of them having a bright metallic lustre, and there are also observable by aid of a lens, spots of a yellowish or brown colour from oxidation of the Iron, and granules of a greenish yellow colour and translucent appearance, probably Olivine. Spherules of earthy matter are also visible and round cavities in which others have been imbedded. When coarsely powdered the spherules are more visible, and when more finely powdered and examined under water with the lens, the lighter portion of the stone exhibits a considerable quantity of a nearly white crystalline matter, the particles of which are tolerably uniform in size, mixed with small angular fragments of black, brownish, opaque and greenish yellow translucent minerals, and irregularly shaped but rounded particles of Iron. The dark grey portion exhibits the same appearances, but with a much larger proportion of dark-coloured earthy minerals. The particles of the iron having resisted trituration now appear much larger than the others. After the metallic matter has been removed by acid, the remainder seems to consist of the white fine crystalline matter, observed in the original light grey portion of the stone, mixed with a few black particles. The stone is not very hard, and but for the particles of Iron, is not difficult to powder.

It is covered with a dark grey nearly black crust, cellular on the surface and corrugated somewhat longitudinally, and of about one third of a millimetre thick.

Many of the older analyses of Meteorites are very imperfect, being very defective even in the detection and estimation of the chemical constituents. Of late the chemical examination has been much more complete, and improvements have been made in their proximate analysis, obviously a matter of the greatest interest. The most recent of these investigations have been the very valuable ones by Daubrée and Meunier of the Museum of Paris, chiefly on Meteoric Iron, for the separation of the uncombined metal from the sulphides and phosphides and other constituents. As my attention had not been previously directed towards the analyses of Meteorites, I did not notice their papers so early as would have been desirable, and lost time and labour in the first processes employed. The separation of the earthy minerals is still very imperfect, and there are no very obvious means available for this purpose.

The general plan of analysis followed was to act upon the powdered stone first by acid solvents, and afterwards to extract the Silica set free from combination by boiling with solution of Carbonate of Soda. The matter resisting the action of these agents was attacked in the usual way by fusion with alkaline carbonate or with baryta. The boiling with Carbonate of Soda was troublesome, the solution could not be filtered perfectly clear: it always carried with it a small portion of undecomposed mineral in a fine state of division.

The constituents were those generally found in meteoric stones of similar appearance. The part soluble in acids consisted chiefly of Silicate of Magnesia and Iron, with interspersed particles of Nickel Iron, and Sulphide of Iron. The part insoluble in acids was also chiefly Silicate of Magnesia and Iron, but with a much larger proportion of Silica.

The analysis of several different portions shewed a certain variety of composition. Thus the insoluble matter varied from 39·5 to 42·6 per cent. of the whole. In the soluble portion, the total amount of Iron varied from 24·7 to 27·7 per cent. in all states. As the particles of Iron differ very considerably in size, it follows that as the proportional quantity of these varies, so must that of the other constituents.

But treatment with acids did not shew the amount of Iron in the free state as distinguished from that in combination. Iodine answered better, but acted partially on the sulphide of Iron as well as on the uncombined metal. Recourse was had to the solvent lately proposed by Meunier, solution of bichloride of Mercury, which dissolves the uncombined metal only: the mercurous chloride produced was removed by a current of chlorine, according to his plan, and metallic mercury by heat; the remaining mineral was then treated by hydrochloric acid, preferably with addition of some nitric acid. From the amount of Iron found in this acid solution, a proportion was deducted as combined with the Sulphur and Phosphorus, the remainder was calculated as oxide. The Sulphide of Iron was taken as $Fe_7 S_8$, Troilite, as contended for by Meunier. The whole of the Nickel is supposed to be in the state of alloy with Iron though probably part exists as Sulphide.

An attempt was made to separate the light-coloured portion of the stone from the dark, so as to compare their composition in the principal points. The light-coloured portion was got free from the dark, but the dark remained still mixed with a considerable portion of the light-coloured. The differences observed will be pointed out after the results of the general analysis have been given.

A little Phosphorus was found, and is supposed to exist in combination with Iron, 1 eq. to 3 eq. Iron,—Schreibersite.

The results of analysis are as follows :—

Dried at 212° F.

Iron,	16·98		91·54
Nickel,	1·26		6·79
Cobalt,	·21		1·15
Chromium,	·10		·52
Nickel Iron,	——	18·55	100·
Iron,	2·69		51·54
Sulphur,	1·76		33·71
Iron,	·65		12·46
Phosphorus,	·12		2·29
Troilite and Schreibersite,	——	5·22	100·
Magnesia,	13·76		39·11
Lime,	·68		1·93
Soda,	·09		·26
Protoxide of Iron,	7·51		21·35
Alumina,	·41		1·17
Silica,	10·73		30·50
Loss; removed by Carbonate of Soda with the Silica,	2·00		5·68
Earthy matter soluble in acids,	——	35·18	100·
Magnesia,	10·04		23·70
Lime,	1·69		4·00
Soda, with trace of Potash,	·78		1·84
Protoxide of Iron,	3·65		8·62
Oxide of Chromium,	·40		·95
Alumina,	1·36		3·22
Silica,	24·44		57·67
Earthy matter, insoluble in acids,	——	42·36	100·
		101·31	

The earthy matter insoluble in acid is Augitic in character and closely resembles in composition the minerals Tremolite and Actynolite, except that above two-thirds of the Lime in those minerals is replaced in this by Protoxide of Iron. It also contains Chrome Iron to the extent of 1·39 per cent., or ·59 per cent. of the entire stone.

The earthy matter soluble in acids is somewhat similar in composition to Chrysolite or Peridote, but contains a larger proportion of Magnesia and Iron. There is probably a much greater mixture of different minerals than in the case of the insoluble portion.

There is a little Chromium soluble in acid, and also soluble in Iodine, at least partially. I have supposed it to be a constituent of the Nickel Iron alloy.

Several portions which had been treated with acids (in which consequently uncombined Iron could not be estimated) contained in the soluble portion more Silica than is given in the above analysis; about 2 per cent. more. The proportion of matter insoluble in acid in these cases was about 39·5 per cent. of the whole stone.

Attention was directed, as already stated, to the differently coloured portions of the stone. Analysis gave the following results—

	Light coloured.	Dark coloured, chiefly.
Specific gravity, in small pieces,.........	3·743	3·612
Ditto ditto again wetted, ...	3·763	3·704
Ditto in powder, ...	3·818	3·729
Constituents soluble in acids:		
Uncombined Iron, ...	17.77	16·20
Sulphur, ...	1·75	1·77
Magnesia, ...	13·65	13·88
Protoxide of Iron, ...	6·67	7·76
Cobalt,..................................	all, or nearly all.	none, or nearly none.

The portion insoluble in acids differed little in the two kinds. It will be observed that the principal difference is in the relative proportion of uncombined and oxidised Iron, the dark portion containing most oxide of Iron, the light part containing most uncombined Iron, and all or almost all the Cobalt. The higher specific gravity of the light-coloured portion accords with the greater quantity of metallic Iron it contains. The state of oxidation of the iron was not experimentally determined, but was assumed to be that of protoxide, in accordance with the analyses given of similar terrestrial minerals. The cause of the difference between the loss of weight sustained by boiling the mineral after the action of acids and the weight of the Silica obtained, appears to depend upon small quantities of other constituents removed by the Carbonate of Soda in solution, or in very fine states of suspension. In one experiment made with great care, the difference of weight was nearly accounted for in this way in Alumina and Oxide of Iron, Lime and Magnesia. In this case, the loss of weight by Carb. of Soda was 12·015 grs., the Silica obtained 11·563 grs., loss only ·452 gr: of the above constituents there was obtained ·315 gr. leaving only unaccounted for ·137 gr. from 100 grs. of the stone.

I have compared its composition with that of other stones, as given in Buchner's Treatise on Meteorites, Liepzig, 1863, and find it bears a pretty close resemblance to that of "Blansko," (Brünner Kreis, Mæhren), November, 1833, and that of "Insel Oesel" in Russia, April, 1855, and a still closer one to that of "Klein-wenden" by Nordhausen, Prussia, of September, 1843.

A Contribution to our knowledge of Pelagic Mollusca, by Captain G. E. Fryer, *Madras Staff Corps.*

[Received 10th March, read 2nd June, 1869.]

Having during the last ten years made four voyages round the Cape of Good Hope, and enjoyed some opportunities of studying the habits of *Pteropods;* and understanding that information regarding them, would not be unacceptable to the Bengal Asiatic Society, I have the pleasure to furnish the following particulars. Thinking also that a few directions may be of use to intending collectors, I have appended some information regarding this point at the end of this paper.

Pteropods are essentially pelagic animals, rarely found in the neighbourhood of coasts. Some are naked, while others have their bodies enclosed in a shell which, wherever it exists, is exceedingly light and delicate. They are taken singly or in pairs, or in shoals. They vary from the size of a hazel-nut to that of a pin's head. They jerk along the surface of the water by the aid of two muscular appendages, from whose wing-like character the name of the class is derived. They generally rise to the surface after sunset, and disappear with daylight, not as some have supposed for the purpose of breathing, since, for the aeration of their systems, the majority possess a special branchial cavity into which the external water has free access. So regular, however, is their appearance after dark, that D'Orbigny regarded it as the evidence of design.

All observers of *Pteropods* are aware that, although for the most part they are blind,* their susceptibility of light is very great. When captured and placed alive in a tumbler of sea-water in a dark spot, they protrude their fins, and flap them away vigorously; but no sooner is the light of a lantern turned on them, than they collapse, sink and lie motionless at the bottom.

I suspect then, with M. D'Orbigny, that light controls the movements of these interesting animals. It is probable that as light dawns, each sinks to that depth suited to its individual sensibility, and sustaining itself in the fluid by its own specific gravity; it adjusts its position as light recedes, by instinctively rising until it finds

* *Clio* excepted.

itself at the surface, easier and more expanded than when compressed in the depths below.*

Now those learned in matters of hydrography, say that the propagation of light through water is not carried far below the surface. Its influence at the depth of 300 feet is scarcely equal to the glimmer of twilight, and below about 700 feet there is probably perpetual darkness.†

If this be so, may we not assume that the vertical range of those species at least, against whom the letters D. C. N. stand, (see table, p. 269) would be between 1 to 50 fathoms? The following experience regarding three of those species, serves to strengthen this view. On the night of the 2nd of October, 1866, while rowing round Ross Island—the head quarters of the Port Blair settlement at the Andamans,—in an open boat I took to seaward of it *H. quadridentata*, *H. uncinata*, and *H. limbata*. By the charts I find the depth thereabouts varies from 9 to 50 fathoms.

Before referring to the table, I will give one or two extracts from my notes during the outward voyages in 1860 and 1868, which I think may interest the readers of the Journal.

1860. Dec. 7,
S. Lat. 39° 55′,
E. Long. 42° 12′,
Therm. 63°,
Sea 67°,
Countercurrent.

8.30 A. M., one or two *Cymbulia*, nothing until 12.30. P. M., two *H. tridentata*, with numberless embryonic forms.

1.30. P. M., six *H. trid.* with *Salpæ*.

4.30. P. M. *Hydrozooids* and *Salpæ*.

7. P. M. three *H. uncinata*, medium size.

7.30 P. M. Dozens of *Sagitta*, imbedded in myriads of red *Entomostraca* (Copepods).

7.45. P. M. Bag full of red *Entomostraca*, *Sagitta*, and two *H. uncinata*, medium size.

8. P. M. Sudden and total disappearance of red *Entomostraca*, succeeded by *Salpæ* with yellow nuclei, and some *Medusæ*, in which were imbedded numbers of *Balantium australe*.

9.30 P. M. Two or three *Cleodora pyramidata* of different sizes.

* Some species, however, seem quite indifferent to solar influence.
† Petermanns Atlas.

The points of interest in the above entry are threefold :—

First,—the capture of *H. tridentata* (*H. Forskahlii* of D'Orb.) at noon-day, D'Orbigny having recorded it as nocturnal in its habits.

Second,—the appearance in scores of *Balantium australe.* As Cape Horn is its recognized habitat, its presence so far to the eastward was interesting. The Salpian mass in which these animals were imbedded was nearly a foot deep in the bottom of the net.

Third,—that which relates to the red *Entomostraca :* but, as they form a group in a separate class, I will merely say here, that this was the second time they had disappeared suddenly at the same hour, *viz.* when night was closing in. On each occasion, they were followed by small *Salpæ* with yellow nuclei, probably immature forms of *S. maxima* within whose organisms, however, there was no appearance of *Entomostraca.*

1868, June 25,
N. Lat. 5° 42′,
W. Long. 22° 42′,
Therm. 79°,
Sea, 81°,
Strong current to N. E.

The net was over from 6 till 10 P. M. At 7.30 P. M. took a solitary specimen of *Cleodora pyramidata.* During the middle watch from 12 to 4 A. M. the Captain's net was in use, and brought up numbers of *Pteropods* and other marine animals.

The next evening the net was again over from 6 to 10.30 P. M. and nothing whatever came up, but three fragmentary Diphyzooids. Thus on two successive occasions from sunset until 10 P. M., no living thing, except those above named, was brought up, yet during the middle of the night large hauls were made. Within equatorial limits, however, I have generally found the middle watch to be the best time.

The vessel here was in the neighbourhood of strong currents, and they are as we know the consequence of a disturbance in the aqueous equilibrium caused by a high temperature and great evaporating force.* Can it be that in these latitudes the process of evaporation has anything to do with the vertical movements of these little creatures?

For some days I see it noted that about here the sea was very phosphorescent. It is thought by some that when such is the case, you are unsuccessful with the bag, but I have never found that it makes any difference.

* Maury.

The table (see p. 269,) accompanying this, has reference merely to those *Pteropods* which are furnished with an external shell; the *Thecosomata* of de Blainville. It shows that the—

Atlantic Ocean	contributed	23	species.
Indian Ocean	„	23	„
Southern Ocean	„	11	„
Bay of Bengal	„	11	„

It will also be seen that the majority of those species can bear a great difference of temperature, for example *H. uncinata*, *Cl. pyramidata*, *Spirialis rostralis*. On such as these the currents have doubtless a strong diffusive influence, and although the Cape of Good Hope may serve in some measure to isolate the fauna of the Indian Ocean, yet the number of species in the South Atlantic common to it, proves that the two populations do mingle,* and not only so, but that some of the fauna of the Indian Ocean finds its way up to, and doubtless through the great equatorial current in the Atlantic.†

As far as my own observations go, and from what I have gathered from those of others in the same field, I think the following species are peculiar to that portion of the North Atlantic through which outward ships shape their course —

1. *Hyalæa teniobranchia*,
2. *H. longirostra*,
3. *H. mucronata (?)*
4. *Cleodora balantium*,

also the large coloured variety of *H. gibbosa*, figured by Rang, pl. x, figs. 3 and 4.

To the Indian Ocean, or more properly speaking, the *Indo-Pacific* province‡ I would assign the following species—

1. *Hyalæa flava*,
2. *H. globulosa*,
3. *H. affinis*,
4. *H. tridentata (?)*

* The drift current of the S. E. trade wind doubtless having much to do with this.

† Woodward.

‡ A bottle thrown overboard 2¼ leagues N. E. of Ascension from the American ship *Lady Montagu* in October 1820, was picked up on the Hanway rocks on the West coast of Guernsey in August, 1821.

Vide p. 155 of the Naut. Mag. for 1854.

5. *Cleodora cuspidata,*
6. *Cuvieria oryza,*
7. *Spirialis trochiformis,*
8. *H. uncinata* (?)

I agree with Rang in thinking that *Cuvieria rosea* is an immature form of *Cuv. collummella,* and I also think *Cuvieria oryza* (Benson) is a still younger form. I have repeatedly taken *Cuv. rosea* and *Cuvieria oryza* with the apex entire, as well as fractured, and of all sizes. The three forms are doubtless one and the same shell.

To the Southern Ocean belong—

1. *Balantium australe,*
2. *B. recurvum* (?).

The remaining seventeen (or fifteen, if we exclude *Cuv. coll.* and *Cuv. rosea*) are common to the Atlantic and Indian Oceans.

As regards their habits the table shows that—

12 species are strictly nocturnal,
7 „ are crepuscular and nocturnal,
12 „ are indifferent to solar influence.

Observations are, however, not sufficient yet to afford proper explanation of much that relates to the habits and geographical distribution of these interesting little creatures. Time alone can accumulate that number of well-ascertained facts which is much required. There are many intelligent and some enthusiastic workers in Mr. Green's employ, and if men so interested as Captain Edward Jones, and Mr. Salier of the "*Superb,*" to whose assistance I am greatly indebted, would from time to time publish the results of their observations, and so stimulate others to varied and continuous experiments, uncertainty regarding these animals would soon be dispelled.

Diagrams were framed, showing the undulations of the temperature of the air, and of the surface temperature of the sea, as registered during two outward voyages round the Cape of Good Hope. On the first occasion, the Cape was rounded during the month of December or at midsummer in that region. On the second, it was passed in June or in the winter season. On both occasions, the observations were made at noon; and as the principal results of these I may, in connexion with the object of this paper mention, that from about the 25th degree of South Latitude to the Equator in the Indian Ocean, the temperature of the water generally is lower than that of the air. From the 8th degree of North Latitude in West Longitude to the Equator in the Indian Ocean the water is on the contrary warmer than the air.

The direction of the several currents in the table (p. 269) is taken from Beecher's sailing directions for the Atlantic and Indian Oceans.

NOTE ON HYALÆA TRIDENTATA, *Lamck.*

With regard to this shell, M. Rang in his work on *Pteropods** says that it presents two varieties, distinguished by their smaller size; the animal and shell of one being darker in colour, the other having a very clear, and almost transparent yellow colour. To the first of these varieties, he refers *H. affinis* of D'Orbigny, but it is not clear to what he refers the second; however, as he elsewhere objects to Peron's *H. teniobranchia* being regarded as a separate species, the inference is, that he considers it identical with his second variety; although, in truth, it is not distinguished from *H. tridentata* by its smaller size.

In explanation of his text, he gives the following illustrations:

first, *H. Forskahlii*, D'Orb., pl. ii, figs. 1 to 5.

second, *H. tridentata*, Lamck., pl. xii, figs,1 to 4,

(figured by Souleyet, both being representations of the same shell; the animals of the first, however, being incorrectly drawn,) and

third, *H. teniobranchia*, Peron,

but no figure is given of the variety he refers to *H. affinis*, D'Orb.

Having been so fortunate as to capture the three shells standing at the head of the list in the table (p. 269), and been able to examine them both in their living and preserved state, I am persuaded that *H. tridentata*, Lamck, *H. teniobranchia*, Peron, and *H. affinis*, D'Orb., represent three separate and distinct species, and I think this will be seen, on referring to plate xxi, where front (1a, 2a, 3a), back (1b, 2b, 3b), and side (1c, 2c, 3c) views of them are shown.†

In their front aspect, that is to say, with the ventral plate uppermost

* Hist. Nat. des Pteropodes, 1852. MM. Rang and Souleyet.

† Figs. 2 and 3, plate xxi, are copied from drawings from nature by Dr. Ramsay Stewart, R. A., a fellow passenger on board the *Superb* to whom my best thanks are due.

figs. 1a, 2a, 3a, the contour of the first is semi-spherical, the second subtriangular, the third somewhat of an elongated oval.

Viewed inferiorly, figs. 1b, 2b, 3b, the sculpture of the dorsal plate in each, presents the following peculiarities.—

In *H. tridentata*, there are five longitudinal ribs, and, as Mr. Benson very accurately observes "the edges of the lateral rifts are expanded and very thin, and on the flatter side* are wrinkled at right angles to the line of the rift and slightly reflected at the edge."†

In *H. teniobranchia* three longitudinal ribs converge separately, and narrowing as they approach the terminal tooth, unite above it. At the lateral points the edge of the ventral plate overlaps the dorsal; at the shoulders the dorsal plate overlaps the ventral.

In *H. affinis*, three longitudinal ribs unite in the upper half of the dorsal plate and thence descend to the terminal tooth in one more or less well defined prominent rib.

The side view shows the degree of convexity in the ventral plate of each shell.

In figures, 1,‡ 2,§ 3, we see differences also in the animals. In fig. 1, the alar appendages are rectangular and trilobated at their external edge; In fig. 3 they are oval; In fig. 2, they are of intermediate shape.

The lateral expansions of the mantle, in *H. tridentata* and *H. affinis*, are both broad and short. In the latter they are yellowish towards the extremity and dark brown at the tips; the buccal mass too is of a dark brown colour. In *H. teniobranchia* on the other hand, the mantle processes are filiform, in length about two inches, extremities yellow, with dark brown tips.

As Dr. J. E. Gray in his catalogue|| has given no description of *H. teniobranchia*, and only a brief one of *H. tridentata*, I append a description of each, recasting the one given by him of *H. affinis* and adding his synonyms of *H. tridentata*.

* *i. e.* dorsal.

† Mr. Benson's notes on *Hyalæa*, Vol. 7. Ann. Mag. Nat. Hist. 3rd Series, No. 37.

‡ After Souleyet.

§ After Peron and Lesueur.

|| Catalogue of *Pteropoda* in the British Museum, London, 1850.

Hyalæa tridentata, Gmel. Pl. xxi, Fig. 1.

Anomia tridentata, Gmelin; Forskahlii, Chemnitz; Chiaje.
Cavolina natans, Abilgaard; Cuvier.
Caulina natans, Poli.
Hyalæa papilionacea, Bory de St. Vincent; Blainville.
Hyalæa cornea, Roissi, Lamck.
Hyalæa tridentata, Bosc; Lamck.; D'Orbigny; Philippi.
Hyalæa Chemnitziana, Peron et Lesueur.
Hyalæa Forskahlii, Les.: D'Orbigny.
Hyalæa tridentée, Voyage Bonite, Moll.
Hyalæa truncata Krauss.

Shell semi-spherical, inflated, gibbous anteriorly, lateral points somewhat convergent, widely cleft, lateral margin of dorsal plate wrinkled, slightly reflected, inferiorly five-ribbed, terminal tooth longer than the lateral ones.

Habitat. Indian and Pacific (?) Oceans.

Hyalæa teniobranchia, Peron, Pl. xxi, Fig. 2.

Hyalæa Peronii, Rang.

Shell sub-triangular, flat, semi-transparent; lateral points wide, somewhat divergent; upper third of cleft overlapped by margin of dorsal plate, lower third overlapped by ventral margin; inferiorly, three ribs converge separately and narrowing unite towards the long terminal tooth.

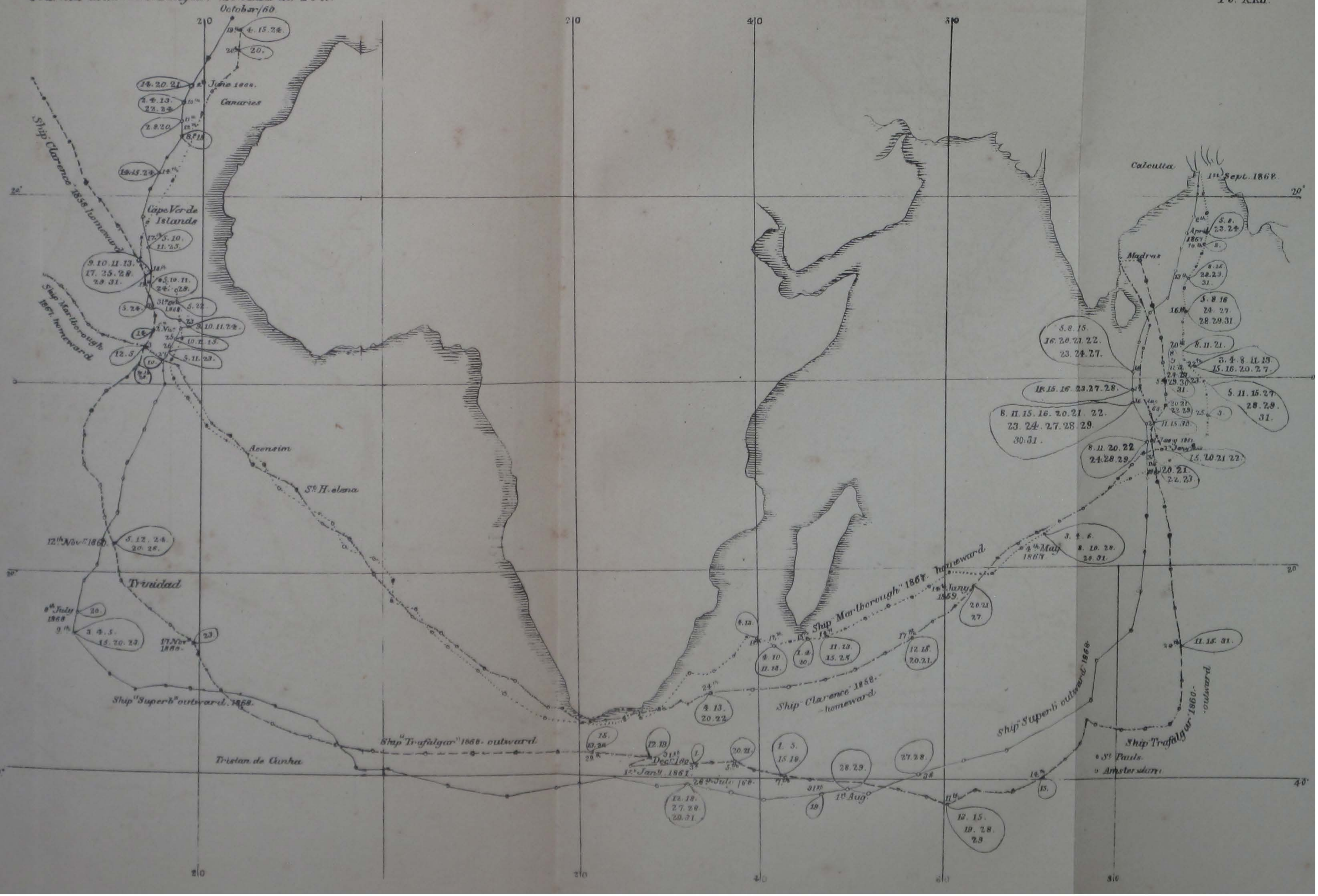
Habitat. North Atlantic.

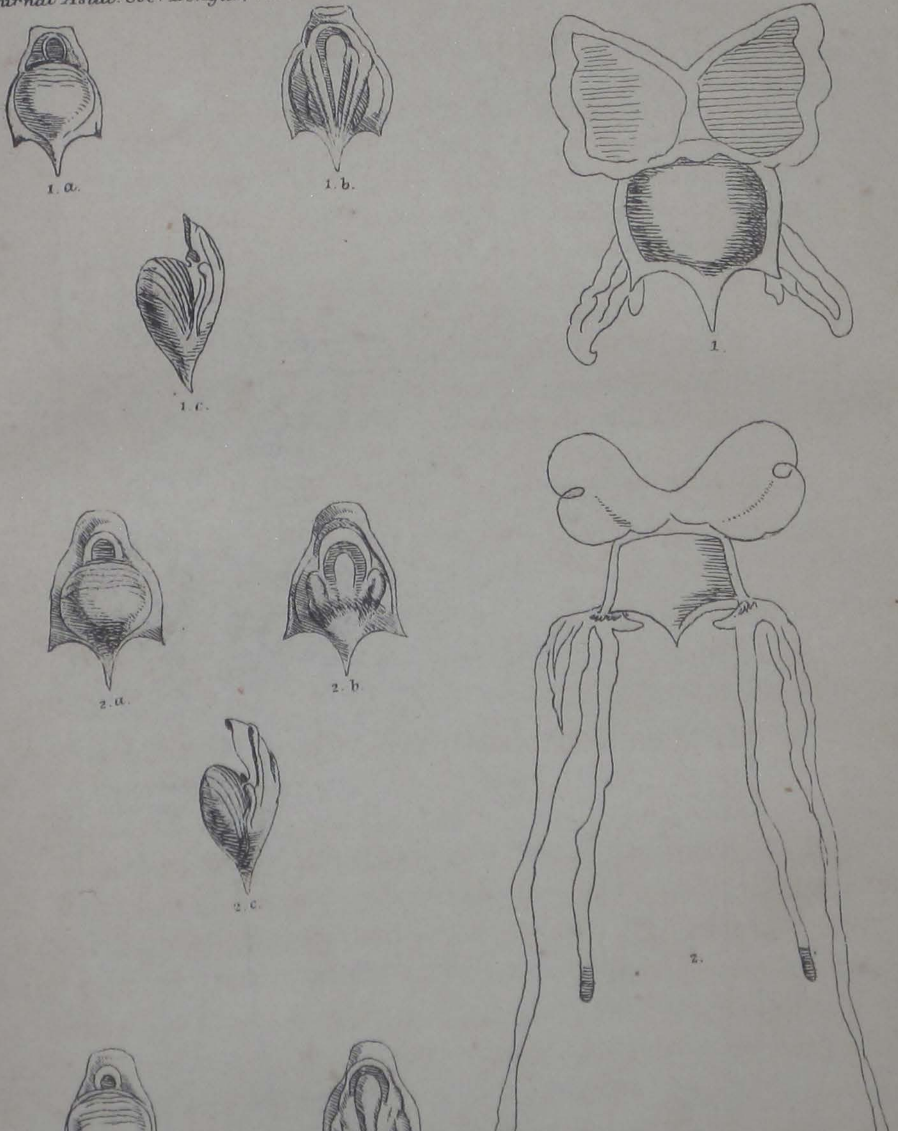
Hyalæa affinis, d'Orb., Pl. xx; Fig. 3.

Hyalæa affinis, Desh. in Lamck. Hist.
(?) Hyalæa Peronii, Les.

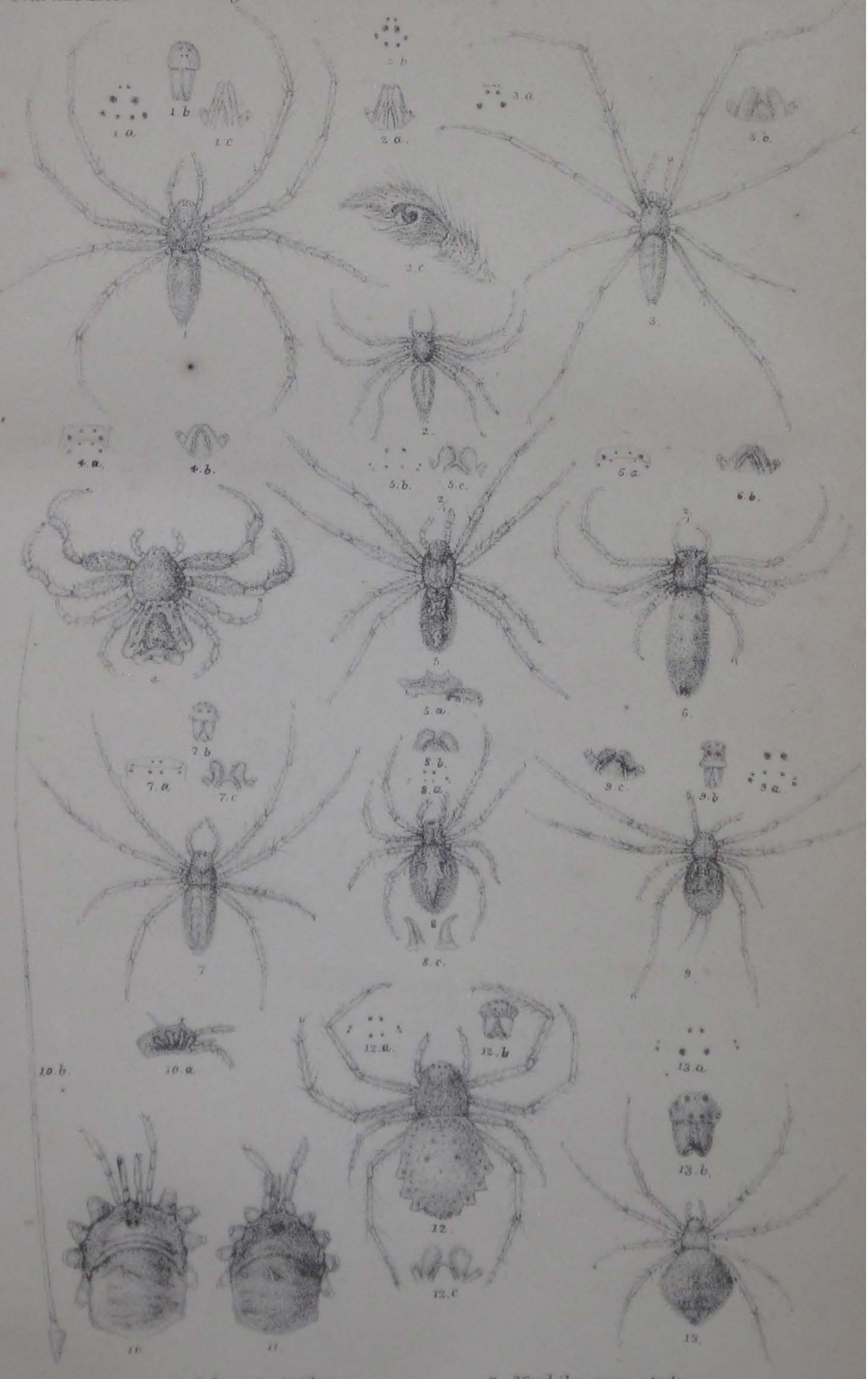
Shell ovoid, inflated, transparent, horny; inferior lip very long, narrow, sinuated superiorly; inferiorly three ribs unite in anterior half of dorsal plate, and thence descend posteriorly in one more or less prominent rib.

Habitat. Indian and Pacific Oceans.


Canaries
Cape Verde Islands
Ship Clarence 1858 homeward
Ship Marlborough 1867 homeward
Ascension
St. Helena
Trinidad
Ship "Superb" outward, 1868.
Ship "Trafalgar" 1860 - outward.
Tristan de Cunha
Calcutta
Madras
Ship Marlborough" 1867 homeward
Ship Clarence 1858 homeward
Ship Superb outward 1868
Ship Trafalgar 1860 outward
St. Pauls
Amsterdam



1. Hyalæa tridentata. 2. H. teniobranchia. 3. H. affinis



1. *Sphasus viridanus.*
2. ——— *Similaris.*
3. *Dolom. longimanus.*
4. *Thom. Pealianus.*
5. *Epeira cicatrosa.*
6. *Thom. elongatus.*
7. *Nephila angustula.*
8. *Epeira braminica.*
9. *Hers. Calcuttensis.*
10. *Gagrella signata.*
11. „ *atrata.*
12. *Ep. (Arg.) mammillaris.*
13. *Epeira hirsutula.*

Directions for collecting.

As my towing net was similar to that used by Mr. McGillivray, I give his description. It "consisted of bag of bunting (used for flags) two feet deep, the mouth of which was sewn round a wooden hoop 14 inches in diameter; three pieces of cord, a foot and a half long, were secured to the hoop at equal intervals, and had their ends tied together. When in use the net was towed astern, clear of the ship's wake, by a stout cord secured to one of the quarter boats, or held in the hand. The scope of the line required was regulated by the speed of the vessel at the time, and the amount of strain caused by the partially submerged net."*

I have tried all kinds of material for nets, and have used iron hoops also, but there is nothing like a red bunting bag of conical shape attached to a wooden hoop. The woollen texture of bunting retains so little water, that when hauled up, the sides of the bag do not stick together, as is the case with muslin or "gunny," and as there is less strain when a wooden hoop is used, there is less mutilation in the contents of the bag, and the most delicate forms may be procured in a perfect state of preservation. It may be three feet deep, with so much of the bottom, or apex of the cone, cut off as to freely admit the fingers inside. I have always preferred the lee side of the ship, as the water is generally smoothed. The following articles are very necessary, a dark lantern with supply of oil, a good thermometer, a three power pocket magnifying lens; 4 thin plain glass tumblers without any pattern on them provided with a stand;† as the breadth of bunting is narrow, I should say 10 yards; a few rolls of cleating cords; a couple of thimbles for the *grey* line or *in haul*, and two quarts of methylated spirit. As regards open-mouthed glass-stoppered bottles, I should recommend three dozen one ounce bottles in a case, filled with methylated spirit and water, half and half; one dozen four-ounce bottles; with some larger ones also. After every haul which, when the animals are plentiful, should take place every ten or fifteen minutes,‡ carefully pick out all the Pteropods—

* Voyage of H. M. S. "*Rattlesnake*," Vol. I. p. 27.

† They are sold at Osler's at one rupee a piece, of the shape of a frustum of a cone.

‡ The bag should be carefully watched and manœuvred, or else it will become filled with every description of filth from the vessel.

naked, as well as shelled ones,—and place them by themselves in a tumbler of fresh sea water, as they accumulate there again by species, taking care to keep the water free from shrimps, fish and crustacea, which soon destroy its purity. After that invert and shake the bag into a basin of water the inside of which should be painted white; as this fills, pour off the floating refuse, preserving the sediment which, on straining the next morning through a pocket handkerchief, will be found to consist of minute *Atlantæ*, some species of *Spirialis*, embryonic univalves of all kinds &c. The little animals die soon after capture. After 24 hours maceration, the retractor muscle will relax sufficiently to allow of their bodies being picked out of the shells with a needle or a pair of delicate forceps, and all that is wanted for them then is cotton wool and pill boxes of sizes.

To those ignorant of the names of these animals, the simplest method would be to put the result of the day's work into one or more of the one-ounce glass-stoppered bottles filled with methylated spirit and water, half and half; number the bottles, and let the numbers be entered on the chart opposite the proper date. The bottles should also bear on a label the following information: the hour and date of capture; the ship's position at noon; the temperature of the air and surface temperature of the sea, and the name and direction of the current.

hart, (pl
capture.

lian Ocean.

n Ocean.

A Table showing the names of the different species of Pteropods, corresponding with the numbers given on the acc
particulars connec

Number as given in the Chart.	Name of Species.	Atlantic Ocean.				Southern Ocean.				Indian Ocean.				Bay of Bengal.				Name o
		Latitude		Longitude		Latitude		Longitude		Latitude		Longitude		Latitude		Longitude		
		In degrees.																
		N.	S.	West.		South.		East.		N.	S.	East.		North.		East.		
1	Hyalæa tridentata, Lam. ...	...	...	..	...	38	39	32	37	0	27	44	88	...	...	...	...	Counter, Equatorial Indi
2	H. teniobranchia, Per. ...	28	...	21	...	...	..	...	...	...	...	...	...	...	...	...	...	N. polar, Brazil.
3	H. affinis, D'Orb. ...	...	26	...	34	...	...	...	...	1	16	71	90	...	...	...	...	Brazil, Equatorial Indian
4	H. gibbosa, Rang. ...	36	27	15	21	...	...	...	...	1	32	34	88	...	...	...	...	Brazil, Equatorial India
5	H. uncinata, Rang. ...	18	26	23	34	...	40	...	42	0	...	81	89	11	61	90	93	Equatorial, Brazil, Coun
6	H. flava, D'Orb. ...	...	...	...	...	...	...	...	...	...	16	...	71	...	...	...	...	Equatorial Indian Ocean
7	H. globulosa, Rang. ...	...	...	...	...	...	...	..	...	0	2	...	81	...	...	...	...	Brazil.
8	H. quadridentata, Les. ...	28	...	22	...	...	...	...	...	3	21	81	33	7	16	87	93	N. Polar Current of N. C
9	H. longirostra, Les. ...	15	...	...	25	...	...	...	...	..	..	...	...	...	...	...	...	
10	H. limbata, D'Orb. ...	15	...	27	...	...	...	...	...	1	27	40	85	...	11	...	93	Equatorial, Equatorial I
11	H. labiata, D'Orb. ..	15	...	26	...	...	..	...	...	3	30	39	89	...	...	...	...	Equatorial Indian Ocea
12	H. inflexa, Les. ..	4	16	26	30	38	...	28	...	...	27	56	..	...	...	...	...	Equatorial, Brazil, Coun
13	H. trispinosa, Les. ..	30	...	22	...	38	42	21	70	1	32	34	88	...	11	...	88	N. polar, Counter Equat
14	H. mucronata, Q. and G. ...	31	...	25	...	38	...	21	...	...	...	...	...	...	...	...	...	N. polar, Counter.
15	Cleodora pyramidata, Per. and Les....	36	26	15	34	38	42	21	70	1	30	47	89	...	11	..	88	N. polar, Brazil, Counte
16	Cl. cuspidata, Q. and G. ...	...	...	...	...	...	...	...	...	0	2	81	88	7	...	87	...	
17	Cl. balantium, Rang. ...	13	...	...	25	...	...	...	...	...	...	...	...	...	...	...	...	
18	Balantium recurvum, Benson. ...	...	...	...	...	...	40	32	...	...	...	...	...	...	...	..	...	Counter.
19	B. australe, D'Orb. ...	...	...	...	...	38	42	28	60	...	...	...	...	...	...	...	...	Counter.
20	Creseis spinifera, Rang. ...	34	26	15	34	38	...	21	37	1	32	34	88	...	...	...	...	N. polar, Brazil, Count
21	Cr. virgula, Rang. ...	30	...	25	...	...	..	...	...	1	32	34	88	...	...	...	...	
22	Cr. corniformis, D'Orb ...	30	...	25	...	...	..	...	...	1	32	34	85	...	...	...	...	North polar currents.
23	Cr. striata, Rang. ...	4	...	23	...	...	...	...	...	...	9	...	83	..	16	...	90	
24	Cr. recta, Les. ...	36	16	15	30	...	...	...	...	...	5	81	85	7	18	87	90	
25	Cuvieria columnella, Rang. ...	15	27	25	47	...	26	...	47	...	...	...	...	...	...	...	...	Brazil. Equatorial In
26	C. rosea, Q and G. ...	...	16	...	30	...	...	...	..	...	...	...	...	...	...	...	...	Brazil.
27	C. oryza, Benson. ..	...	...	...	...	...	...	...	..	1	2	81	88	7	...	87	...	
28	Spirialis rostralis, Eyd. and Soul. ...	13	...	25	...	40	42	32	60	...	16	71	81	7	11	87	88	Counter. Equatorial In
29	Sp. ventricosa, Eyd. and Soul. ...	13	...	25	...	40	42	49	60	...	16	71	89	7	11	87	88	Counter. Equatorial In
30	Sp. trochiformis, Eyd. and Soul. ...	...	...	...	...	...	...	...	...	...	5	81	85	...	...	...	...	
31	Sp. bulimoides Eyd. and Soul. ..	13	...	25	...	...	40′	32	...	3	30	...	86	7	11	87	88	Counter. Equatorial I

CLASSIFIED INDEX.

[Species, relating which any additional information has been published, are printed in *Italics*, and new genera and species are marked with an asterisk].

PLANTÆ.

ANIMALIA.

CŒLENTERATA.

MOLLUSCA.

Ciliipoda or Bryozoa.

Pelecypoda.

(or Lamellibranchia),

Gastropoda.

Prosobranchia.

Opisthobranchia.

Neurobranchia.

Pulmonata.

Pteropoda.

ARTHROPODA.

Arachnoidea.

VERTEBRATA.

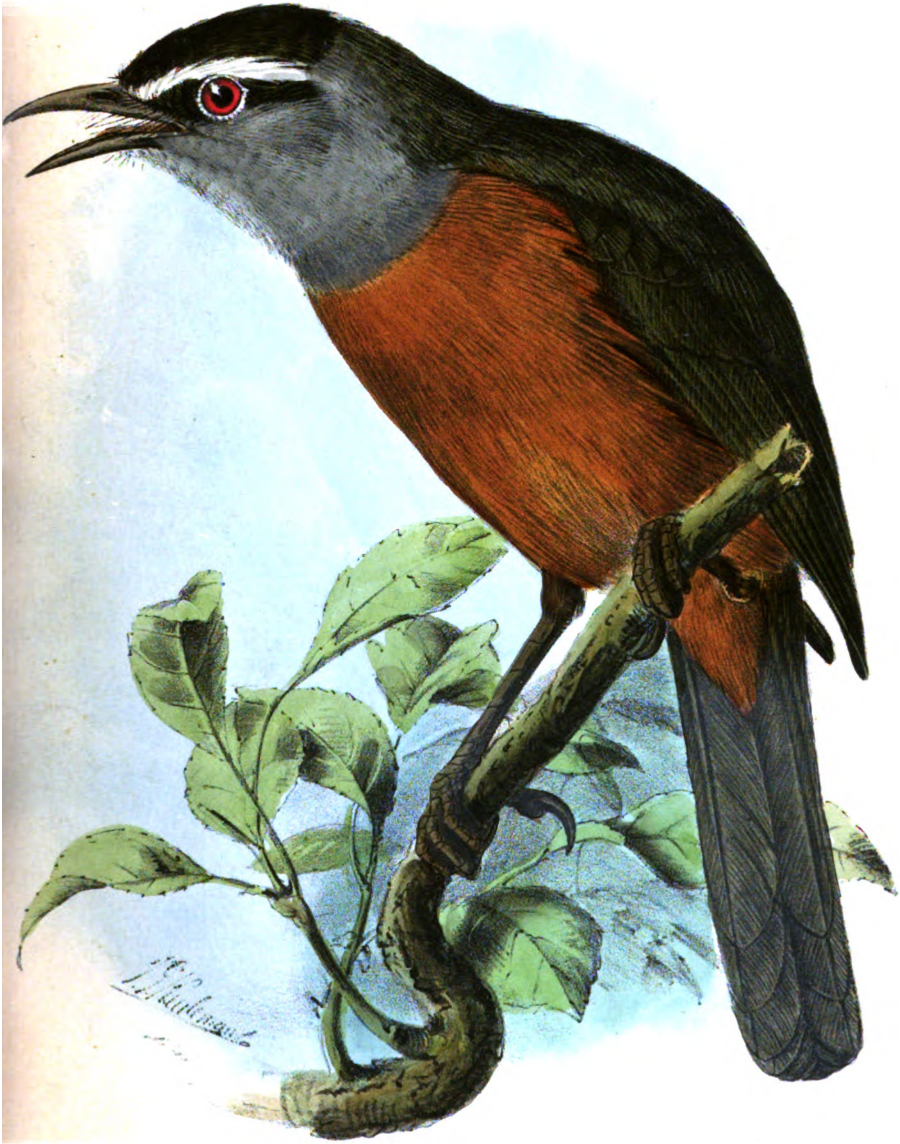
Reptilia.

Sauria.

Aves.

ERRATA IN PART II, OF VOL. XXXVIII.

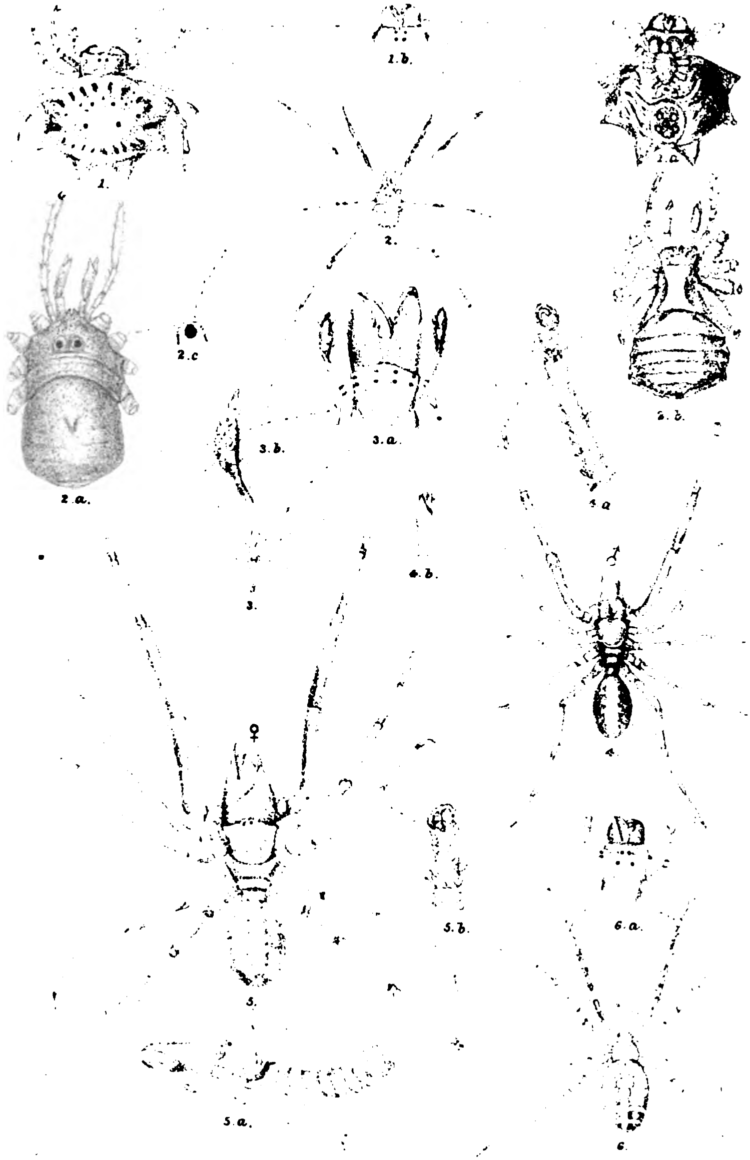
Page,	*line,*	*for,*	*read,*
2	10	Bog	Boga.
4	13	portions	position.
5	18	being sided	sides.
8	22	Lúmdellor	Lúmdokorh.
9	25-26	they so vary	so even.
24	21	;	omit.
16	20	Purjonkla, clearing the strata &c.	Poronkla Clearing; the strata &c.
„	21	and belonging	belong.
20	27	is another stream	is reached, and another &c.
26	20	to	from
„	27	Asbik river	Ashek-river.
32	32	*instructis*	*instructo.*
79	3	pedalia	pedales.
121	16	vitrifolius	vitifolius.
147	11	S.	P.
149	5	*fragraus*	*fragrans.*
167	15	but	for.
„	„ (at end of line) for		but
168	28	Conystes	Coccystes.
„	31	Tacconia	Taccocua.
179	12	Cyp. Abyssinicus	Cyp. affinis.
173	30	but	best.
176	1	*pennis*	*plumis.*
„	34	the parts	the lower parts.
177	18	*Malacolmi*	*Malcolmi.*
„	22	paler	pale.
„	27	sonalis	socialis.
178	36	*Janthia*	*Ianthia.*
179	12	cyanotus	cyanota.
180	12	*atragularis*	*atrogularis.*
192	8	T.	V.
199	5	præ-nasal	pre-anal.
„	6	post-nasal	post-anal.
204	22	*Peel*	Peal.
229	20	Peelianus	Pealianus.
231	11	A. C. Peel	S. E. Peal.
251	10	*Peelianus*	Pealianus.
263	6	collummella	*columnella.*
267	27	grey	guy.
289 in the last column		*H. Chaptula*	*Cl. Chaptalii.*



Drawn and lith. by J. Keulemans

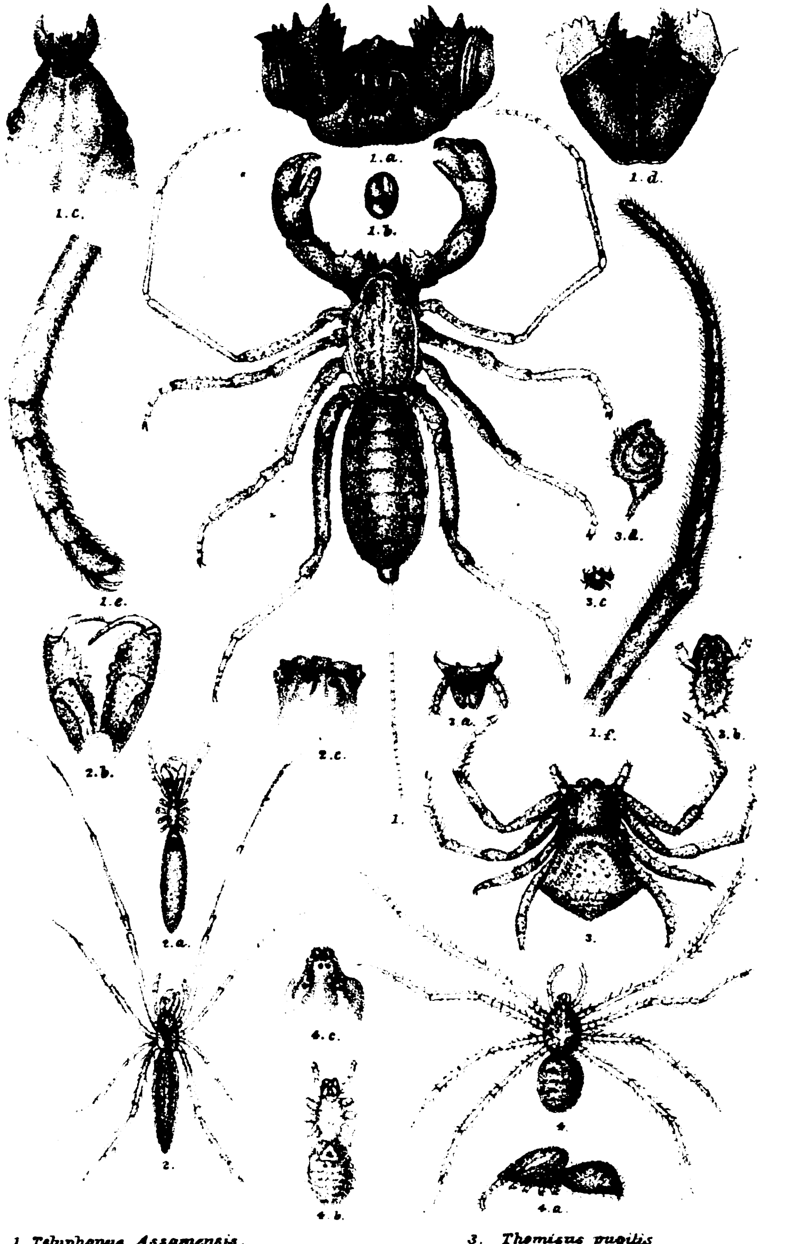
TROCHALOPTERON FAIRBANKI.

Printed and Coloured by P.W.M. Trap, Leyden

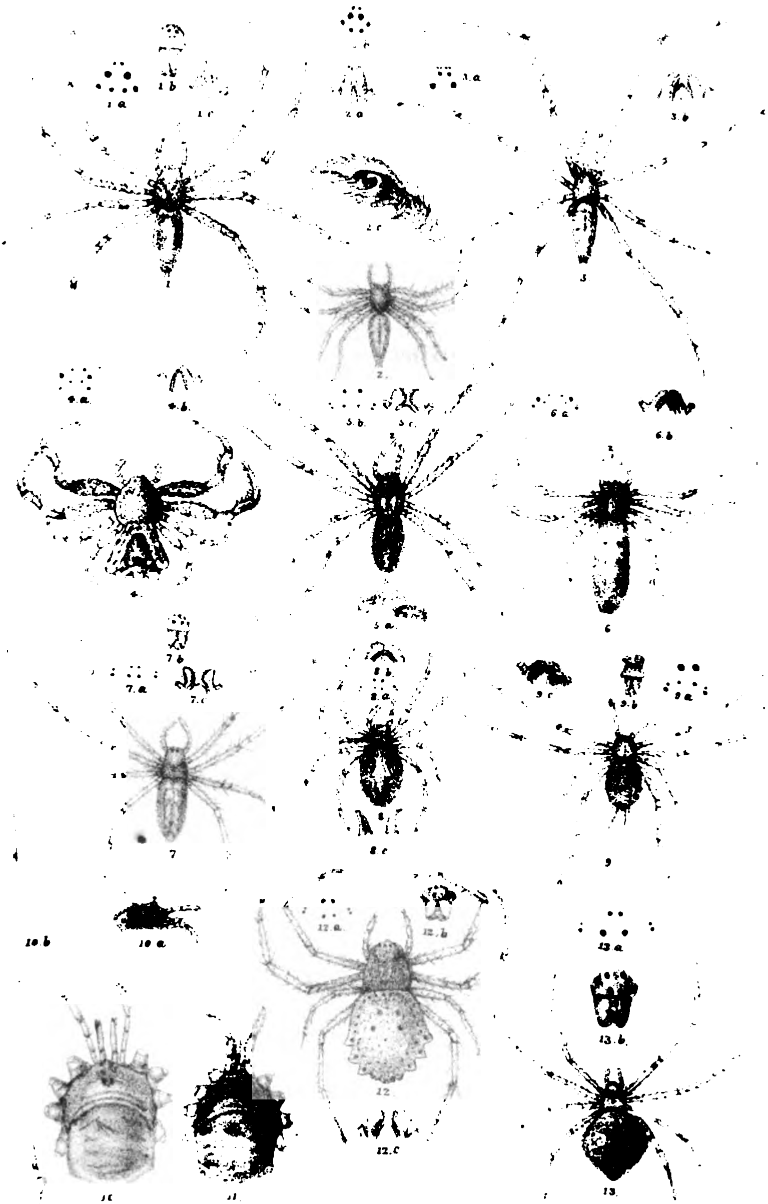


Calcutta.

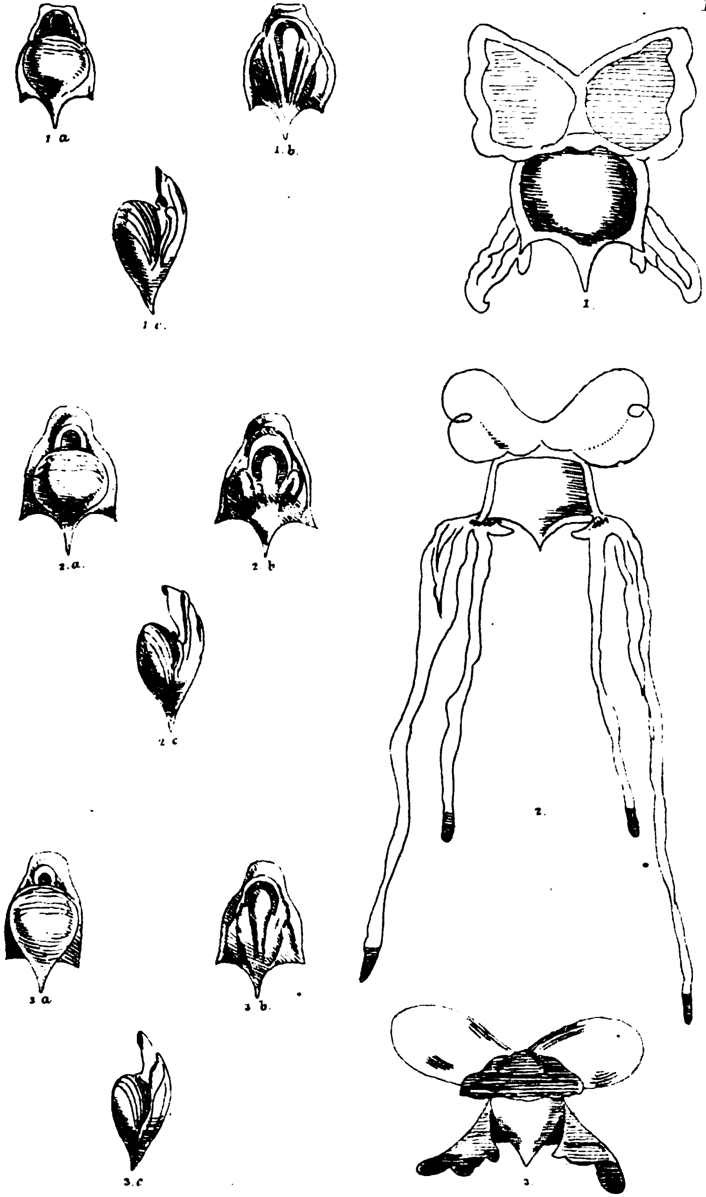
1. Gastracantha Canningensis.
2. Gagrella atrata
3. Tetragnatha viridescens.
4. Galeodes orientalis ♂
5. " " ♀
6. Epeira (Argyopes) stellata



1. Telyphonus Assamensis.
2. Meta gracilis.
3. Thomisus pugilis
4. Scytodes propinquus.

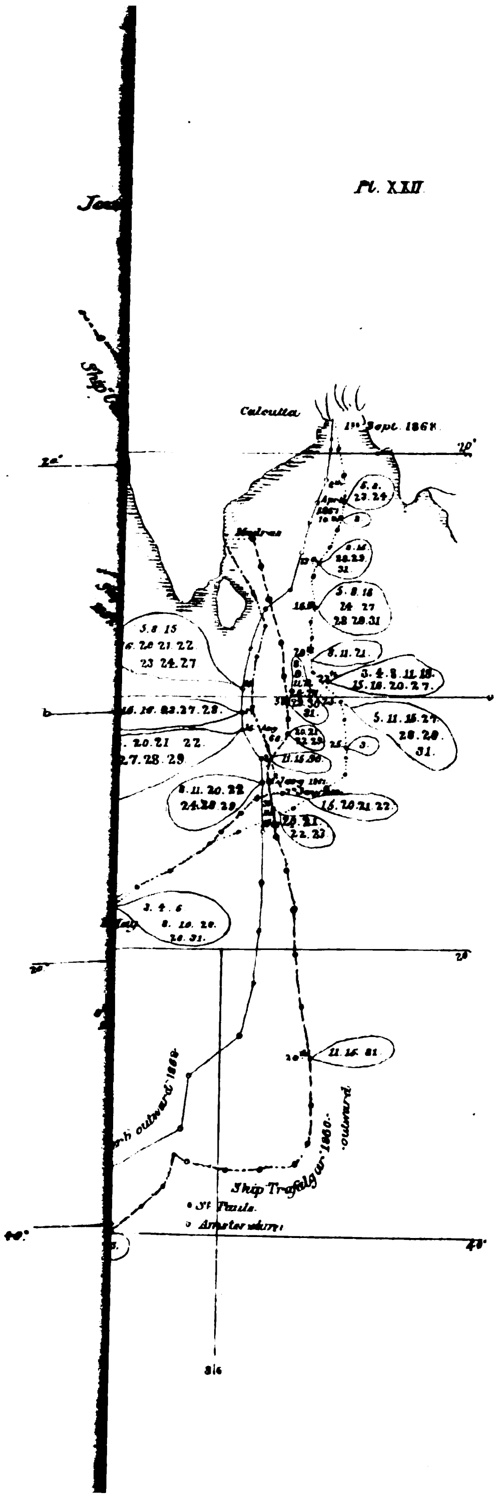


1 Sphasus viridanus.
2 ——— Similaris
3 Dolom. longimanus
4 Thom. Peelianus
5 Epeira cicatrosa.
6 Thom. elongatus.
7. Nephila angustata.
8 Epeira braminica.
9. Hers. Calcuttensis
10. Gagrella signata.
11. „ atrata.
12. Ep. (Arg.) mammillaris.
13 Epeira hirsutula.



1. Hyalæa tridentata. 2. H. tenuibranchia. 3. H. affinis

Pl. XXII


Calcutta
Madras
Ship Trafalgar 1860
outward
St Pauls
Amsterdam
316

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.828	29.894	29.753	0.141	85 2	90.0	81.0	9.0
2	.764	.828	.700	.128	85.8	91.4	81.6	9.8
3	.695	.747	.618	.129	85.3	91.8	81.0	10.8
4	.656	.703	.571	.132	83.7	91.4	78.4	13.0
5	.660	.703	.611	.092	82.9	87.4	79.5	7.9
6	.679	.727	.619	.108	84.4	88.4	81.8	6.6
7	.724	.792	.638	.154	84.4	91.0	79.0	12.0
8	.743	.807	.671	.136	82.5	89.2	78.0	11.2
9	.739	.796	.673	.123	85.1	91.0	80.5	10.5
10	.695	.749	.609	.140	85.1	91.0	81.7	9.3
11	.608	.679	.521	.158	82.7	88.0	80.0	8.0
12	.539	.585	.485	.100	80.7	83.0	79.0	4.0
13	.525	.608	.474	.134	81.0	84.7	79.5	5.2
14	.579	.648	.516	.132	83.6	89.2	79.4	9.8
15	.591	.633	.529	.104	85.6	91.3	81.0	10.3
16	.590	.635	.541	.094	84.3	90.5	81.8	8.7
17	.540	.601	.447	.154	83.3	87.5	80.0	7.5
18	.574	.665	.479	.186	81.4	85.0	78.8	6.2
19	.651	.718	.583	.135	82.9	87.9	80.0	7.9
20	.645	.713	.579	.134	83.7	88.6	78.0	10.6
21	.652	.701	.601	.100	83.1	86.9	80.7	6.2
22	.690	.747	.649	.098	83.6	87.5	79.5	8.0
23	.685	.736	.621	.115	82.5	86.8	80.2	6.6
24	.671	.718	.622	.096	82.5	85.8	80.0	5.8
25	.719	.779	.661	.118	81.2	87.6	78.9	9.0
26	.775	.837	.728	.109	79.1	84.0	77.5	6.5
27	.803	.862	.744	.118	81.5	86.0	77.5	8.5
28	.822	.881	.761	.120	81.6	85.2	77.6	7.6
29	.823	.891	.753	.138	81.2	85.4	77.4	8.0
30	.792	.854	.724	.130	83.0	87.7	78.9	8.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.7	4.5	77.5	7.7	0.925	9.88	2.73	0.78
2	81.3	4.5	78.1	7.7	.943	10.06	.77	.78
3	81.3	4.0	78.5	6.8	.955	.21	.43	.81
4	80.6	3.1	78.4	5.3	.952	.21	1.86	.85
5	80.6	2.3	79.0	3.9	.970	.42	.37	.88
6	81.8	2.6	80.0	4.4	1.001	.72	.59	.87
7	79.7	4.7	76.4	8.0	0.893	9.55	2.76	.78
8	79.8	2.7	77.9	4.6	.937	10.06	1.58	.86
9	81.1	4.0	78.3	6.8	.949	.14	2.43	.81
10	81.3	3.8	78.6	6.5	.958	.23	.34	.81
11	80.1	2.6	78.3	4.4	.949	.20	1.52	.87
12	79.4	1.3	78.5	2.2	.955	.31	0.73	.93
13	79.7	1.3	78.8	2.2	.964	.40	.74	.93
14	80.9	2.7	79.0	4.6	.970	.40	1.63	.87
15	82.2	3.4	79.8	5.8	.995	.62	2.14	.83
16	81.9	2.4	80.2	4.1	1.008	.79	1.49	.88
17	80.9	2.4	79.2	4.1	0.976	.48	.45	.88
18	79.5	1.9	78.2	3.2	.946	.19	.08	.90
19	80.8	2.1	79.3	3.6	.979	.51	.28	.89
20	80.6	3.1	78.4	5.3	.952	.21	.86	.85
21	80.6	2.5	78.8	4.3	.964	.36	.50	.87
22	81.1	2.5	79.3	4.3	.979	.51	.52	.87
23	80.1	2.4	78.4	4.1	.952	.23	.41	.88
24	80.6	1.9	79.3	3.2	.979	.53	.11	.91
25	79.6	1.6	78.5	2.7	.955	.29	0.92	.92
26	78.0	1.1	77.2	1.9	.916	9.91	.62	.94
27	79.4	2.1	77.9	3.6	.937	10.08	1.23	.89
28	79.3	2.3	77.7	3.9	.931	.02	.32	.88
29	78.9	2.3	77.3	3.9	.919	9.90	.31	.88
30	79.8	3.2	77.6	5.4	.928	.97	.85	.84

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Septemver 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.695	29.856	29.514	0.342	81.5	84.4	78.7	5.7
1	.683	.848	.499	.349	81.3	84.2	78.5	5.7
2	.675	.840	.482	.358	81.1	83.7	78.5	5.2
3	.665	.828	.474	.354	80.8	83.5	77.6	5.9
4	.661	.817	.476	.341	80.6	83.0	78.0	5.0
5	.652	.829	.484	.345	80.5	83.0	78.0	5.0
6	.685	.848	.498	.350	80.3	83.0	77.6	5.4
7	.704	.873	.518	.355	80.9	83.8	77.5	6.3
8	.721	.890	.544	.346	82.1	85.5	77.4	8.1
9	.732	.894	.562	.332	83.7	87.5	78.0	9.5
10	.732	.893	.549	.344	84.9	89.0	78.8	10.2
11	.722	.884	.541	.343	85.5	89.8	79.5	10.3
Noon.	.703	.868	.550	.318	86.5	90.6	79.2	11.4
1	.677	.841	.518	.323	86.9	91.5	77.5	14.0
2	.649	.809	.495	.314	86.6	91.8	77.8	14.0
3	.630	.779	.466	.313	86.6	91.4	78.7	12.7
4	.622	.761	.456	.305	86.2	91.0	79.2	11.8
5	.633	.774	.447	.327	84.6	91.3	78.5	12.8
6	.645	.792	.467	.325	83.2	89.0	78.5	10.5
7	.666	.803	.488	.315	82.6	86.6	78.5	8.1
8	.685	.828	.498	.330	82.4	86.5	77.5	9.0
9	.702	.850	.537	.313	82.0	86.0	78.2	7.8
10	.708	.865	.528	.337	81.8	85.0	78.5	6.5
11	.700	.853	.510	.343	81.6	84.9	78.5	6.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	80.0	1.5	78.9	2.6	0.967	10.41	0.90	0.92
1	79.9	1.4	78.9	2.4	.967	.43	.81	.93
2	79.8	1.3	78.9	2.2	.967	.43	.74	.93
3	79.5	1.3	78.6	2.2	.958	.34	.73	.93
4	79.3	1.3	78.4	2.2	.952	.27	.74	.93
5	79.2	1.3	78.3	2.2	.949	.24	.74	.93
6	79.0	1.3	78.1	2.2	.943	.18	.73	.93
7	79.2	1.7	78.0	2.9	.940	.13	.97	.91
8	79.9	2.2	78.4	3.7	.952	.23	1.28	.89
9	80.7	3.0	78.6	5.1	.958	.28	.79	.85
10	81.2	3.7	78.6	6.3	.958	.26	2.23	.82
11	81.4	4.1	78.5	7.0	.955	.21	.51	.80
Noon.	81.8	4.7	79.0	7.5	.970	.33	.77	.79
1	81.9	5.0	78.9	8.0	.967	.30	.95	.78
2	81.5	5.1	78.4	8.2	.952	.15	.99	.77
3	81.6	5.0	78.6	8.0	.958	.21	.93	.78
4	81.5	4.7	78.2	8.0	.946	.09	.90	.78
5	81.1	3.5	78.6	6.0	.958	.26	.13	.83
6	80.3	2.9	78.3	4.9	.949	.18	1.71	.86
7	80.2	2.4	78.5	4.1	.955	.27	.41	.88
8	80.2	2.2	78.7	3.7	.961	.33	.28	.89
9	80.0	2.0	78.6	3.4	.958	.32	.15	.90
10	80.1	1.7	78.9	2.9	.967	.41	0.99	.91
11	79.9	1.7	78.7	2.9	.961	.35	.99	.91

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	129.6	...	SSW, Sby W & SW	3.0	85.1	⌒i & \i to 6 P. M. \‿i afterwards. Brisk wind at $2\frac{1}{4}$ P. M.
2	133.0	...	S. W. & S. S. W.	0.7	352.7	\‿i to 8 A. M. ⌒i to 5 P. M. \i afterwards. Lightning to W at 7 P. M. Thunder at 8 P. M.
3	134.2	0.12	S. S. W. & S. W.	1.6	208.5	_i to 4 A. M. \‿i to 8 A. M. \i to 3 P. M. \⁀‿i to 8 P. M. Stratoni afterwards. Brisk wind & rain at $4\frac{1}{4}$ P. M. Thunder at 6 & 7 P. M. Lightning to S W at 7 & 8 P. M.
4	131.4	3.10	S. W.	...	205.9	\i to 2 A. M. ⌒i to 4 P. M. Overcast afterwards. High wind from $4\frac{1}{4}$ to $6\frac{3}{4}$ P. M. Thunder at 5 & 6 P. M. Lightning from 6 to 10 P. M. Rain from $4\frac{1}{2}$ to 11 P. M.
5	...	...	S. by W. & S.	...	221.2	Chiefly \‿i. Lightning at midnight & 1 A. M. & at 7 & 8 P. M. Drizzled at $5\frac{1}{2}$ A. M.
6	130.0	0.05	S. E. & S. S. E.	...	144.2	Stratoni to 5 A. M. ⌒i to 3 P. M. Stratoni afterwards. Thunder at 4 & 5 P. M. Lightning to W at 8 & 9 P. M. Light rain at 11 A. M. & at 4 & 5 P. M.
7	135.0	0.30	S. E.	...	92.1	⌒i to 4 P. M. \⁀‿i. afterwards. Thunder at 3 & 4 A. M. & at 6 & 9 P. M. Lightning at 3 & 4 A. M. & from 6 to 11 P. M. Rain at 3 & 4 A. M.
8	136.0	0.44	N. N. E. & variable.	...	139.6	⌒i & \⁀‿i. Lightning & rain at midnight. Thunder at 1 A. M.
9	135.0	...	S. E, E. S. E. & S.	...	97.7	\‿i to 4 A. M. \i to 8 A. M. ⌒i to 6 P. M., clear afterwards.
10	137.5	...	S. & variable.	1.5	81.8	Clear to 5 A. M. ⌒i to 4 P. M., clear afterwards. Brisk wind at $2\frac{1}{2}$ P. M. Thunder at 2 P. M. Lightning from 7 to 11 P. M.
11	131.8	0.74	S. & E.	3.5	89.5	\‿i to 4 A. M. \⁀‿i to 8 A. M. Stratoni & ⌒i to 4 P. M. Overcast afterwards. Brisk wind at $4\frac{1}{2}$ P. M. Rain from 7 to 9 A. M. & from $4\frac{1}{2}$ to 9 P. M.
12	...	1.21	E.	1.9	239.0	Chiefly overcast. Brisk wind from $8\frac{1}{2}$ to $9\frac{1}{2}$ & at $12\frac{1}{4}$ A. M. Thunder & Lightning at $9\frac{1}{2}$ P. M. Rain after intervals.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
13	...	1.09	E. S. E. & E.	1.8	322.5	Overcast to 1 P. M. Stratoni afterwards. Brisk wind from 3 to $11\frac{1}{2}$ A. M. Thunder from 2 to 5 A. M. Lightning at 3 A. M. Rain from midnight to 7 A. M. & from 9 to noon & at $1\frac{1}{2}$, $3\frac{1}{2}$ & 6 P. M.
14	134.5	0.27	S. E. & S. by E.	0.7	229.3	⌒i to 6 A. M. Scuds from SE to 10 A. M. ⌒i to 7 P. M., clear afterwards. Rain at $4\frac{1}{2}$ & $10\frac{1}{2}$ A. M. & at $5\frac{1}{2}$ P. M.
15	134.5	...	S.S.E., S.E & S.W.	...	148.9	Clear to 3 A. M. ⌒i to 7 P. M. clear afterwards.
16	132.0	0.10	S. W. & E.	...	52.7	\i to 5 A. M. ⌒i to 1 P. M. Stratoni afterwards. Thunder & light rain at $1\frac{1}{2}$ P. M. Lightning at 3 A. M.
17	127.0	0.13	E. & E. N. E.	3.1	82.6	Stratoni to 5 A. M. ⌒i to 4 P. M. Overcast afterwards. Brisk wind from noon to 2 P. M. & from $6\frac{1}{2}$ to 11 P. M. Lightning at 9 P. M. Light rain at 8 & $10\frac{1}{2}$ A. M. & from $5\frac{1}{2}$ to 11 P. M.
18	...	0.94	S. S. E. & S. E.	2.1	324.7	Overcast to 5 A. M. \⌒i to 10 A. M. ⌒i & \i to 6 P. M., clear afterwards. Brisk wind at $2\frac{1}{2}$ $6\frac{1}{2}$ & 10 A. M. Lightning from 3 to 5 A. M. & at 9 & 10 P. M. Rain at midnight, 2, 3, 7, 9 & 10 A. M. & at $5\frac{1}{2}$ P. M.
19	132.0	0.26	S. S. E, S. E. & S.	...	145.3	Clear to 4 A. M., clouds of different kinds afterwards. Rain at 5 & 8 A. M. & at 2 & $4\frac{1}{2}$ P. M.
20	130.8	0.99	S. & S. by W,	...	80.1	Clear to 2 A. M. ⌒i to 5 P. M. \i afterwards. Rain from $6\frac{1}{2}$ to $7\frac{1}{2}$ A. M.
21	122.0	0.19	S. & S. by E.	0.6	168.4	Clear to 4 A. M. ⌒i to 1 P. M. Overcast to 6 P. M., clear afterwards. Thunder at 2 P. M. Rain at $9\frac{1}{2}$ & $12\frac{1}{2}$ A. M. & at $3\frac{1}{2}$ & $5\frac{1}{2}$. P. M.
22	...	0.24	S. by E, S. & S. S. E.	0.2	156.0	Stratoni to 5 A. M., clouds of different kinds afterwards. Thunder at 4 & $5\frac{1}{2}$ A. M. Lightning at 3 & 4 A. M. Rain at $4\frac{1}{2}$, $5\frac{1}{2}$ & $10\frac{1}{2}$ A. M. & at $5\frac{1}{2}$ P. M.

Abstract of the Result of the Hourly Meterological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

Solar Radiation, Weather, &c.,

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
				lb	Mlies	
23	129.0	0.90	S, & S. by W.	0.3	138.9	Clear to 5 A. M. ⌒i to 6 P. M. \i afterwards. Rain at 10 & $12\frac{1}{2}$ A. M. & from 3 to 5 P. M.
24	131.5	0.05	S. by E. & S.S. E.	0.2	132.1	Clouds of different kinds to noon, ⌒i to 7 P. M. \i afterwards. Thunder at 5 A. M. Lightning at 7 & 8 P. M. Light rain at $4\frac{1}{2}$ and Noon.
25	131.0	1.93	S. by E, & S. E.	0.4	102.3	Stratoni to 8 A. M. \i to Noon. Overcast afterwards, Thunder at $12\frac{1}{2}$ A. M. Rain at $2\frac{1}{2}$ A. M. and from $12\frac{1}{2}$ to 9 P. M.
26	...	1.15	E, & E. S. E.	0.5	167.8	Overcast to 6 P. M. Stratoni afterwards. Lightning to N. at 4 A. M. Drizzled at midnight. Rain from $10\frac{1}{2}$ A. M. to 2 P. M. & at 5, 8, 9 & 10 P. M.
27	122.0	...	S.S.W. & S. by E.	0.4	105.9	Stratoni to 2 A. M., overcast to 8 A. M. ⌒i afterwards. Drizzled at $2\frac{1}{2}$, $4\frac{1}{2}$ & $6\frac{1}{2}$ A. M.
28	...	0.83	S. by E. & S.	1.2	159.1	Overcast to 11 A. M. Stratoni to 3 P. M. \i & ⌒i afterwards. Lightning to S, at 3 A. M. Thunder at $5\frac{1}{2}$ A. M. Rain from $1\frac{1}{2}$ to 7 & at 11 A. M.
29	...	0.66	S. & S. by E.	1.8	164.6	\i to 2 A. M., overcast to 1 A. M. \i to 8 P. M. Stratoni afterwards. Thunder at 6 & $12\frac{1}{2}$ A. M. Lightning at 6 A. M. & at 11 P. M. Rain from 5 to 7 A. M. and at 1 P. M.
30	130.0	...	S. & S. by E.		164,8	\i to 8 A. M. ⌒i to 1 P. M. \i afterwards. Drizzled at 2 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌢i Cumulo strati, \\~i Nimbi \\ⁿi Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1868.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.682
Max. height of the Barometer occurred at 9 A. M. on the 1st. ...	29.894
Min. height of the Barometer occurred at 5 P. M. on the 17th. ...	29.447
Extreme range of the Barometer during the month	0.447
Mean of the daily Max. Pressures	29.741
Ditto ditto Min. ditto	29.616
Mean daily range of the Barometer during the month	0.125

	o
Mean Dry Bulb Thermometer for the month	83.1
Max. Temperature occurred at 2 P. M. on the 3rd.	91.8
Min. Temperature occurred at 8 A. M. on the 29th.	77.4
Extreme range of the Temperature during the month	14.4
Mean of the daily Max. Temperature	88.0
Ditto ditto Min. ditto, ...	79.6
Mean daily range of the Temperature during the month... ...	8.4

Mean Wet Bulb Thermometer for the month	80.4
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	2.7
Computed Mean Dew-point for the month	78.5
Mean Dry Bulb Thermometer above computed mean Dew-point ...	4.6
	Inches.
Mean Elastic force of Vapour for the month	0.955

	Troy grain.
Mean Weight of Vapour for the month	10.25
Additional Weight of Vapour required for complete saturation ...	1.61
Mean degree of humidity for the month, complete saturation being unity	0.86

	Inches.
Rained 25 days,—Max. fall of rain during 24 hours	3.10
Total amount of rain during the month	15.69
Total amount of rain indicated by the Gauge attached to the anemometer during the month	10.59
Prevailing direction of the Wind... ...	S. & S. E.

Note.—The clock attached to the Anemometer being out of order from 4th to 8th, the Max. Pressure and Rain could not be registered.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Sept. 1868.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.
Mid night									2	2	1		2	
1									1		1		3	1
2													3	
3													3	1
4													3	1
5													2	1
6											1			
7					1								1	
8					1								4	1
9					1		1				1		2	
10					1				2					
11					1						1		1	
Noon.							1		1				2	
1							1						2	
2			1						3				1	
3									3				2	1
4							1				1		2	1
5							1		1				2	2
6									1	1			3	1
7									2	2			3	1
8									3	2			2	1
9											2	2	3	2
10									1	1	1	1	2	
11											1		3	1

Hour.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.
Mid night	1		1	1	1		2		5		5	
1					3		2		4		7	
2	1	1			3	1	2		5	1	7	
3	1	1	1		1		4	1	4	2	6	
4			1		4		3		3		5	
5	2		2	1	2	1	4	1	4	1	5	1
6	3	1	3		4		2		2		4	2
7	3	2	3		5	1	1		3	1	4	2
8	2	1	2	1	5	1	1		2		6	
9	2	1	1		5	1	2		1		5	1
10	1	1	3	1	8	1	3	1	4	1	1	
11			5	3	4	1	2		1		6	1
Noon.	2		2		3		4	3	3		3	
1	2				7	2	4	1	1	1	4	1
2			2	1	4	1	3		1		5	2
3			2		3		1		4		7	2
4	2		2	1	1		3	1	2		3	2
5	1	1	2	1	4	1	2	1	1		7	1
6			2	2	2	1	3	2	1		10	2
7					2	1	3		4		7	
8					2	1	3		3		8	
9			1		2	1	4		3		6	
10			2	1	2		1		6		6	
11			2	1	2		1		6		6	

Hour.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	4		1		2																	
1	3		1		2																	
2	2				3																	
3	2		2	1	3																	
4	3		2		3																	
5	2		2	1	4																	
6	3	1	3	1	4																	
7	3		3		2										1	1						
8	2		2		3																	
9	3		3		3																	
10	1		5		1																	
11	3	1	3	1	2	1	1															
Noon.	3		1		5																	
1	1		4	1	4																	
2	2		3	1	5	1																
3	1		2		4																1	
4	5	1	4		2		1				1	1										
5	3	1	6	1																		
6	2		5	1	1																	
7	1		4		1						1	1										
8	2		3		1																	
9	1		4		1																	
10	2	1	3		2																	
11	3	1	2		2																	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.787	29.854	29.719	0.135	83.2	87.5	80.0	7.5
2	.775	.838	.712	.126	84.2	88.5	80.5	8.0
3	.773	.821	.714	.107	84.2	90.2	82.0	8.2
4	.760	.825	.707	.118	83.9	87.7	81.0	6.7
5	.755	.801	.705	.096	83.4	88.3	81.2	7.1
6	.737	.791	.680	.111	84.9	90.0	81.5	8.5
7	.745	.811	.692	.119	84.8	90.6	80.0	10.6
8	.750	.810	.701	.109	84.4	90.0	80.4	9.6
9	.767	.823	.721	.102	84.0	89.4	78.5	10.9
10	.820	.880	.784	.096	83.0	88.4	77.8	10.6
11	.838	.902	.792	.110	82.9	87.5	79.5	8.0
12	.863	.923	.812	.111	83.6	87.7	79.6	8.1
13	.870	.943	.824	.119	85.4	91.0	80.6	10.4
14	.872	.950	.826	.124	85.1	92.1	80.0	12.1
15	.869	.929	.821	.108	83.2	87.5	78.5	9.0
16	.907	.962	.867	.095	82.5	88.7	78.0	10.7
17	.941	30.004	.890	.114	83.1	89.0	79.0	10.0
18	.946	.015	.888	.127	82.5	87.6	77.0	10.6
19	.956	.030	.904	.126	81.7	87.5	75.5	12.0
20	.942	.012	.899	.113	81.7	87.3	76.4	10.9
21	.910	29.982	.855	.127	82.0	88.5	76.6	11.9
22	.872	.935	.810	.125	81.0	88.0	75.0	13.0
23	.876	.953	.826	.127	79.8	87.3	72.2	15.1
24	.886	.963	.840	.123	80.4	87.0	73.7	13.3
25	.876	.940	.823	.117	80.8	87.6	74.8	12.8
26	.903	.965	.860	.105	80.9	87.2	76.0	11.2
27	.945	30.025	.901	.124	79.9	87.5	73.5	14.0
28	.961	.035	.909	.126	79.5	86.5	73.0	13.5
29	.942	.017	.880	.137	78.0	85.5	70.8	14.7
30	.935	.017	.874	.143	77.5	85.4	71.5	13.9
31	.962	.042	.905	.137	77.6	84.6	71.0	13.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.5	2.7	78.6	4.6	0.958	10.28	1.61	0.87
2	80.8	3.4	78.4	5.8	.952	.19	2.05	.83
3	81.1	3.1	78.9	5.3	.967	.37	1.87	.85
4	81.4	2.5	79.6	4.3	.989	.60	.53	.87
5	81.2	2.2	79.7	3.7	.992	.63	.33	.89
6	80.3	4.6	77.1	7.8	.913	9.76	2.73	.78
7	78.8	6.0	74.6	10.2	.843	.02	3.44	.72
8	78.2	6.2	73.9	10.5	.824	8.81	.50	.72
9	77.3	6.7	72.6	11.4	.790	.47	·70	.70
10	78.1	4.9	74.7	8.3	.846	9.08	2.74	.77
11	79.8	3.1	77.6	5.3	.928	.97	1.82	.85
12	80.2	3.4	77.8	5.8	.934	10.01	2.02	.83
13	80.5	4.9	77.1	8.3	.913	9.76	.92	.77
14	79.2	5.9	75.1	10.0	.857	.15	3.42	.73
15	79.0	4.2	76.1	7.1	.885	.50	2.39	.80
16	76.5	6.0	72.3	10.2	.783	8.41	3.23	.72
17	76.1	7.0	71.2	11.9	.756	.10	.76	.68
18	75.0	7.5	69.7	12.8	.720	7.72	.92	.66
19	74.8	6.9	70.0	11.7	.727	.81	.56	.69
20	75.6	6.1	71.3	10.4	.758	8.16	.21	.72
21	75.3	6.7	70.6	11.4	.741	7.97	.50	.70
22	73.1	7.9	67.6	13.4	.672	.25	.89	.65
23	73.0	6.8	68.2	11.6	.686	.40	.35	.69
24	74.2	6.2	69.9	10.5	.725	.80	.14	.71
25	75.2	5.6	71.3	9.5	.758	8.16	2.91	.74
26	74.8	6.1	70.5	10.4	.739	7.97	3.13	.72
27	72.8	7.1	67.8	12.1	.677	.30	.48	.68
28	71.6	7.9	66.1	13.4	.640	6.92	.74	.65
29	70.0	8.0	64.4	13.6	.605	.55	.64	.64
30	70.1	7.4	64.9	12.6	.615	.67	.37	.66
31	71.1	6.5	66.5	11.1	.648	7.03	.04	.70

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.861	29.963	29.745	0.218	79.6	83.2	74.0	9.2
1	.852	.945	.733	.212	79.1	83.0	73.6	9.4
2	.843	.946	.727	.219	78.7	82.8	73.0	9.8
3	.837	.932	.719	.213	78.3	82.5	72.0	10.5
4	.842	.947	.715	.232	77.9	82.5	71.9	10.6
5	.854	.963	.727	.236	77.6	82.2	71.0	11.2
6	.872	.983	.746	.237	77.4	82.0	70.8	11.2
7	.890	30.000	.758	.242	78.5	83.0	71.5	11.5
8	.913	.022	.772	.250	81.0	85.2	75.0	10.2
9	.926	.042	.789	.253	83.0	86.7	77.7	9.0
10	.926	.039	.791	.248	84.8	87.5	80.0	7.5
11	.907	.017	.778	.239	85.8	89.0	81.4	7.6
Noon.	.886	29.984	.761	.223	86.5	90.0	82.7	7.3
1	.856	.957	.730	.227	87.0	90.2	83.4	6.8
2	.831	.932	.703	.229	87.4	90.5	84.5	6.0
3	.816	.919	.686	.233	87.6	90.6	84.5	6.1
4	.814	.910	.686	.224	87.1	91.0	83.0	8.0
5	.818	.912	.680	.232	86.5	92.1	81.5	10.6
6	.828	.924	.689	.235	84.2	87.4	80.0	7.4
7	.842	.947	.701	.246	82.9	86.2	78.5	7.7
8	.862	.962	.725	.237	81.9	85.0	77.2	7.8
9	.874	.982	.747	.235	81.0	84.6	76.3	8.3
10	.880	.992	.756	.236	80.3	84.0	75.5	8.5
11	.875	.980	.755	.225	79.8	83.5	74.9	8.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	76.7	2.9	74.7	4.9	0.846	9.14	1.55	0.86
1	76.5	2.6	74.7	4.4	.846	.16	.37	.87
2	76.2	2.5	74.4	4.3	.838	.08	.33	.87
3	75.9	2.4	74.2	4.1	.832	.02	.26	.88
4	75.7	2.2	74.2	3.7	.832	.02	.14	.89
5	75.7	1.9	74.4	3.2	.838	.10	0.97	.90
6	75.7	1.7	74.5	2.9	.840	.12	.89	.91
7	76.6	1.9	75.3	3.2	.862	.34	1.01	.90
8	77.1	3.9	74.4	6.6	.838	.02	2.12	.81
9	77.0	6.0	72.8	10.2	.795	8.54	3.28	.72
10	77.2	7.6	71.9	12.9	.773	.26	4.20	.66
11	77.1	8.7	71.0	14.8	.751	.00	.83	.62
Noon.	76.9	9.6	71.1	15.4	.753	.03	5.07	.61
1	76.7	10.3	70.5	16.5	.739	7.85	.44	.59
2	76.7	10.7	70.3	17.1	.734	.81	.64	.58
3	76.6	11.0	70.0	17.6	.727	.71	.81	.57
4	76.5	10.6	70.1	17.0	.729	.76	.57	.58
5	76.8	9.7	71.0	15.5	.751	.99	.11	.61
6	76.9	7.3	71.8	12.4	.771	8.25	3.99	.67
7	77.3	5.6	73.4	9.5	.811	.69	.10	.74
8	77.2	4.7	73.9	8.0	.824	8.87	2.57	.78
9	77.0	4.0	74.2	6.8	.832	.96	.18	.80
10	76.9	3.4	74.5	5.8	.840	9.07	1.84	.83
11	76.7	3.1	74.5	5.3	.840	.09	.66	.85

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	129.0	0.22	S by E. & S.S.W.	...	138.1	\i to 8 A. M. ⌒i to 4 P. M., stratoni to 8 P. M. _i afterwards. Thunder at $2\frac{1}{2}$ & $3\frac{1}{2}$ P. M. Rain at 1 P. M.
2	129.0	...	S.S.W.&S. by W.	...	93.6	Scuds from S S W to 3 A. M. \i to 3 P. M., clouds of different kinds afterwards. Lightning to S at 5 A. M.
3	135.0	...	S.S.W. & S.by E.	...	76.4	\i to 7 A. M. ⌒i to 2 P. M. _i afterwards. Thunder at 2 & 3 P. M. Lightning to N W at 3 A. M. Drizzled at 4 & 5 P. M.
4	131.2	...	S. by E. & S.	1.0	84.0	\i to 7 A. M. ⌒i to 3 P. M., stratoni afterwards. Lightning to W at 11 P. M.
5	...	1.31	S. & S. by E.	0.5	118.0	\i & ⌒i to 11 A. M., overcast to 4 P. M., clouds of different kinds afterwards. Thunder at $1\frac{1}{2}$ & 2 P. M. Lightning at 7 P. M. Rain from 11 A. M. to 2 P. M.
6	125.0		S. S. W. & N. W.		30.4	\i to 7 A. M. Clear afterwards.
7	130.0		W. S.W. &. S.W.		83.2	\i to 10 A. M. ⌒i to 4 P. M. Clear afterwards. Foggy from 9 to 11 P. M.
8	127.0		S.W & W .N. W.		52.8	Clear to 3 A. M. \i to 9 A. M. \i & ⌒i to 5 P. M., clear afterwards. Slightly, foggy at 11 P. M.
9	128.0		W. N. W. & N,		46.8	Chiefly \i.
10	126.5		N, N. by E. & E.		86.6	\i to 9 A. M. ⌒i to 6 P. M. Clear afterwards. Drizzled at 3 P. M.
11	120.0		E,E.byN.&E.byS.		127.4	\i to 6 A. M. ⌒i to 7 P. M. clear afterwards.
12	125.0		E. by S. & N. W.		76.1	\i to 7 A.M. ⌒i to 6 P.M., stratoni afterwards.
13	128.6		E.S.E. & E. N. E.		101.3	Clear to 9 A. M. ⌒i to 6 P. M. Clear afterwards. Slightly, foggy from 8 to 10 P. M.
14	128.8		E.N.E.&W.by N.		65.7	Clear to 10 A. M. ⌒i to 6 P. M. clear afterwards.
15	128.5		S. W. & S.		50.2	Clear to 5 A. M. ⌒i afterwards. Thunder & Lightning to S at 8 P. M.
16	128.5		S. S. W. & S.		89.4	Clouds of different kinds.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
17	129.0	...	N. N. W. & S. W.	...	68.5	Clear to 10 A. M. ⌒i to 6 P. M., clear afierwards.
18	126.5	...	W.N.W.& S.S.E.	...	74.5	╲_i to 2 A. M., clear to 11 A. M. ⌒i to 4 P.M., clear afterwards.
19	127.7	...	W. N. W, & W.	...	68.9	Clear to 10 A. M. ⌒i to 6 P. M. clear afterwards.
20	126.0	...	W,S.W.& S.S.W.	...	59.6	Clear to 6 A. M. ╲i & ⌒i to 6 P M., clear afterwards. Slightly foggy from 8 to 11 P. M.
21	138.0	...	S. S. W. & S. W.	...	41.6	Chiefly clear. Foggy from 7 to 11 P. M.
22	125.4	...	N.N.W.&S. by E.	0.4	65.1	Clear
23	126.0	...	N.N.W. &N.N.E.	...	97.0	Clear
24	127.0	...	E.S.E. & variable	...	76.3	Clear. Foggy from 7 to 10 P M.
25	129.0	...	S. by W. & S. W.	...	54.0	Clear to 9 A. M. ╲i & ⌒i to 6 P M., clear to 9 P. M. ╲i afterwards.
26	125.6	...	WSW,WNW & S	...	60.0	Clear to 5 A. M. ╲i to Noon. ╲_i to 3 P. M., clear afterwards. Slightly foggy from 9 to 11 P. M.
27	125.5	...	S.byE. & E.N.E.	...	46.5	Clear to 4 A. M. ╲i to 2 P. M. ⌒i to 5 P.M. clear afterwords. Foggy from 8 to 11 P. M.
28	126.0	...	N by E&W.N.W.	...	75.4	Clear.
29	126.0	...	N. E. & N. N. W.	...	87.0	Clear.
30	122.0	...	S.S. E. & W.S.W.	...	85.9	Clear, foggy from 7 to 11 P. M.
31	121.0	...	S. W.	...	47.5	Clear to 11 A. M. ⌒i to 1 P. M. Clear afterwards. Foggy at midnight & 1 A. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒_i Cumulo strati, ╲⌒_i Nimbi
╲⌒i Cirro cumuli

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1868.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.862
Max. height of the Barometer occurred at 9 A. M. on the 31st. ...	30.042
Min. height of the Barometer occurred at 5 P. M. on the 6th. ...	29.680
Extreme range of the Barometer during the month	0.362
Mean of the daily Max. Pressures	29.929
Ditto ditto Min. ditto	29.811
Mean daily range of the Barometer during the month	0.118

	o
Mean Dry Bulb Thermometer for the month	82.2
Max. Temperature occurred at 5 P. M. on the 14th.	92.1
Min. Temperature occurred at 6 A. M. on the 29th.	70.8
Extreme range of the Temperature during the month	21.3
Mean of the daily Max. Temperature	88.1
Ditto ditto Min. ditto, ...	77.3
Mean daily range of the Temperature during the month... ...	10.8

Mean Wet Bulb Thermometer for the month	76.6
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	5.6
Computed Mean Dew-point for the month	72.7
Mean Dry Bulb Thermometer above computed mean Dew-point ...	9.5
	Inches.
Mean Elastic force of Vapour for the month	0.792

	Troy grain.
Mean Weight of Vapour for the month	8.51
Additional Weight of Vapour required for complete saturation ...	3.03
Mean degree of humidity for the month, complete saturation being unity	0.74

	Inches.
Rained 4 days,—Max. fall of rain during 24 hours	1.31
Total amount of rain during the month	1.53
Total amount of rain indicated by the Gauge attached to the anemometer during the month	1.42
Prevailing direction of the Wind... ...	S. W. & S. S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Oct. 1868.

Monthly Results.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.
Mid night	1		1						3			
1	1		1						1		1	
2	1						1		1			
3	1						1		1			
4			1				1		1		1	
5			1				1		1		1	
6			1				1		1		1	
7			1				1		1		1	
8					1		2		2			
9							2		1		2	
10			1				2		3			
11					1		4		3			
Noon.			1		1		2		2		1	
1					1		3		3			
2	1				1		1		3			
3	3		1				1		2	1		
4	2				4		2					
5	1		1		1		1		2			
6	1		1		1				3			
7	1		1		1				2			
8	1		1		1				2			
9	1		1		1				2			
10	1		1		1				2			
11	1		1				1		2			

Hour.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night	1		1		1				2		3	
1	1		2		2				2		2	
2	1		1		2		1				3	
3	1		1		2				2		3	
4			1		2		1		1		3	
5			1		2				1		4	
6			1		2				1		3	
7			1		2				2		1	
8			1		2		2		2		1	
9	1				1				3		3	
10							4		3		2	
11	2				1		1				2	
Noon.	1				2		1				3	
1	1				1		2				3	1
2							2		1		1	
3							1		1		1	
4									2	1	1	
5	1				1				2	1		
6			1						1		1	
7	1		1						1		2	
8	1		1						1		2	
9	1		1						1		2	
10	1		1						1		2	
11	1		1		1				1		2	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.
Mid night	2		1		3		4					
1	4		1		3		3		1			
2	5		1		4		2		2			
3	4		2		4		2		3			
4	3		2		3		2		4			
5	1		2		4		2		5			
6	2		1		6		3		4			
7	2		4		8		1		2			
8	2		3		3		5		2			
9	1		3		3		2		3		1	
10	1		2		1		5				2	
11	4		3		1	1	1		3			
Noon.	1	1	1		1		4		2		1	
1			2				1	1	4		1	
2	1				1		5	1	2		1	
3	1				2		5		1			
4	1		1		2		1		3		2	
5	1		2		1		2		1		2	
6	1		3		3		4		1			
7	1		2		3		5					
8	2		1		3		5					
9	3				4		5					
10	3		1		4		4					
11	3		1		3		5					

Hour.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	3				2				3			
1	2				2				2			
2	1				2				2			
3					2				1			
4					3				1			
5					3				1			
6					3				1			
7			2		1				1			
8	1		1		1							
9	1		2		1				1			
10	1				2		1				1	
11	1		1		1						2	
Noon.			1		1		3		1		1	
1			1		4		2		2			
2	2				4		3		1		1	
3	3				5		2		1		1	
4			1		2		5		1		1	
5	1		2		3		4		2			
6	1		1		3		2		3			
7	1		1		3		2		3			
8	1		1		3		2		3			
9	2				2		2		3			
10	2				2		2		3			
11	3				2				3			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.989	30.062	29.940	0.122	78.0	85.4	71.5	13.9
2	.975	.059	.924	.135	78.5	85.4	73.0	12.4
3	.985	.061	.934	.127	79.2	87.0	73.0	14.0
4	.980	.057	.935	.122	78.8	85.2	73.0	12.2
5	.908	29.979	.832	.147	78.8	85.0	73.5	11.5
6	.845	.901	.782	.119	79.1	86.0	72.2	13.8
7	.856	.907	.819	.088	77.6	83.7	72.5	11.2
8	.818	.895	.753	.142	77.0	83.0	72.5	10.5
9	.789	.848	.730	.118	76.9	84.7	71.4	13.3
10	.801	.874	.740	.134	78.3	85.8	71.5	14.3
11	.841	.912	.796	.116	79.5	87.1	73.2	13.9
12	.881	.939	.833	.106	78.0	84.0	73.0	11.0
13	.865	.925	.800	.125	76.1	82.3	71.0	11.3
14	.883	.950	.825	.125	75.0	84.0	67.4	16.6
15	.949	30.015	.901	.114	75.6	85.0	68.8	16.2
16	30.024	.103	.940	.163	73.3	82.4	66.5	15.9
17	.034	.110	.970	.140	72.1	81.0	64.8	16.2
18	.009	.083	.940	.143	72.7	81.6	64.5	17.1
19	29.991	.061	.927	.134	73.1	81.9	66.0	15.9
20	.974	.049	.924	.125	72.1	80.6	64.8	15.8
21	.987	.047	.942	.105	71.6	79.6	64.5	15.1
22	.990	.046	.936	.110	72.0	80.5	64.5	16.0
23	30.026	.106	.972	.134	72.3	81.3	64.0	17.3
24	.048	.126	.996	.130	71.8	80.2	64.5	15.7
25	.080	.162	30.025	.137	71.6	79.5	64.5	15.0
26	.082	.154	.023	.131	71.8	79.6	65.2	14.4
27	.062	.139	29.993	.146	72.8	81.0	66.0	15.0
28	.072	.137	30.023	.114	73.2	81.7	67.4	14.3
29	.093	.185	.021	.164	71.5	79.5	66.0	13.5
30	.042	.128	29.966	.162	71.7	80.0	65.0	15.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	71.4	6.6	66.8	11.2	0.655	7.10	3.09	0.70
2	72.6	5.9	68.5	10.0	.692	.50	2.85	.73
3	72.8	6.4	68.3	10.9	.688	.43	3.13	.70
4	72.6	6.2	68.3	10.5	.688	.43	.01	.71
5	72.6	6.2	68.3	10.5	.688	.43	.01	.71
6	72.1	7.0	67.2	11.9	.664	.17	.36	.68
7	72.1	5.5	68.2	9.4	.686	.44	2.63	.74
8	72.5	4.5	69.3	7.7	.711	.70	.19	.78
9	72.0	4.9	68.6	8.3	.695	.55	.31	.77
10	72.0	6.3	67.6	10.7	.672	.28	3.00	.71
11	72.1	7.4	66.9	12.6	.657	.09	.57	.67
12	72.7	5.3	69.0	9.0	.704	.62	2.57	.75
13	68.7	7.4	63.5	12.6	.588	6.38	3.25	.66
14	67.5	7.5	62.2	12.8	.563	.13	.18	.66
15	66.8	8.8	60.6	15.0	.534	5.80	.68	.61
16	63.4	9.9	55.5	17.8	.450	4.92	.92	.56
17	63.1	9.0	55.9	16.2	.456	.99	.54	.59
18	64.5	8.2	57.9	14.8	.488	5.33	.35	.61
19	65.4	7.7	59.2	13.9	.509	.57	.22	.63
20	64.9	7.2	59.1	13.0	.508	.56	2.97	.65
21	65.2	6.4	60.1	11.5	.525	.75	.65	.69
22	65.2	6.8	59.8	12.2	.520	.69	.81	.67
23	66.4	7.9	58.1	14.2	.491	.38	3.20	.63
24	65.1	6.7	59.7	12.1	.518	.68	2.77	.67
25	65.4	6.2	60.4	11.2	.530	.82	.58	.69
26	65.9	5.9	61.2	10.6	.544	.97	.48	.71
27	65.9	6.9	60.4	12.4	.530	.81	.90	.67
28	66.8	6.4	61.7	11.5	.554	6.01	.70	.69
29	65.9	5.6	61.4	10.1	.548	.02	.36	.72
30	64.6	7.1	58.9	12.8	.504	5.52	.91	.66

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.967	30.101	29.796	0.305	71.9	76.8	68.0	8.8
1	.957	.092	.790	.302	71.3	76.4	67.0	9.4
2	.947	.080	.779	.301	70.8	75.8	66.4	9.4
3	.940	.082	.773	.309	70.1	75.0	66.0	9.0
4	.939	.083	.772	.311	69.5	74.5	65.0	9.5
5	.951	.090	.764	.326	69.1	73.8	64.5	9.3
6	.968	.110	.777	.333	68.6	74.5	64.0	10.5
7	.988	.134	.784	.350	68.9	74.3	64.5	9.8
8	30.013	.161	.814	.347	71.3	76.7	66.5	10.2
9	.032	.185	.848	.337	74.2	80.0	68.8	11.2
10	.031	.170	.843	.327	77.0	82.5	71.8	10.7
11	.011	.144	.826	.318	79.4	84.5	75.5	9.0
Noon.	29.982	.122	.788	.334	80.8	85.6	77.0	8.6
1	.948	.071	.751	.320	82.0	86.5	78.8	7.7
2	.924	.045	.736	.309	82.5	87.0	78.0	9.0
3	.911	.031	.730	.301	82.6	87.1	77.6	9.5
4	.907	.026	.735	.291	81.4	85.5	77.4	8.1
5	.916	.037	.743	.294	80.0	84.6	75.7	8.9
6	.928	.051	.754	.297	77.7	82.6	74.0	8.6
7	.946	.066	.789	.277	76.2	82.6	72.2	10.4
8	.964	.092	.804	.288	75.0	80.8	71.2	9.6
9	.977	.109	.813	.296	74.0	79.5	70.0	9.5
10	.982	.110	.818	.292	73.2	78.0	69.0	9.0
11	.977	.106	.805	.301	72.4	77.2	68.0	9.9

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	67.8	4.1	64.5	7.4	0.607	6.67	1.81	0.79
1	67.4	3.9	64.3	7.0	.603	.63	.70	.80
2	67.0	3.8	64.0	6.8	.597	.56	.64	.80
3	66.5	3.6	63.6	6.5	.590	.48	.55	.81
4	66.3	3.2	63.7	5.8	.591	.51	.37	.83
5	65.9	3.2	63.3	5.8	.584	.43	.35	.83
6	65.6	3.0	63.2	5.4	.582	.43	.24	.84
7	65.7	3.2	63.1	5.8	.580	.39	.35	.83
8	67.1	4.2	63.7	7.6	.591	.48	.85	.78
9	68.0	6.2	63.7	10.5	.591	.45	2.64	.71
10	68.9	8.1	63.2	13.8	.582	.31	3.58	.64
11	69.6	9.8	62.7	16.7	.572	.17	4.45	.58
Noon.	69.5	11.3	61.6	19.2	.552	5.94	5.13	.54
1	69.8	12.2	61.3	20.7	.546	.86	.61	.51
2	69.7	12.8	60.7	21.8	.536	.74	.90	.49
3	69.6	13.0	60.5	22.1	.532	.71	.97	.49
4	69.4	12.0	61.0	20.4	.541	.82	.45	.52
5	69.8	10.2	62.7	17.3	.572	6.17	4.64	.57
6	69.9	7.8	64.4	13.3	.605	.56	3.54	.65
7	69.7	6.5	65.1	11.1	.619	.74	2.92	.70
8	69.2	5.8	65.1	9.9	.619	.75	.56	.73
9	68.6	5.4	64.8	9.2	.613	.71	.33	.74
10	68.3	4.9	64.4	8.8	.605	.62	.20	.75
11	67.9	4.5	74 3	8.1	.603	.61	1.99	.77

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	125.5	...	S. W. & S. by W.	...	57.7	Clear to 11 A. M., scatd. ⌒i to 2 P. M., clear afterwards.
2	123.5	...	S.W. & S.by W.	...	78.3	Clear to 11 A. M., scatd. ⌒i to 6 P. M., clear afterwards.
3	122.5	...	S.S.W,N.&E.S.E.	...	58.3	Clear to 10 A.M., scatd. ⌒i to 4 P. M., clear afterwards. Foggy from 8 to 11 P. M.
4	112.0	...	E.S. E.& N. W.		64.9	Clear to 5 A. M., scatd. ╲i & ⌒i afterwards. Foggy from midnight to 5 A. M.
5	127.0	...	E.,S.byE.&S.S.W		55.7	Scatd. ⌒i to 3 P. M., clear afterwards.
6	122.6	...	N.W. & variable		79.5	Scatd. ╲i & ╲_i to 6 P. M., clear afterwards.
7	122.5	...	E. by S. & S. E.		83.2	Chiefly ╲i. Foggy from 7 to 9 A. M.
8	124.9	...	S. E.		73.7	╲i to 9 A. M., scatd. ⌒i to 7 P. M., clear afterwards.
9	125.4	...	S. E. & N. E.	1.0	91.6	Clear to noon, clouds of different kinds to 6 P. M., clear afterwards. Brisk wind from noon to 2 P. M.
10	126.5	...	N. E.	1.8	224.6	Clear to 2 A. M., scatd. ╲i & ╲_i to 6 P. M., stratoni afterwards. Brisk wind from $9\frac{1}{2}$ to $12\frac{1}{2}$ A. M.
11	128.4	...	NNE,NE&NbyE.		228.6	╲i to 2 A. M., ╲i & ╲⌒i to 7 P. M., ⌒i afterwards.
12	116.7	...	N byE,NNE,&N.		183.8	Stratoni to 11 A.M., ⌒i to 7 P. M., stratoni afterwards. Drizzled at $6\frac{1}{2}$ P. M.
13	116.0	...	N. W. &N. N.W.		194.9	Stratoni to 4 A. M., ╲i to 5 P. M., clear afterwards.
14	125.0	...	N. W. & variable		84.7	Clear. Slightly foggy at 8 P. M.
15	121.0	...	W SW.& variable		179.2	Clear.
16	128.4	...	W. N. W. & N.		106.5	Chiefly clear. Slightly foggy at 8 P. M.
17	118.7	...	N. N.W. & N. W.		123.7	Clear to 6 A. M., scatd. ╲i to 6 P. M., clear afterwards.
18	120.8	...	NW,Nby W & NNW.		136.6	Clear.
19	117.0	...	NNW,NW& W by N.		120.8	Clear.
20	115.0	...	S. W.& S.S.W.		60.4	Clear. Foggy from 7 to 11 P.M.
21	121.5	...	S.W. & S. S. W.		38.1	Clear. Slightly foggy at midnight, 1 & 11 A. M. & from 7 to 11 P. M.

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November* 1868.**

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		℔	Miles	
22	122.0	...	S. S.W.	...	41.9	Clear. Foggy from midnight to 8 A. M. & from 7 to 11 P. M.
23	122.0	...	N. & variable.	...	38.6	Clear. Slightly foggy at 5 & 6 A. M. & at 7, 9, 10 & 11 P. M.
24	119.4	...	N, N by W & W.	...	68.2	Chiefly clear. Foggy at midnight & 1 A. M. & at 7, 8, 10 & 11 P. M.
25	116.0	...	S.W, W by N&W. [by S.	...	37.3	Clear to 6 A. M., scatd. _i & \i to 4 P. M., clear afterwards. Foggy from midnight to 4 A.M. & from 8 to 11 P. M.
26	115.0	...	S. W. & variable.	...	54.0	Clear to 11 A. M., scatd. ⌒i to 8 P. M., scatd. \i afterwards.
27	121.0	...	SSW, WSW & SW		55.1	Clear to 6 A. M., scatd. \i to 5 P. M., scatd. _i afterwards. Slightly foggy at 6 A. M. & at 7 & 8 P. M.
28	123.0	...	N.N.E.&W. by N.	...	58.3	Chiefly scatd. \i. Slightly foggy from 7 to 10 P. M.
29	120.0	...	NE, NNE & E by N.	...	73.5	Stratoni to 8 A. M., \i to 2 P. M., stratoni to 4 P. M., clouds of different kinds afterwards. Slightly foggy from 9 to 11 P.M.
30	123.6	...	N. E. & N.	...	50.3	⌒\i to 9 A. M., \i & _i afterwards.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒—i Cumulo strati, \⌒—i Nimbi ⌒\i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1868.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.963
Max. height of the Barometer occurred at 9 A. M. on the 29th. ...	30.185
Min. height of the Barometer occurred at 3 P. M. on the 9th. ...	29.730
Extreme range of the Barometer during the month	0.455
Mean of the daily Max. Pressures	30.034
Ditto ditto Min. ditto	29.905
Mean daily range of the Barometer during the month	0.129

	o
Mean Dry Bulb Thermometer for the month	75.0
Max. Temperature occurred at 3 P. M. on the 11th.	87.1
Min. Temperature occurred at 6 A. M. on the 23rd	64.0
Extreme range of the Temperature during the month	23.1
Mean of the daily Max. Temperature	82.8
Ditto ditto Min. ditto, ...	68.5
Mean daily range of the Temperature during the month... ...	14.3

Mean Wet Bulb Thermometer for the month	68.2
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.8
Computed Mean Dew-point for the month	63.4
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.6
	Inches.
Mean Elastic force of Vapour for the month	0.586

	Troy grain.
Mean Weight of Vapour for the month	6.37
Additional Weight of Vapour required for complete saturation ...	2.94
Mean degree of humidity for the month, complete saturation being unity	0.68

	Inches.
Drizzled 1 day,—Max. fall of rain during 24 hours	Nil
Total amount of rain during the month	Nil
Total amount of rain indicated by the Gauge attached to the anemometer during the month	Nil
Prevailing direction of the Wind... ...	S. W., N. E. & N. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Nov. 1868.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W.N.W.	Rain on.	N. W.	Rain on.	N.N.W.	Rain on.	N. by W.	Rain on
Mid night	2				2		1				1		1		1		1		3						1		1		4		4		1		1				1		1		1		2		1	
1	1		1		1		2				1		1		1		1		3						1		1		3		5		1		1				1		1		1		2		1	
2	2		1		1		1				1		1		1		1		4						1		1		3		5		2								1		1		3			
3	1		1		2		2						1		1		2		3								2		4		3		3								1		2		2			
4	1		2		1		2						1		1		2		2						1		1		5		3		3								1		2		2			
5					2		3								1		2		1				1		1		1		4		3		2		1				1		1		2		2		2	
6					2		3						1		1				2				1				2		4		3		2		1				1		1		1		3		2	
7					2		4								1				2		1		1		1		1		2		3		1		1		1		1		1		2		3		2	
8					3		4								1		1		1		1		1		1				2		8		2				1		3		1		2		2		1	
9	1		1		2		4								1		2		3				1		1				1		3				1		3		2		1		3					
10	1		1				5		1		1				1		1		2				1		1				1		3						1		5		2		2		1			
11	1				3		3		2		2				1		1		2						1				1		3						1		2		1		4		2			
Noon.	2		2		3		3		2		1		1		2														1		1		2		2		2				2		2		1		1	
1	2				2		5				1		2						1		1										2		1		1		2		2		3		3		2			
2	3		1		1		3		4				1								2										1		2				1		1		4		4				1	
3	6				4		4		1				1																		1		5		1		1						3		2			
4	2		1		3		1		2				1																1		3		1		2		3		1		1		3		5			
5	4		1		2		3				2														1				1		4				2		2		1				5		1		1	
6	4		1		2		3						1						1								1		3		4				1		1		1				5		1		1	
7	4		1		3	1	2						1						1								1		3		4				1		1		1				5		1		1	
8	4		1		2		1				1						1		2								1		3		4				1		2		1				5				1	
9	3		1		1		2				1						1		2		1						1		3		3				2		2		1				4		2			
10	3		1		1		2				1		2				1		2						1		1		3		4				2				2				2		2			
11	3				1		2				1		2				1		3		1				1		1		3		8				1				1		1		1		3			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.013	30.086	29.962	0.124	68.6	76.0	63.5	12.5
2	.089	.163	30.039	.124	68.0	77.6	60.0	17.6
3	.115	.183	.049	.134	67.9	77.5	59.5	18.0
4	.119	.184	.060	.124	68.6	77.0	62.0	15.0
5	.112	.186	.051	.135	69.9	79.0	62.5	16.5
6	.092	.161	.027	.134	70.9	79.5	62.5	17.0
7	.076	.157	29.992	.165	70.3	77.5	64.0	13.5
8	.029	.111	.961	.150	69.6	77.7	62.5	15.2
9	.002	.055	.934	.121	69.0	76.6	62.4	14.2
10	29.997	.074	.935	.139	69.1	77.2	62.4	14.8
11	.961	.034	.895	.139	69.7	77.5	62.5	15.0
12	.944	.015	.891	.124	70.9	79.5	63.5	16.0
13	.992	.070	.927	.143	72.2	81.0	66.0	15.0
14	30.052	.137	30.001	.136	71.7	80.0	64.4	15.6
15	.093	.156	.028	.128	71.5	80.0	65.5	14.5
16	.143	.206	.088	.118	70.2	79.0	64.3	14.7
17	.142	.200	.081	.119	70.1	78.3	62.5	15.8
18	.106	.177	.033	.144	69.9	78.5	62.2	16.3
19	.071	.136	.019	.117	70.2	78.2	65.0	13.2
20	.103	.194	.061	.133	69.0	76.4	63.2	13.2
21	.048	.123	29.992	.131	66.9	74.6	60.0	14.6
22	.024	.103	.967	.136	66.5	74.0	59.5	14.5
23	.043	.134	.986	.148	64.7	73.2	56.5	16.7
24	.021	.103	.973	.130	64.7	73.7	56.0	17.7
25	.026	.091	.973	.118	67.6	76.4	59·8	16.6
26	.063	.146	.995	.151	66.2	75.7	58.5	17.2
27	.017	.098	.949	.149	66.0	75.5	57.0	18.5
28	.010	.084	.963	.121	69.1	79.1	61.4	17.7
29	.005	.090	.946	.144	68.9	78.0	61.0	17.0
30	.027	.116	.983	.133	67.0	74.4	61.5	12.9
31	.066	.166	30.018	.148	64.4	72.4	58.0	14.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	62.1	6.5	56.9	11.7	0.472	5.19	2.48	0.68
2	60.4	7.6	54.3	13.7	.432	4.77	.76	.63
3	59.5	8.4	52.8	15.1	.411	.54	.97	.61
4	60.8	7.8	54.6	14.0	.437	.82	.85	.63
5	63.5	6.4	58.4	11.5	.496	5.45	.53	.68
6	64.6	6.3	59.6	11.3	.516	.67	.56	.69
7	64.2	6.1	59.3	11.0	.511	.61	.47	.69
8	63.6	6.0	58.8	10.8	.503	.53	.37	.70
9	63.1	5.9	58.4	10.6	.496	.46	.30	.70
10	63.4	5.7	58.8	10.3	.503	.54	.24	.71
11	64.0	5.7	59.4	10.3	.513	.64	.29	.71
12	66.2	4.7	62.4	8.5	.567	6.22	.01	.76
13	67.7	4.5	64.1	8.1	.599	.56	1.99	.77
14	66.8	4.9	62.9	8.8	.576	.31	2.12	.75
15	65.9	5.6	61.4	10.1	.548	.02	.36	.72
16	63.6	6.6	58.3	11.9	.494	5.43	.62	.68
17	63.3	6.8	57.9	12.2	.488	.36	.67	.67
18	63.1	6.8	57.7	12.2	.485	.33	.65	.67
19	63.5	6.7	58.1	12.1	.491	.40	.65	.67
20	61.9	7.1	56.2	12.8	.461	.07	.69	.65
21	59.2	7.7	53.0	13.9	.414	4.58	.70	.63
22	58.5	8.0	52.1	14.4	.401	.45	.74	.62
23	56.7	8.0	50.3	14.4	.377	.20	.60	.62
24	57.3	7.4	51.4	13.3	.392	.36	.44	.64
25	62.2	5.4	57.9	9.7	.488	5.38	.06	.72
26	58.3	7.9	52.0	14.2	.400	4.43	.69	.62
27	58.5	7.5	52.5	13.5	.407	.51	.57	.64
28	63.4	5.7	58.8	10.3	.503	5.54	.24	.71
29	61.5	7.4	55.6	13.3	.452	4.99	.75	.65
30	59.8	7.2	54.0	13.0	.428	.73	.57	.65
31	57.1	7.3	50.5	13.0	.389	.23	·51	.63

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.055	30.163	29.941	0.222	65.6	69.5	60.5	9.0
1	.047	.152	.936	.216	64.8	69.0	59.8	9.2
2	.038	.140	.925	.215	64.2	68.5	59.0	9.5
3	.030	.134	.920	.214	63.5	68.0	58.6	9.4
4	.028	.131	.914	.217	62.9	67.5	57.5	10.0
5	.040	.135	.924	.211	62.3	67.0	57.0	10.0
6	.054	.151	.939	.212	61.8	66.5	56.4	10.1
7	.075	.163	.961	.202	61.8	66.2	56.0	10.2
8	.102	.188	.986	.202	63.6	67.5	56.8	10.7
9	.123	.202	30.006	.196	67.2	71.0	61.8	9.2
10	.126	.206	.015	.191	70.8	75.0	65.5	9.5
11	.107	.190	29.998	.192	73.5	77.0	67.6	9.4
Noon.	.075	.162	.959	.203	75.1	78.5	69.0	9.5
1	.040	.128	.925	.203	76.2	79.8	70.5	9.3
2	.016	.101	.905	.196	76.9	81.0	71.5	9.5
3	.001	.095	.891	.204	76.8	79.6	72.4	7.2
4	29.997	.088	.893	.195	75.7	78.6	71.2	7.4
5	30.005	.099	.900	.199	74.3	77.3	70.0	7.3
6	.017	.116	.914	.202	71.8	75.2	67.6	7.6
7	.032	.144	.929	.215	70.2	73.8	65.5	8.3
8	.048	.148	.947	.201	68.9	72.6	64.0	8.6
9	.060	.165	.955	.210	67.8	71.5	63.3	8.2
10	.069	.172	.970	.202	66.7	70.7	61.8	8.9
11	.064	.169	.954	.215	65.9	70.5	61.0	9.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	61.6	4.0	58.4	7.2	0.496	5.50	1.50	0.79
1	61.1	3.7	58.1	6.7	.491	.45	.38	.80
2	60.6	3.6	57.4	6.8	.480	.33	.36	.79
3	60.1	3.4	57.0	6.5	.473	.27	.28	.81
4	59.7	3.2	56.8	6.1	.470	.25	.18	.82
5	59.2	3.1	56.4	5.9	.464	.18	.13	.82
6	58.7	3.1	55.9	5.9	.456	.10	.11	.82
7	58.7	3.1	55.9	5.9	.456	.10	.11	.82
8	59.9	3.7	56.6	7.0	.467	.21	.36	.79
9	61.3	5.9	56.6	10.6	.467	.16	2.19	.70
10	63.0	7.8	56.8	14.0	.470	.16	3.04	.63
11	63.7	9.8	56.8	16.7	.470	.13	.77	.58
Noon.	64.0	11.1	56.2	18.9	.461	.01	4.33	.54
1	64.0	12.2	55.5	20.7	.450	4.89	.77	.51
2	64.2	12.7	55.3	21.6	.447	.85	5.01	.49
3	63.9	12.9	54.9	21.9	.441	.78	.05	.49
4	63.5	12.2	55.0	20.7	.442	.81	4.70	.51
5	63.9	10.4	56.6	17.7	.467	5.09	.03	.56
6	64.3	7.5	58.3	13.7	.494	.40	3.05	.64
7	63.9	6.3	58.9	11.3	.504	.55	2.50	.69
8	63.3	5.6	58.8	10.1	.503	.54	.20	.72
9	62.6	5.2	58.4	9.4	.496	.48	.00	.73
10	62.3	4.4	58.8	7.9	.503	.56	1.67	.77
11	61.8	4.1	58 5	7.4	.498	.52	.54	.78

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1⅓ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	111.0	...	W.S.W.,W&SW.	...	52.7	Chiefly ∖i. Slightly foggy at midnight & at 1 A. M.
2	118.5	...	S.W. & W. by N	...	73.2	Scatd. ∖i to 5 P. M., clear afterwards. Foggy at 9& 10 P.M.
3	116.4	...	N.byW.&N.byE.	...	102.7	Scatd. ∖i to 1 P. M., clear to 5 P. M., scatd. ∖i afterwards.
4	119.0	...	N. N. W.	...	147.4	Scatd. ∖i to 6 P. M. clear afterwards.
5	120.5	...	N.N.W,NNE&N.	...	126.4	Clear to 2 P. M., scatd. ∖i to 6 P. M., clear afterwards.
6	126.0	...	N. & S. E.	...	115.0	Clear to 5 A. M., ∖⌒i to 9 A. M. ⌒i & ‿i to 5 P.M., ⌒i afterwards.
7	119.4	...	E. by S. & N.	...	78.2	Scatd. ∖i to 5 A. M., ∖⌒i to 8 A. M.; ⌒i to 3 P. M., clear afterwards. Slightly foggy from 7 to 11 P. M.
8	118.7	...	N.,N. W. & S. W.	...	91.0	Clear. Slightly foggy at 8, 9 & 11 P. M.
9	118.0	...	S. S. W. & S. W.	...	51.0	Clear. Foggy from midnight to 4 A. M., at 8 A. M., & at 9 P. M.
10	117.0	...	S. & S. S. W.	...	46.7	Clear. Slightly foggy from 6 to 8 A. M. & at 6 & 9 P. M.
11	112.5	...	E., S. E. & S. W.	...	38.5	Clear to 11 A. M., scatd. ⌒i to 4 P. M., clear afterwards. Foggy at 6 & 7 A. M., & at 8 P. M.
12	119.8	...	S. & S. W.	...	47.5	Clear to 9 A. M., scatd. ⌒i to 3 P. M., clear afterwards. Foggy from 3 to 8 A. M.
13	120.6	...	S. & S. S. W.	...	60.7	Clear to 9 A. M., scatd. ⌒i to 5 P. M., clouds of different kinds afterwards. Foggy from 3 to 9 A. M.
14	122.0	...	S. S. E. &SS W.	...	98.5	Clear to 6 A. M., scatd. ∖i to 10 A. M., scatd. ⌒i to 6 P. M., clear afterwards.
15	120.0	...	SE,WNW& variable.	...	43.2	Clear to noon, scatd. ⌒i to 5 P. M., clear afterwards. Slightly foggy at 5 & 6 A. M. & at 7 & 8 P. M.
16	131.0	...	S. S. E. & N.	...	77.8	Chiefly clear.
17	117.0	...	N. & W.by N.	...	114.1	Clear. Slightly foggy at 10 & 11 P. M.
18	119.8	...	S W. & W by S.	...	49.7	Clear to 1 P. M., ∖⌒i to 8 P. M., clear afterwards. Slightly foggy at 6 & 7 A. M.
19	117.4	...	E byN&variable.	...	94.3	Chiefly clear. Foggy at 7 P.M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
20	122.0	...	N.N.E.&W.N.W.	...	98.0	Clear to 3 A. M., ⌒i to 8 A. M., clear to noon, ⌒i to 5 P. M., clear afterwards. Slightly foggy at 10 & 11 P. M.
21	116.0	...	N. E. & S. W.	...	86.9	Clear. Slightly foggy from 7 to 11 P. M.
22	110.6	...	S.S.W. & variable	...	65.3	Clear. Slightly foggy at midnight & 1 A. M. & from 7 to 11 P. M.
23	116.0	...	N. by E. & N. E.	...	55.0	Clear. Slightly foggy from 8 to 11 P. M.
24	117.0	...	NbyE &W. S.W	...	57.4	Clear. Slightly foggy at midnight & 1 A. M. & from 7 to 10 P. M.
25	115.0	...	S. byW.,S.&S.W.	...	30.8	Clear to 7 A. M., scatd. ⌒i to 5. P. M., clear afterwards.
26	111.8	...	E.N.E & N.NE.	...	115.5	Clear. Slightly foggy from 7 to 11 P. M.
27	116.0	...	N. E. & S.by W.	...	53.0	Clear. Foggy at midnight & 1 A. M.
28	118.5	...	s.byw.E.S.E&NNW.	...	42.1	Clear to 6 A. M., stratoni to 10 A M., clear afterwards. Slightly foggy from 9 to 11 P. M.
29	112.0	...	N.N.W.	...	59.2	Clear. Foggy to midnight & 1 A. M. & from 7 to 11 P. M.
30	109.5	...	WSW&variable.	...	79.1	Clear to 5 A, M., scatd. ╲i to noon, clear afterwards. Slightly foggy from midnight to 4 A. M. & from 8 to 10 P. M.
31	115.0	...	N.byE.&W.N.W.	...	75.0	Clear. Foggy at midnight & from 8 to 11 P. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒i Cumulo strati, ╲⌒i Nimbi ˙i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1868.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	30.052
Max. height of the Barometer occurred at 10 A. M. on the 16th. ...	30.206
Min. height of the Barometer occurred at 3 P. M. on the 12th. ...	29.891
Extreme range of the Barometer during the month	0.315
Mean of the daily Max. Pressures	30.127
Ditto ditto Min. ditto	29.993
Mean daily range of the Barometer during the month	0.134

	o
Mean Dry Bulb Thermometer for the month	68.7
Max. Temperature occurred at 2 P. M. on the 13th.	81.0
Min. Temperature occurred at 7 A. M. on the 24th	56.0
Extreme range of the Temperature during the month	25.0
Mean of the daily Max. Temperature	77.1
Ditto ditto Min. ditto, ...	61.6
Mean daily range of the Temperature during the month... ...	15.5

Mean Wet Bulb Thermometer for the month	62.1
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.6
Computed Mean Dew-point for the month	56.8
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.9
	Inches.
Mean Elastic force of Vapour for the month	0.470

	Troy grain.
Mean Weight of Vapour for the month	5.18
Additional Weight of Vapour required for complete saturation ...	2.41
Mean degree of humidity for the month, complete saturation being unity	0.67
	o
Mean Max. Solar radiation Temperature for the month.	117.0

	Inches.
Rained no day,—Max. fall of rain during 24 hours	Nil
Total amount of rain during the month	Nil
Total amount of rain indicated by the Gauge attached to the anemometer during the month	Nil
Prevailing direction of the Wind... ...	N. N. W., S. W. & N.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Decr. 1868.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	3		1		1		2		2				1		1				2						2		2		1		5								1		2		1		4			
1	4		1		2				3				1		1				2		1				3		3				2		1						1		1				4		1	
2	4		1		2		1		2				1		1				1		3				4		2				2		1						1		1				3		1	
3	3		2		2		1		2				1		1				1		3				5		1				1		2		1						1				3		1	
4	2		2				3		2				1		1						2		1		5		1				1		2		1						1				5		1	
5	1		4				3		3						1						4		1		4						1		3		1						1				4			
6	2		3		1		3		3						1		2				2		1		3		1				1		3		1										3		1	
7	1		4		1		2		3		1				2		3		1		1				3		1				2		2								1				3		1	
8	1		3		2		2		5						1		2		2		2				3						1						2				2				3			
9	1		3		1		5		1		1		3		1		2		1		3				1		1		1								1				1				4			
10	2				3		4		4		4				2		2				3		1		1		2										1						1		1			
11	2				5		3		1		2		1		1		2		2				1		3				1		1		1				1		1		1				2			
Noon.	2		1		1		2								3		1		1						2				2		3		1				2				1		2		5		2	
1	5		2		1		1		1														1		2						3						5		1		2		2		4		1	
2	3		1		4								1												1				1		2		2				5				3		3		3		2	
3	4		1		1														1										3		3		2		1		2		2		2		4		5			
4	3		1		3														1										2		4		3		1		1		3		3		3		2		1	
5	3		2		1														1										5		4		2				2		1		2		3		2		3	
6	3		1		1						1								1										5		6		1		1				1		4		1		3		2	
7	3		1		1						1								1						1		1		4		6		1						1		3		2		3		2	
8	4		1		1						1								1						1		1		5		5		1						1		3		1		3		2	
9	3		1		2						1				1								1		1		2		5		4								1		3		1		4		1	
10	3		1		2		1				1		1		1				1		1		1		1		1		3		6								1		2				4		1	
11	3		1		2		1		1				1		1				1						2		3		2		5						1		1		2				4			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.073	30.154	30.026	0.128	64.4	74.0	56.7	17.3
2	.106	.182	.061	.121	65.7	75.4	57.5	17.9
3	.119	.184	.068	.116	68.1	76.0	60.6	15.4
4	.103	.196	.022	.174	70.5	76.3	64.2	12.1
5	.032	.103	29.969	.134	70.7	78.0	66.2	11.8
6	.104	.183	30.054	.129	66.8	76.2	58.6	17.6
7	.115	.191	.059	.132	67.0	76.2	59.0	17.2
8	.096	.186	.028	.158	65.9	74.5	58.6	15.9
9	.092	.175	.044	.131	66.3	75.0	59.0	16.0
10	.106	.178	.052	.126	65.3	75.4	56.3	19.1
11	.117	.212	.068	.144	66.7	76.9	58.5	18.4
12	.112	.197	.049	.148	67.7	78.0	58.9	19.1
13	.089	.161	.041	.120	69.7	79.0	61.0	18.0
14	.123	.190	.063	.127	72.5	80.0	66.8	13.2
15	.195	.294	.134	.160	69.7	78.0	62.0	16.0
16	.130	.220	.066	.154	67.3	77.0	58.5	18.5
17	.078	.159	.007	.152	67.2	76.5	59.2	17.3
18	.044	.119	29.985	.134	68.0	76.9	59.7	17.2
19	.058	.148	30.009	.139	67.9	77.2	60.2	17.0
20	.081	.168	.019	.149	68.6	78.8	59.5	19.3
21	.052	.160	29.965	.195	70.3	81.2	61.0	20.2
22	29.983	.074	.919	.155	72.2	82.4	64.6	17.8
23	.924	29.998	.871	.127	73.8	83.3	67.2	16.1
24	.922	.987	.864	.123	74.9	85.8	68.5	17.3
25	.967	30.057	.918	.139	72.7	80.5	66.0	14.5
26	.985	.062	.935	.127	72.4	80.5	65.2	15.3
27	30.000	.066	.942	.124	74.1	80.2	69.0	11.2
28	.009	.081	.963	.118	69.3	72.0	67.5	4.5
29	29.945	.015	.880	.135	72.2	80.8	65.0	15.8
30	.942	.114	.900	.114	73.9	80.0	70.0	10.0
31	.965	.045	.901	.144	73.9	80.6	69.5	11.1

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during he day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	57.5	6.9	51.3	13.1	0.390	4.34	2.40	0.64
2	59.9	5.8	55.3	10.4	.447	.97	.05	.71
3	64.7	3.4	62.0	6.1	.559	6.18	1.37	.82
4	65.3	5.2	61.1	9.4	.543	5.97	2.16	.73
5	65.6	5.1	61.5	9.2	.550	6.05	.13	.74
6	60.4	6.4	55.3	11.5	.447	4.95	.31	.68
7	59.6	7.4	53.7	13.3	.423	.69	.61	.64
8	59.6	6.3	54.6	11.3	.437	.85	.21	.69
9	59.4	6.9	53.9	12.4	.426	.73	.42	.66
10	58.0	7.3	52.2	13.1	.402	.47	.46	.65
11	59.5	7.2	53.7	13.0	.423	.69	.54	.65
12	61.3	6.4	56.2	11.5	.461	5.08	.38	.68
13	64.5	5.2	60.3	9.4	.528	.82	.11	.73
14	67.0	5.5	62.6	9.9	.570	6.24	.39	.72
15	60.6	9.1	53.3	16.4	.418	4.61	3.32	.58
16	58.4	8.9	51.3	16.0	.390	.32	.05	.59
17	59.0	8.2	52.4	14.8	.405	.48	2.87	.61
18	60.0	8.0	53.6	14.4	.422	.67	.86	.62
19	59.9	8.0	53.5	14.4	.421	.66	.85	.62
20	61.4	7.2	55.6	13.0	.452	.99	.68	.65
21	65.2	5.1	61.1	9.2	.543	5.97	.11	.74
22	66.2	6.0	61.4	10.8	.548	6.00	.55	.70
23	67.4	6.4	62.9	10.9	.576	.29	.69	.70
24	68.5	6.4	64.0	10.9	.597	.50	.78	.70
25	65.6	7.1	59.9	12.8	.521	5.70	.98	.66
26	66.5	5.9	61.8	10.6	.555	6.07	.53	.71
27	68.7	5.4	64.9	9.2	.615	.73	.32	.74
28	67.2	2.1	65.5	3.8	.628	.92	0.91	.88
29	68.7	3.5	65.9	6.3	.636	.98	1.57	.82
30	68.9	5.0	65.4	8.5	.626	.82	2.19	.76
31	70.2	3.5	67.7	6.0	.674	7.37	1·59	.82

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.057	30.185	29.931	0.254	66.2	72.0	59.4	12.6
1	.049	.186	.930	.256	65.5	71.8	58.5	13.3
2	.040	.185	.921	.264	65.0	71.4	58.0	13.4
3	.032	.179	.910	.269	64.4	71.0	58.5	12.5
4	.028	.178	.894	.284	63.9	71.0	58.2	12.8
5	.037	.190	.906	.284	63.4	71.5	57.7	13.8
6	.052	.204	.915	.289	62.8	70.6	57.0	13.6
7	.073	.221	.939	.282	62.5	70.0	56.3	13.7
8	.099	.253	.957	.296	63.5	70.5	58.2	12.3
9	.124	.285	.978	.307	66.6	72.0	62.2	9.8
10	.133	.294	.987	.307	70.1	75.0	66.0	9.0
11	.114	.276	.971	.305	73.4	77.2	68.5	8.7
Noon.	.084	.232	.934	.298	75.4	80.7	69.0	11.7
1	.050	.196	.909	.287	76.7	83.5	70.0	13.5
2	.022	.166	.886	.280	77.6	84.5	70.9	13.6
3	.005	.148	.871	.277	78.0	85.8	71.5	14.3
4	29.998	.134	.864	.270	77.3	85.1	72.0	13.1
5	30.005	.140	.868	.272	76.1	83.0	71.5	11.5
6	.014	.145	.878	.267	73.7	79.3	68.3	11.0
7	.030	.154	.895	.259	71.8	77.2	66.5	10.7
8	.050	.172	.913	.259	70.4	76.9	64.6	12.3
9	.063	.183	.934	.249	69.1	75.0	63.8	11.2
10	.069	.187	.939	.248	68.1	74.0	62.5	11.5
11	.063	.182	.933	.249	67.2	73.0	61.5	11.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	62.2	4.0	59.0	7.2	0.506	5.61	1.51	0.79
1	61.8	3.7	58.8	6.7	.503	.57	.41	.80
2	61.4	3.6	58.5	6.5	.498	.52	.35	.80
3	61.2	3.2	58.3	6.1	.494	.49	.25	.82
4	60.9	3.0	58.2	5.7	.493	.48	.15	.83
5	60.5	2.9	57.9	5.5	.488	.42	.11	.83
6	60.0	2.8	57.5	5.3	.481	.38	.03	.84
7	59.7	2.8	57.2	5.3	.476	.32	.03	.84
8	60.4	3.1	57.6	5.9	.483	.37	.18	.82
9	62.1	4.5	58.5	8.1	.498	.51	.70	.76
10	63.8	6.3	58.8	11.3	.503	.53	2.50	.69
11	64.8	8.6	57.9	15.5	.488	.31	3.56	.60
Noon.	65.4	10.0	58.4	17.0	.496	.39	4.04	.57
1	65.7	11.0	58.0	18.7	.489	.30	.50	.54
2	66.3	11.3	58.4	19.2	.496	.37	.70	.53
3	66.1	11.9	57.8	20.2	.486	.26	.93	.52
4	65.8	11.5	57.7	19.6	.485	.24	.74	.53
5	65.9	10.2	58.8	17.3	.503	.46	.17	.57
6	65.9	7.8	60.4	13.3	.530	.80	3.16	.65
7	65.5	6.3	60.5	11.3	.532	.84	2.61	.69
8	64.7	5.7	60.1	10.3	.525	.77	.33	.71
9	64.1	5.0	60.1	9.0	.525	.78	.00	.74
10	63.6	4.5	60.0	8.1	.523	.78	1.77	.77
11	63.0	4.2	59.6	7.6	.516	.71	.64	.78

All the Hygrometrical elements are computed by the Greenwich Constants.

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January* 1869.**

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	115.2	...	E. & W. S. W.	...	40.4	Clear. Slightly foggy from midnight to 2 A. M., & from 6 to 11 P. M.
2	111.5	...	S.W. & variable.	...	29.2	Clear. Slightly foggy from 4 to 8 A. M., & from 8 to 11 P. M.
3	112.0	...	S.S. W. & S. S. E.	...	37.0	Clear to 5 A. M., scatd. ⌒i & ╲i afterwards. Foggy from midnight to 8 A. M. Light rain at 11½ P. M.
4	120.0	...	Variable.	...	49.3	╲i to 4 A. M., ⌒i to 5 P. M., clear afterwards.
5	110.6	...	S. by E. & N. W.	...	56.7	⌒i to 5 A. M., stratoni to 11 A. M., ⌒i to 4 P. M., clear afterwards. Slightly foggy at 8 & 9 A. M.
6	111.2	...	E.N.E.&N.N.W.	...	16.6	Clear. Slightly foggy at 9 P.M.
7	116.2	...	N.N,E.&N.byE	...	169.7	Clear. Foggy from 7 to 11 P.M.
8	114.8	...	N.E. & S.S. W.	...	57.0	Clear. Slightly foggy from 7 to 10 P. M.
9	113.4	...	WNW& W by S.	...	40.0	Clear. Foggy at 9 & 10 P. M.
10	111.0	...	E.N. E & variable	...	45.5	Chiefly clear. Slightly foggy from 7 to 11 P. M. Two sharp shocks of earthquake were felt at 4 h. 43½M. P. M.
11	117.4	...	S. S. E.	...	42.4	Clear to 6 A. M., scatd. ╲i to 6 P. M., clear afterwards. Foggy from 7 to 9 P. M.
12	109.5	...	S. S. E. & S. E.	...	18.7	Clear to 6 A. M., scatd. ╲i to 5 P.M., clear afterwards. Slightly foggy at 8 & 9 P. M.
13	113.2	...	S. byE& S. S.E	...	62.1	Chiefly clear.
14	113.5	...	S. W. & N.	...	50.0	Scatd. ⌒i to 4 P. M., clear afterwards.
15	116.5	...	NNE,& N. by W.	0.4	158.7	Clear.
16	114.0	...	N.W. & N. by E.	...	151.3	Clear.
17	116.0	...	W, N. W. & NW.	...	106.2	Clear.
18	115.5	...	W.N. W. & S.W.	...	99.9	Clear to 1 P. M., scatd. ╲i afterwards.
19	112.5	...	SW,WNW&WS. [W.	...	49.7	Clear to 10 A. M., scatd. ╲i to 6 P. M., clear afterwards. Slightly foggy at 7 A. M.
20	111.5	...	S. S. W. & W.	...	41.3	Clear.
21	119.4	...	S by W. & S.SW.	...	54.6	Clear. Foggy from 1 to 8 A.M.
22	118.6	...	S S. W. &S by W	...	157.3	Chiefly clear.
23	121.0	...	SbyW,SW& SSW	...	168.6	Clear.
24	120.8	...	S.S.W, S. W. & S.	...	158.8	Clear to 3 P. M., scatd. ╲i afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
25	112.0	...	E.N.E. & E by N.	1.5	202.6	Scatd. ╲i to 2 A. M., clear to 5 A. M., ╲⌒i afterwards.
26	111.5	...	E.byN.& variable.	...	99.0	Clear to 5 A. M., scatd. ╲i to 10 A. M., ╲⌒i afterwards.
27	119.0	...	SbyE,N&variable	...	65.8	╲⌒i to 3 A. M., stratoni to 8 A M. Scatd. ⌒i to 6 P. M., stratoni afterwards. Thunder at 11 P. M.
28	...	0.78	SS. E. & variable.	...	111.4	Overcast to 2 P.M., scatd. ╲⌒i afterwards. Thunder & Lightning at midnight. Foggy at 8 P. M. Rain at midnight & light rain from $5\frac{1}{2}$ to 11 A. M. & at 9 P. M.
29	122.5	...	SSE.& S. W.	...	83.3	Chiefly scatd. ⌒i.
30	120.4	0.12	SSW,NE.&ENE.	...	135.0	⌒i to 6 PM., clear afterwards. Rain at $3\frac{1}{2}$ A. M.
31	121.4	...	S. S. E. & S. W.	...	62.3	Clear to 4 A. M., stratoni to 11 A. M., ⌒i to 5 P. M., clear afterwards. Foggy from 2 to 10 A. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒_i Cumulo strati, ╲⌒_i Nimbi ╲⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	30.054
Max. height of the Barometer occurred at 10 A. M. on the 15th. ...	30.294
Min. height of the Barometer occurred at 4 P. M. on the 24th. ...	29.864
Extreme range of the Barometer during the month	0.430
Mean of the daily Max. Pressures	30.134
Ditto ditto Min. ditto	29.996
Mean daily range of the Barometer during the month	0.138

	o
Mean Dry Bulb Thermometer for the month	69.5
Max. Temperature occurred at 3 P. M. on the 24th.	85.8
Min. Temperature occurred at 7 A. M. on the 10th	56.3
Extreme range of the Temperature during the month	29.5
Mean of the daily Max. Temperature	78.1
Ditto ditto Min. ditto, ...	62.4
Mean daily range of the Temperature during the month... ...	15.7

Mean Wet Bulb Thermometer for the month	63.4
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.1
Computed Mean Dew-point for the month	58.5
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.0
	Inches.
Mean Elastic force of Vapour for the month	0.498

	Troy grain.
Mean Weight of Vapour for the month	5.48
Additional Weight of Vapour required for complete saturation ...	2.40
Mean degree of humidity for the month, complete saturation being unity	0.70
Mean Max. Solar radiationTemperature for the month.	115.4

	Inches.
Rained 3 days,—Max. fall of rain during 24 hours	0.78
Total amount of rain during the month	0.90
Total amount of rain indicated by the Gauge attached to the anemometer during the month	0.80
Prevailing direction of the Wind... ...	S. W., S. S. W. & S. S. E.

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Jany.* 1869.**

Monthly Results.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night					1		2	1	1		1								1		4		2		2		4		4		2		1				1				2		1		1		1	
1	1				1		2		1		1		1						1		5		2		2		2		6		3										1		1		1			
2	1		1		1		2		2		1				1		1				3		4				3		5		2										2		2					
3			2		1		1		1		1				2		2				4		3		1		2		4		3										2		1		1			
4			2		2		1		1		1		1				2		1		4		3				2		3		4										2		1	1	1			
5			2		2		1		1		1		2				2		1		3		3		1		1		3		4										2		1		1			
6			2		3		1		2		1		1				1		1		4		2				1		1		7										2		1				1	1
7	1				4		1		2		1		1		1				2		4		1				1		1		6										2		2	1			1	
8	1				3	1	2		3				1		2		1		3		3		1		2		1		1		1		2								2		1				1	
9	1				1		4	1	4				1		2		2		2		3						1		3		1		2						1		2		1					
10	1				3		3	1	3				1		2		1		3		3		1						1		4						1				3		1					
11	2				2		2		2		1		1		1		1		3		5	1							2		3		1		1		1		1		1		1					
Noon.					2		2						1				1		3		2		2		1		1		3		4				1		3				1				3		1	
1	1		1				1				1						1		1		2		1						3		4		3		1		6				1		3				1	
2	2		·						2								1				1				1				1		5		3		3		2		1		3		6					
3	1				1						1		1								2								3		1		4		6		2		1		4		1		1		2	
4			1								1		1		1				1						1		1		1		6		4		2		1		3		2		1		4			
5	1				1				2								2		2						1		3		1		5		2		2		1		1		3				3		1	
6	1				1				1		1						1		1		1		1		2				7		3		1		2		1				2		2		2		1	
7	1				1				1		1						1		1		1		1		1		2		8		1		3		1		1				1		3		1		1	
8	1				1				1		1				1						3		4				6		3		1		2		1		1				1		2		1		1	
9	1				1		1		1		1		1								6		1		1		4		4		1		2		1		1				1		1		1		1	
10	1				1		1		1		1		1								5		3		2		2		3		2		2				1				2		1		1		1	
11			1		1		1		1		1		1				1				3		3		4		1		3		2		2								2		1		2		1	

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February* 1869.**

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.877	29.971	29.792	0.179	76.2	82.7	71.5	11.2
2	.772	.863	.692	.171	76.2	83.0	71.3	11.7
3	.819	.900	.734	.166	73.6	80.6	68.4	12.2
4	.954	30.044	.874	.170	70.5	77.8	64.5	13.3
5	.998	.090	.932	.158	69.4	77.5	61.0	16.5
6	.914	.000	.833	.167	71.5	82.1	61.0	21.1
7	.891	29.962	.815	.147	67.0	72.6	63.0	9.6
8	.982	30.051	.944	.107	67.0	75.2	59.0	16.2
9	.992	.037	.945	.092	62.1	67.0	60.0	7.0
10	.996	.053	.941	.112	61.3	64.7	59.2	5.5
11	30.049	.133	30.000	.133	65.2	74.5	57.5	17.0
12	.017	.098	29.961	.137	67.4	76.2	59.5	16.7
13	29.999	.071	.944	.127	70.5	79.5	62.5	17.0
14	30.013	.084	.959	.125	72.2	81.6	65.2	16.4
15	29.991	.076	.935	.141	73.4	82.2	66.5	15.7
16	.948	.013	.881	.132	75.3	83.7	69.0	14.7
17	.983	.060	.914	.146	76.9	85.0	71.2	13.8
18	30.033	.126	.984	.142	76.9	84.0	71.5	12.5
19	29.972	.065	.886	.179	75.4	84.8	69.0	15.8
20	.953	.027	.886	.141	77.7	86.5	71.4	15.1
21	.933	29.989	.881	.108	78.6	89.0	71.9	17.1
22	.930	30.003	.869	.134	79.1	90.0	70.0	20.0
23	.918	29.981	.868	.113	79.5	90.0	71.5	18.5
24	.969	30.043	.910	.133	80.0	90.0	72.0	18.0
25	.994	.081	.933	.148	81.0	91.5	73·0	18.5
26	.958	.036	.898	.138	79.7	90.5	72.0	18.5
27	.972	.034	.930	.104	78.6	87.4	71.0	16.4
28	.984	.048	.928	.120	76.5	82.0	72.5	9.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	73.3	2.9	71.3	4.9	0.758	8.25	1.41	0.85
2	69.9	6.3	65.5	10.7	.628	6.83	2.83	.71
3	63.8	9.8	56.9	16.7	.472	5.14	3.79	.58
4	59.4	11.1	50.5	20.0	.380	4.18	.95	.51
5	58.7	10.7	50.1	19.3	.375	.13	.73	.53
6	61.1	7.4	58.2	13.3	.493	5.41	2.97	.65
7	62.9	4.1	59.6	7.4	.516	.72	1.58	.78
8	60.7	6.3	55.7	11.3	.453	.02	2.28	.69
9	60.0	2.1	58.1	4.0	.491	.49	0.78	.88
10	59.9	1.4	58.6	2.7	.499	.59	.53	.91
11	61.1	4.1	57.8	7.4	.486	.40	1.51	.78
12	61.9	5.5	57.5	9.9	.481	.32	2.07	.72
13	65.1	5.4	60.8	9.7	.537	.90	.23	.73
14	67.6	4.6	63.9	8.3	.595	6.52	.03	.76
15	66.0	7.4	60.1	13.3	.525	5.74	3.13	.65
16	70.6	4.7	67.3	8.0	.666	7.25	2.15	.77
17	72.3	4.6	69.1	7.8	.706	.66	.20	.78
18	71.9	5.0	68.4	8.5	.690	.48	.38	.76
19	70.0	5.4	66.2	9.2	.642	6.99	.44	.74
20	72.6	5.1	69.0	8.7	.704	7.62	.48	.75
21	71.4	7.2	66.4	12.2	.646	.00	3.38	.67
22	70.9	8.2	65.2	13.9	.621	6.72	.81	.64
23	72.9	6.6	68.3	11.2	.688	7.43	.23	.70
24	71.7	8.3	65.9	14.1	.636	6.86	.95	.64
25	70.1	10.9	62.0	19.0	.559	.01	5.13	.54
26	69.5	10.2	62.4	17.3	.567	.11	4.61	.57
27	71.4	7.2	66.4	12.2	.646	7.00	3.38	.67
28	70.1	6.4	65.6	10.9	.630	6.85	2.90	.70

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.962	30.041	29.759	0.282	70.6	76.8	60.2	16.6
1	.951	.036	.750	.286	70.0	76.0	59.8	16.2
2	.942	.033	.745	.288	69.5	75.2	59.2	16.0
3	.933	.028	.734	.294	68.8	74.3	58.8	15.5
4	.926	.030	.752	.278	68.3	74.5	58.5	16.0
5	.937	.037	.767	.270	67.8	73.0	57.8	15.2
6	.954	.053	.781	.272	67.5	73.5	57.5	16.0
7	.976	.068	.798	.270	67.4	73.3	57.5	15.8
8	30.000	.091	.820	.271	68.5	75.0	58.0	17.0
9	.023	.119	.850	.269	70.9	79.2	59.5	19.7
10	.031	.133	.863	.270	73.7	84.0	59.5	24.5
11	.020	.124	.843	.281	76.2	86.5	60.5	26.0
Noon.	29.994	.094	.816	.278	78.2	87.7	60.5	27.2
1	.964	.058	.773	.285	79.7	89.5	60.5	29.0
2	.936	.030	.734	.296	80.7	91.4	60.3	31.1
3	.917	.010	.705	.305	81.4	91.5	60.0	31.5
4	.907	.000	.698	.302	81.2	91.5	60.0	31.5
5	.908	.005	.692	.313	80.3	90.0	60.5	29.5
6	.919	.029	.697	.332	78.1	86.5	61.0	25.5
7	.929	.019	.715	.304	75.7	83.4	60.5	23.9
8	.948	.037	.739	.298	74.2	81.0	60.2	20.8
9	.964	.046	.760	.286	72.9	79.2	60.5	18.7
10	.974	.060	.771	.289	71.8	78.2	60.4	17.8
11	.970	.053	.761	.292	71.1	77.4	60.4	17.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	67.3	3.3	64.7	5.9	0.611	6.72	1.43	0.83
1	67.0	3.0	64.6	5.4	.609	.71	.29	.84
2	66.5	3.0	64.1	5.4	.599	.60	.28	.84
3	66.1	2.7	63.9	4.9	.595	.56	.15	.85
4	65.6	2.7	63.4	4.9	.586	.46	.14	.85
5	65.2	2.6	63.1	4.7	.580	.41	.07	.86
6	64.9	2.6	62.8	4.7	.574	.35	.07	.86
7	64.8	2.6	62.7	4.7	.572	.33	.06	.86
8	65.6	2.9	63.3	5.2	.584	.44	.21	.84
9	66.4	4.5	62.8	8.1	.574	.31	.92	.77
10	67.3	6.4	62.8	10.9	.574	.27	2.69	.70
11	67.7	8.5	61.7	14.5	.554	.00	3.66	.62
Noon.	68.0	10.2	60.9	17.3	.539	5.83	4.42	.57
1	68.3	11.4	60.3	19.4	.528	.70	5.02	.53
2	68.4	12.3	59.8	20.9	.520	.59	.45	.51
3	68.3	13.1	59.1	22.3	.508	.46	.81	.48
4	68.0	13.2	58.8	22.4	.503	.40	.81	.48
5	68.5	11.8	60.2	20.1	.527	.67	.24	.52
6	68.9	9.2	62.5	15.6	.568	6.15	4.07	.60
7	68.3	7.4	63.1	12.6	.580	.30	3.21	.66
8	68.1	6.1	63.8	10.4	.593	.48	2.61	.71
9	67.6	5.3	63.4	9.5	.586	.40	.33	.73
10	67.3	4.5	63.7	8.1	.591	.48	1.97	.77
11	67.2	3.9	64.1	7.0	.599	.58	.70	.80

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	...	0.04	S. S. W.	...	90.9	Stratoni to 11 A. M., scatd. ⌒i to 6 P. M., clear afterwards. Slightly foggy from 2 to 7 A. M. Rain at $11\frac{1}{2}$ A. M.
2	123.0	...	S.S.W.&W.byS.	0.2	147.6	Scuds from S. W., to 7 A. M. clear to 7 P. M., scatd. ⌒i afterwards.
3	119.0	...	NNW.&variable.	0.3	135.7	Chiefly clear.
4	116.5	...	W.S.W,N.W.&NNW.	0.4	129.0	Clear.
5	120.0	...	S.S.E. & S. S. W.	...	108.0	Clear. Slightly foggy at 8 & 9 P. M.
6	120.3	...	S. S. E.	0.4	96.3	Clear to 1 A. M., ⌒i afterwards. Lightning from 7 to 11 P. M.
7	108.0	0.12	N.N,W.&N.E.	1.9	212.9	Overcast to 1 P. M., clear afterwards. Lightning from midnight to 2 A. M. Thunder at 2 A. M. Rain at $2\frac{1}{2}$ A. M.
8	113.0	...	N.N.W.&E.N.E.	0.2	99.4	Clear to 1 P. M., stratoni afterwards.
9	...	1.93	E. & N. E.	...	119.2	\i & ⌒i to 7 A. M., overcast afterwards. Rain from $7\frac{1}{4}$ A. M. to 11 P. M.
10	...	0.63	N. E. & E. N. E	...	183.8	Overcast to 6 P. M., clear afterwards. Thunder at 1 & 2 A. M. Slightly foggy at 11 P. M. Rain from midnight to noon.
11	113.0	...	E .N. E. & N.	...	50.0	Chiefly clear. Foggy at 7. & 8. A. M. & from 9 to 11 P. M.
12	120.5	...	N.byW.&W.SW.	...	58.4	Clear. Slightly foggy from midnight to 3 A. M. & at 8 & 9 P. M.
13	117.8	...	S. W. & S. S. W.	...	75.0	Clear.
14	120.0	...	S. S. W. & S. W.	...	112.7	Chiefly clear. Foggy from 6 to 9 A. M. & at 8 & 9 P. M.
15	122.0	...	W,WNW&WbyS	...	86.3	Clear to 2 P. M., stratoni to 8 A. M., clear afterwards. Foggy from midnight to 2 & from 6 to 8 A. M.
16	128.0	...	S. S. W.	...	108.0	Clear to 6 A. M., stratoni to 9 A. M., scatd. ⌒i to 4 P. M., clear afterwards. Foggy from 3 to 7 A. M.
17	126.6	...	S.S.W,S.W.&E.	...	134.0	Clear to 4 A. M., stratoni to 9 A. M., scatd. ⌒i to 3 P. M., clear afterwards. Foggy from 7 to 9 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	Wind.			General aspect of the Sky.
			Prevailing direction.	Max. Pressure	Daily Velocity.	
	o	Inches		lb	Miles	
18	129.0	...	S.S.W, W.N.W. & W. by S.	...	62.0	Clear to 10 A. M., ⌒i to 5 P. M., clear afterwards.
19	126.6	...	W. S. W. & S. W.	...	82.3	Clear to 6 A. M., stratoni to 10 A. M., clear afterwards. Foggy at 7 & 8 A. M. & at 11 P. M.
20	124.0	...	S. S. W. & S. W.	1.0	116.7	Stratoni to 9 A. M., clear afterwards. Foggy from 5 to 8 A. M.
21	126.6	...	S. by W, S.W. & S.	0.8	130.5	Chiefly clear
22	123.0	...	S. S. W. & W. by S.	...	285.8	Clear
23	121.0	...	S. S. W. & S. W.	...	94.0	Clear
24	125.5	...	S. & N. N. E.	...	109.6	Clear to 2 P. M., scatd. \i afterwards. Foggy at 7 & 8 P. M.
25	131.5	...	N. W. & W. S. W.	...	89.4	⌣i to 4 A. M., scatd \i afterwards.
26	128.5	...	S. S. W.	...	125.3	Chiefly scatd. \i
27	129.0	...	S. W. & S. S. W.	...	101.7	Chiefly scatd. \i
28	...	...	S W. & W. N. W.	...	78.6	Clouds of different kinds.

\i Cirri, —i Strati, ⌒i Cumuli, ⌞i Cirro-strati, ⌒i Cumulo strati, ⌣i Nimbi ⌣i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1869.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.958
Max. height of the Barometer occurred at 10 A. M. on the 11th. ...	30.133
Min. height of the Barometer occurred at 5 P. M. on the 2nd. ...	29.692
Extreme range of the Barometer during the month	0.441
Mean of the daily Max. Pressures	30.034
Ditto ditto Min. ditto	29.895
Mean daily range of the Barometer during the month	0.139

	o
Mean Dry Bulb Thermometer for the month	73.5
Max. Temperature occurred at 3 & 4 P. M. on the 25th.	91.5
Min. Temperature occurred at 6 & 7 A. M. on the 11th	57.5
Extreme range of the Temperature during the month	34.0
Mean of the daily Max. Temperature	81.8
Ditto ditto Min. ditto, ...	67.0
Mean daily range of the Temperature during the month... ...	14.8

Mean Wet Bulb Thermometer for the month	67.1
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.4
Computed Mean Dew-point for the month	62.6
Mean Dry Bulb Thermometer above computed mean Dew-point ...	10.9
	Inches.
Mean Elastic force of Vapour for the month	0.570

	Troy grain.
Mean Weight of Vapour for the month	6.23
Additional Weight of Vapour required for complete saturation ...	2.67
Mean degree of humidity for the month, complete saturation being unity	0.70
	o
Mean Max. Solar radiation Thermometer for the month.	122.2

	Inches.
Rained 4 days,—Max. fall of rain during 24 hours	1.93
Total amount of rain during the month	2.72
Total amount of rain indicated by the Gauge attached to the anemometer during the month	2.53
Prevailing direction of the Wind... ... S. S. W., & S. W.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Feb. 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night									1				1						1	1	3			
1	1								1				1						1	1	2		1	
2									2				1						1	1	2		1	
3									2	1	1						1	1			2			
4	1	1							1		2										2			
5	1				1				1		1				1						2			
6	1		1	1			1		1												2			
7	1						2	1					1								1			
8							1		1	1			1	1							1			
9							2		1	1							1				1			
10					2		2	1					1	1							1			
11	1				1				1		1	1	1	1							1			
Noon.	3		1		1		2																1	
1	1		1		1		1	1																
2					2				1	1														
3					1		2	1																
4	1				2		2	1					1								1			
5					1		2	1	1				1										1	
6	1				1		1		1				1								1			
7	1				1		1		1				2	1							1			
8	1				1		1		1				1						1		1			
9	1								3				2						1	1	1			
10	1								2				1								3	1	1	
11	1								1				1						1	1	4			

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	2		1		12		2		2								1				1		1	
1	1		2		11		2		2								1				1		1	
2	1		1		11		1		3								1				2		1	
3	1		1		10		3		4												2		1	
4	3				7		4		2								2		1		2		1	
5	1		2		6		4		1		1		1				2				2		1	
6			2		5		5		1		1		1		1		2		1		2		1	
7			2		4		5		1		2		1		1		2		1		3		1	
8			2		5		4				2		2				3		2		2		2	
9	1				5		4		1		1		1				2		4		1		3	
10			2		2		5		1		1		1		1		4		3		2			
11	1		1		1		6		2		2						4		2		2		1	
Noon.	1				2		5	1	2		2		3		2		1		1		1			
1	1				1		7		2		3		2		1		3		3				1	
2	1				3		6		1		3		3				4		1		2		1	
3	2				1		5		2		5		3		2				4		1			
4	3						5		3		3		5				1				1			
5			2		4		3		6		3		1						1		1		1	
6	2				5		5		4		2				1				1		2	1		
7					10		4		2		2				1						2			
8	1		1		10		2		2		2				1						2			
9	2		1		10		2		2		1				1						1			
10	2		2		8		3		4												1			
11	2		1		9		4		2								1				1			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.932	30.016	29.862	0.154	77.9	86.8	71.5	15.3
2	.867	29.933	.808	.125	79.8	88.3	73.6	14.7
3	.863	.931	.797	.134	86.5	89.5	74.0	15.5
4	.904	.966	.834	.132	77.9	81.5	76.0	5.5
5	.925	.987	.865	.122	79.8	86.5	74.4	12.1
6	.913	30.030	.815	.215	75.4	84.5	68.8	15.7
7	.900	29.997	.826	.171	73.5	79.5	68.0	11.5
8	.868	.941	.814	.127	75.7	83.0	68.6	14.4
9	.901	.987	.841	.146	78.7	86.8	71.6	15.2
10	.934	30.092	.843	.249	73.2	76.5	65.8	10.7
11	.883	29.966	.819	.147	75.5	83.5	68.0	15.5
12	.870	.960	.809	.151	78.6	87.7	71.4	16.3
13	.848	.925	.783	.142	80.4	88.5	74.3	14.2
14	.821	.889	.756	.133	81.9	89.8	76.0	13.8
15	.807	.865	.749	.116	83.4	92.7	76.8	15.9
16	.874	.952	.834	.118	82.8	89.7	78.0	11.7
17	.855	.926	.800	.126	84.0	93.4	76.8	16.6
18	.844	.921	.797	.124	81.7	87.9	76.5	11.4
19	.803	.875	.731	.144	81.0	92.5	74.5	18.0
20	.806	.890	.749	.141	80.5	89.4	73.6	15.8
21	.825	.892	.770	.122	77.9	85.6	73.7	11.9
22	.877	.955	.812	.143	78.0	87.5	69.0	18.5
23	.883	.971	.812	.159	78.3	87.4	70.4	17.0
24	.878	.954	.806	.148	82.3	90.5	75.4	15.1
25	.852	.944	.790	.154	81.6	89.5	75·5	14.0
26	.841	.926	.775	.151	84.1	92.3	76.9	15.4
27	.848	.939	.774	.165	83.9	93.8	76.5	17.3
28	.892	.963	.828	.135	82.6	91.4	75.5	17.9
29	.893	.960	.839	.121	83.6	92.0	76.0	16.0
30	.886	.949	.818	.131	82.8	92.0	75.0	17.0
31	.897	.974	.849	.125	84.4	94.5	74.7	19.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	73.2	4.7	69.9	8.0	0.725	7.85	2.31	0.77
2	70.8	9.0	64.5	15.3	.607	6.56	4.19	.61
3	76.3	4.2	73.4	7.1	.811	8.75	2.23	.80
4	74.9	3.0	72.8	5.1	.795	.62	1.54	.85
5	75.6	4.2	72.7	7.1	.792	.56	2.19	.80
6	71.3	4.1	68.4	7.0	.690	7.51	1.92	.80
7	69.3	4.2	66.4	7.1	.646	.07	.83	.79
8	70.4	5.3	66.7	9.0	.653	.10	2.41	.75
9	73.2	5.5	69.3	9.4	.711	.69	.72	.74
10	70.5	2.7	68.3	4.9	.688	.52	1.30	.85
11	69.6	5.9	65.5	10.0	.628	6.84	2.62	.72
12	73.6	5.0	70.1	8.5	.729	7.89	.49	.76
13	76.4	4.0	73.6	6.8	.817	8.80	.14	.80
14	75.5	6.4	71.0	10.9	.751	.07	3.37	.71
15	77.2	6.2	72.9	10.5	.797	.54	.42	.71
16	76.0	6.8	71.2	11.6	.756	.10	.65	.69
17	75.2	8.8	69.0	15.0	.704	7.53	4.64	.62
18	71.7	10.0	64.7	17.0	.611	6.57	.80	.58
19	70.9	10.1	63.8	17.2	.593	.39	.75	.57
20	71.1	9.4	64.5	16.0	.607	.54	.44	.60
21	72.2	5.7	68.2	9.7	.686	7.43	2.73	.73
22	71.7	6.3	67.3	10.7	.666	.21	.98	.71
23	73.5	4.8	70.1	8.2	.729	.90	.38	.77
24	76.5	5.8	72.4	9.9	.785	8.43	3.15	.73
25	75.8	5.8	71.7	9.9	.768	.26	.08	.73
26	74.7	9.4	68.1	16.0	.684	7.31	4.90	.60
27	74.4	9.5	67.7	16.2	.674	.22	.91	.60
28	73.7	8.9	67.5	15.1	.670	.20	.48	.62
29	73.0	10.6	65.6	18.0	.630	6.75	5.28	.56
30	71.7	11.0	63.9	18.9	.595	.38	.37	.54
31	73.5	10.9	65.9	18.5	.636	.79	.52	.55

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.879	29.979	29.801	0.178	76.4	81.0	68.0	13.0
1	.867	.960	.795	.165	76.0	80.3	69.0	11.3
2	.855	.954	.786	.168	75.6	79.5	68.8	10.7
3	.847	.950	.780	.170	75.2	78.8	68.8	10.0
4	.841	.943	.773	.170	74.6	78.6	68.9	9.7
5	.850	.947	.783	.164	74.2	78.4	68.5	9.9
6	.869	.953	.797	.156	74.0	78.0	68.5	9.5
7	.892	.979	.825	.154	74.3	78.0	68.0	10.0
8	.921	.993	.858	.135	76.3	80.6	70.5	10.1
9	.942	30.092	.865	.227	78.6	84.5	65.8	18.7
10	.946	.045	.865	.180	81.0	87.0	66.4	20.6
11	.934	.016	.851	.165	83.2	90.0	66.5	23.5
Noon.	.914	.011	.820	.191	84.8	92.2	70.5	21.7
1	.886	29.963	.809	.154	86.1	92.5	72.3	20.2
2	.857	.940	.785	.155	86.9	93.6	73.6	20.0
3	.832	.885	.761	.124	87.2	94.3	75.0	19.3
4	.817	.878	.731	.147	87.4	94.5	76.5	18.0
5	.813	.889	.738	.151	86.7	93.9	75.5	18.4
6	.817	.898	.741	.157	84.5	90.3	74.5	15.8
7	.830	.909	.750	.159	82.3	87.2	73.5	13.7
8	.852	.936	.761	.175	80.9	86.0	73.5	12.5
9	.874	.943	.785	.158	79.3	84.0	73.0	11.0
10	.883	30.000	.805	.195	78.3	82.6	73.2	9.4
11	.884	.030	.802	.228	77.4	81.8	68.8	13.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	72.6	3.8	69.9	6.5	0.725	7.87	1.85	0.81
1	72.5	3.5	70.0	6.0	.727	.90	.70	.82
2	72.2	3.4	69.8	5.8	.722	.85	.63	.83
3	72.0	3.2	69.8	5.4	.722	.87	.50	.84
4	72.0	2.6	70.2	4.4	.732	.99	.21	.87
5	71.8	2.4	70.1	4.1	.729	.97	.12	.88
6	71.7	2.3	70.1	3.9	.729	.97	.07	.88
7	72.1	2.2	70.6	3.7	.741	8.08	.04	.89
8	73.0	3.3	70.7	5.6	.744	.08	.61	.83
9	73.3	5.3	69.6	9.0	.717	7.76	2.62	.75
10	73.6	7.4	68.4	12.6	.690	.42	3.72	.67
11	74.0	9.2	67.6	15.6	.672	.20	4.69	.61
Noon.	74.1	10.7	66.6	18.2	.651	6.95	5.51	.56
1	74.2	11.9	65.9	20.2	.636	.78	6.17	.52
2	74.1	12.8	66.4	20.5	.646	.87	.38	.52
3	74.2	13.0	66.4	20.8	.646	.87	.50	.51
4	74.4	13.0	66.6	20.8	.651	.91	.54	.51
5	74.4	12.3	67.0	19.7	.659	7.01	.17	.53
6	74.7	9.8	67.8	16.7	.677	.23	5.12	.59
7	74.5	7.8	69.0	13.3	.704	.56	4.02	.65
8	74.1	6.8	69.3	11.6	.711	.64	3.46	.69
9	73.6	5.7	69.6	9.7	.717	.74	2.85	.73
10	73.3	5.0	69.8	8.5	.722	.81	.47	.76
11	73.1	4.3	70.1	7.3	.729	.92	.09	.79

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	120.0	...	S.S.W,W.S.W.& S.byW.	...	106.5	Clear to 2 A. M., \i to 7 A. M., clear to 1 P. M., ⌒i to 6 P. M., clear afterwards.
2	125.0	...	S. S. W. & S. W.	...	150.2	Chiefly clear.
3	127.0	...	S. by W.	...	88.6	Clear to 2 A. M., scuds to 9 A. M., ⌒i to 7 P. M., clear afterwards. Foggy at 6 A. M. Lightning at 11 P. M.
4	...	0.04	Variable.	7.0	212.0	Clouds of different kinds to 11 A. M., stratoni to 7 P. M., clear afterwards. High wind at $11\frac{1}{4}$ A. M. Thunder at 4 & 5 A.M. Lightning at 4, 5 & 11 A. M. & at 7 P. M. Light rain at 4 & $11\frac{1}{4}$ A.M.
5	120.4	...	S. & S. S. W.	2.0	118.3	Clouds of different kinds to 8 A. M. ⌒i to 6 P. M. ∽i afterwards. Brisk wind at $11\frac{1}{2}$ P. M. Thunder at 11 P. M. Lightning at 10 & 11 P. M.
6	121.5	1.19	Variable.	20.0	116.5	Chiefly stratoni. Storm at 10 P. M. Thunder at midnight & 1 A. M. & at 10 & 11 P. M. Lightning at midnight, & 1 A. M. & from 9 to 11 P. M. Rain at midnight & at 10 & 11 P. M.
7	117.5	...	S. E. & variable.	0.4	182.4	Stratoni to 6 A. M. \i to 6 P. M. clear afterwards.
8	123.5	...	S. E. & S.	6.0	116.5	∽i to 5 A. M. \i to 11 A. M. \i to 2 P. M., ⌒i to 6 P. M. clear afterwards. High wind at 0 h. 20 m. Thunder & drizzled at midnight. Lightning to S at 4 & 5 A. M.
9	126.5	...	S. & N.	...	85.0	Chiefly clear & \i.
10	110.0	1.04	S. S. E. & variable	10.0	138.4	Clear to 4 A. M., stratoni to 8 A. M., overcast to 11 A. M., clouds of different kinds afterwards. High wind from $8\frac{1}{4}$ to 10 A. M. Foggy at 7 & 8 A. M. Thunder & Lightning at 8 & 9 A. M. & at 8 P. M. Rain from $8\frac{1}{2}$ to 11 A. M. & at $1\frac{1}{2}$ & $8\frac{1}{2}$ P. M.
11	125.0	...	N. N. E., W. S. W. & S. S. W.	...	95.7	\i to 10 A. M., clear afterwards.
12	131.0	...	S. by W. & S. S. W.	0.3	136.2	Clear to 9 A. M., ⌒i to 4 P. M. \i 7 to P. M., clear afterwards.
13	127.8	...	S. S. W.	0.2	150.8	Clear to 4 A. M., \i & ⌒i afterwards. Slightly foggy at 4 & 5 A. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
14	131.0	...	S. W.	...	159.9	Clear to 5 A. M. \i & _i to 6 P. M., clear afterwards.
15	129.0	...	S. S. W. & S. W.	...	88.3	Stratoni to 7 A. M. \i to 6 P. M., clear afterwards. Foggy at 6 A. M.
16	126.0	...	S. W.	...	109.7	\i to 4 A. M., stratoni to 2 P. M., \i to 6 P. M., clear afterwards.
17	130.0	...	S. W.	...	93.4	Clear to 6 A. M., \i afterwards.
18	125.5	...	S. W. & S. S. W.	...	100.6	Clear to 5 A. M., stratoni afterwards.
19	131.0	...	S. & variable.	4.7	93.5	Clear to 5 A. M. \⌒i to 9 A. M. \i afterwards. Brisk wind from $1\frac{1}{4}$ to $2\frac{3}{4}$ P. M.
20	127.5	...	W.S.W.&variable	...	162.3	Stratoni to 6 A. M. \i to 6 P. M., clear afterwards.
21	119.5	...	S.S.W.& variable.	3.1	104.3	Clear to 5 A. M. \i to 11 A. M., stratoni to 3 P. M. \i afterwards. Brisk wind from noon to $3\frac{1}{4}$ P.M. Light rain at 4 & $5\frac{1}{2}$ P.M.
22	129.0	2.32	Variable	23.0	180.0	\i to noon ⌒i to 6 P. M., \⌒i afterwards. Storm from $8\frac{3}{4}$ to $9\frac{1}{2}$ P. M. Thunder at 8 & 9 P. M. Lightning at midnight & from 7 to 10 P. M. Rain at 9 & 10 P. M.
23	129.0	...	S.by W.&W.S.W.	...	121.8	Clear to 10 A. M. ⌒i to 4 P. M. clear afterwards.
24	131.5	...	S.W, W.S.W.&S. [S.W.	...	93.4	Clear to 3 A. M., clouds of different kinds afterwards. Foggy at 6 & 7 A. M.
25	130.5	...	S. W, & S. S. W.	...	157.4	\⌒i to 5 A. M. ⌒i to 3 P. M., clear afterwards. Drizzled at 4 A. M.
26	130.0	...	S. S. W. & S. W.	...	118.9	Chiefly clear.
27	130.2	...	S. W. & W. S. W.	8.5	87.2	Clear to 4 P. M., clouds of different kinds afterwards High wind from $8\frac{1}{4}$ to $8\frac{1}{2}$ P. M. Thunder at 9 P. M. Lightning at 8 & 9 P. M. Drizzled at 9 & 10 P. M.
28	129.0	...	S. & variable.	...	205.2	\i to 5 A.M., clear afterwards
29	130.0	...	N.by W. & S.S.E.		97.6	Clear to 5 A. M., clouds of different kinds afterwards.
30	131.0	...	S. W.	3.3	97.3	Stratoni to 7 A. M., \⌒i & ⌒i to 11 A. M., clear afterwards. Brisk wind from 2 to $2\frac{1}{2}$ A. M.
31	135.0	...	S. W .& S. S. W.	...	126.5	Clear.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒ i Cumulo strati, \⌒i Nimbi ⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.871
Max. height of the Barometer occurred at 9 A. M. on the 10th. ...	30.092
Min. height of the Barometer occurred at 4 P. M. on the 19th. ...	29.731
Extreme range of the Barometer during the month	0.361
Mean of the daily Max. Pressures	29.951
Ditto ditto Min. ditto	29.807
Mean daily range of the Barometer during the month	0.144

	o
Mean Dry Bulb Thermometer for the month	80.1
Max. Temperature occurred at 4 P. M. on the 31st.	94.5
Min. Temperature occurred at 9 A. M. on the 10th	65.8
Extreme range of the Temperature during the month	28.7
Mean of the daily Max. Temperature	88.2
Ditto ditto Min. ditto, ...	73.4
Mean daily range of the Temperature during the month... ...	14.8

Mean Wet Bulb Thermometer for the month	73.3
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.8
Computed Mean Dew-point for the month	68.5
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.6
	Inches.
Mean Elastic force of Vapour for the month	0.692

	Troy grain.
Mean Weight of Vapour for the month	7.47
Additional Weight of Vapour required for complete saturation ...	3.37
Mean degree of humidity for the month, complete saturation being unity	0.69
	o
Mean Max. Solar radiation Thermometer for the month.	126.7

	Inches.
Rained 8 days,—Max. fall of rain during 24 hours	2.32
Total amount of rain during the month	4.59
Total amount of rain indicated by the Gauge attached to the anemometer during the month	3.45
Prevailing direction of the Wind... ...	S. W., & S. S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
																				No. of days																												
Mid night							1														3		1		3		2		9		8	1			1	1	1										1	
1													1								2		1		3		3		9		7						1						1		1		1	
2	1												1						1		2		1		3		3		9		7						1										1	
3	1				1								1						1		1				3		3		7		7		2		1				1								1	
4					1				1										2		2	1			4	1	4		6		5		3						1								1	
5					1								1						2		1				4		4		7		5		2						1		1						1	
6					1														3		2				2		4		5		6		4				1								1		1	
7													1		1		1		1		1				1		4		4		6		6				2				1						2	
8	1																2		1		1		1		2		2		4		5		6				1				4						1	
9							1						1				1		1				1				2		4		7		5								4		2	1	1		1	
10	3	1											1						1								1		1		6		5		1		5		1		3		3					
11	2				1		3	1	1				1								1		1				1		1		8		3				4		1				2		1			
Noon.	4				2		3	1							1												4		2		9		1		1		2		1				1					
1	1				2		2		2														1				1		3		8		4				3		1		1				2			
2	1						2		1	1	2		1												1		2				6		3		3		3				4		1				1	
3					1		1		2				1				1		1				1		1				4		3		5				2		2		2		4					
4	1				1						1								2		1		1		2		1		3		5		4				4		1		1		3	1				
5	1						1										1		2				1		2		2		7		4		4		1				2		3							
6	1						1										1				2				1		3		7		8		3		1		1	1	1									
7	1						1								1				1		1		1		4				10		5		3		1				1									
8					1				1										2	1	2		1		4		1		9		7		2															
9									1												3		1		4		1		9		6		2	1			1						2	2				
10																			2		2		2		3		3		7		9	1					1		1	1								
11																					2		1		4		5		6		8						2								1	1	1	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.888	29.968	29.821	0.147	85.7	95.5	77.5	18.0
2	.845	.912	.762	.180	85.8	95.5	79.0	16.5
3	.805	.875	.753	.122	86.6	96.8	77.5	19.3
4	.836	.910	.787	.123	86.7	96.5	77.9	18.6
5	.828	.924	.745	.179	87.1	98.0	76.6	21.4
6	.746	.836	.655	.181	88.2	99.5	79.0	20.5
7	.710	.806	.625	.181	87.1	95.5	80.1	15.4
8	.680	.743	.607	.136	87.2	98.1	79.0	19.1
9	.703	.766	.656	.110	85.6	93.0	80.0	13.0
10	.792	.909	.701	.208	84.8	92.5	79.5	13.0
11	.819	.914	.756	.158	84.9	95.2	79.0	16.2
12	.816	.891	.750	.141	85.4	95.4	77.5	17.9
13	.786	.850	.711	.139	85.6	93.8	79.5	14.3
14	.724	.797	.641	.156	85.3	92.0	80.8	11.2
15	.673	.767	.566	.201	85.6	91.0	82.6	8.4
16	.664	.742	.530	.212	83.6	91.8	75.0	16.8
17	.677	.734	.630	.104	87.3	96.3	81.5	14.8
18	.714	.782	.643	.139	87.7	95.6	82.5	13.1
19	.730	.799	.655	.144	86.2	91.5	80.6	10.9
20	.769	.830	.718	.112	86.2	92.2	82.0	10.2
21	.814	.884	.743	.141	86.5	93.3	81.5	11.8
22	.796	.877	.681	.196	86.6	93.3	81.7	11.6
23	.704	.771	.608	.163	87.2	94.8	81.5	13.3
24	.661	.739	.578	.161	87.3	95.4	81.4	14.0
25	.722	.851	.652	.199	87.1	94.0	76.5	17.5
26	.762	.820	.704	.116	86.7	96.4	77.0	19.4
27	.744	.814	.660	.154	87.6	97.5	81.7	15.8
28	.725	.805	.659	.146	87.1	98.5	79.0	19.5
29	.751	.812	.677	.135	87.7	97.5	80.5	17.0
30	.796	.860	.725	.135	88.5	98.2	80.3	17.9

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	75.3	10.4	68.0	17.7	0.681	7.26	5.54	0.57
2	74.8	11.0	67.1	18.7	.661	.04	.79	.55
3	74.7	11.9	67.6	19.0	.672	.16	.98	.55
4	73.6	13.1	65.7	21.0	.632	6.73	6.45	.51
5	74.5	12.6	66.9	20.2	.657	.99	.34	.52
6	76.6	11.6	69.6	18.6	.717	7.60	1.6	.55
7	75.2	11.9	68.1	19.0	.684	.26	.07	.55
8	79.2	8.0	74.4	12.8	.838	8.91	4.46	.67
9	79.4	6.2	75.1	10.5	.857	9.13	3.63	.72
10	75.4	9.4	68.8	16.0	.699	7.46	5.00	.60
11	76.0	8.9	69.8	15.1	.722	.71	4.78	.62
12	75.8	9.6	69.1	16.3	.706	.53	5.15	.59
13	79.6	6.0	75.4	10.2	.865	9.24	3.52	.72
14	79.4	5.9	75.3	10.0	.862	.21	.43	.73
15	79.4	6.2	75.1	10.5	.857	.13	.63	.72
16	78.5	5.1	74.9	8.7	.851	.11	2.92	.76
17	80.7	6.6	76.7	10.6	.902	.58	3.83	.71
18	81.3	6.4	77.5	10.2	.925	.84	.72	.73
19	80.6	5.6	76.7	9.5	.902	.60	.39	.74
20	80.5	5.7	76.5	9.7	.896	.56	.43	.74
21	80.6	5.9	77.1	9.4	.913	.74	.36	.74
22	80.7	5.9	77.2	9.4	.916	.77	.37	.74
23	81.2	6.0	77.6	9.6	.928	.87	.50	.74
24	81.8	5.5	78.5	8.8	.955	10.16	.25	.76
25	81.0	6.1	77.3	9.8	.919	9.78	.55	.73
26	80.5	6.2	76.8	9.9	.905	.63	.55	.73
27	79.7	7.9	75.0	12.6	.854	.07	4.45	.67
28	78.0	9.1	72.5	14.6	.787	8.37	.96	.63
29	79.7	8.0	74.9	12.8	.851	9.04	.52	.67
30	80.0	8.5	74.9	13.6	.851	.02	.86	.65

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.764	29.900	29.664	0.236	82.4	84.2	77.0	7.2
1	.753	.890	.653	.237	81.8	84.0	76.0	8.0
2	.743	.883	.646	.237	81.3	83.6	75.5	8.1
3	.734	.871	.640	.231	80.9	83.6	75.0	8.6
4	.934	.874	.639	.235	80.5	83.5	75.6	7.9
5	.749	.889	.656	.233	80.3	83.5	75.6	7.9
6	.769	.904	.681	.223	80.2	84.0	76.6	7.4
7	.793	.932	.697	.235	81.1	84.5	77.5	7.0
8	.814	.950	.717	.233	83.4	86.6	79.5	7.1
9	.827	.968	.726	.242	86.0	88.5	79.0	9.5
10	.828	.967	.734	.233	88.5	91.0	82.0	9.0
11	.819	.958	.721	.237	90.9	93.6	85.4	8.2
Noon.	.797	.932	.704	.228	92.5	95.8	88.2	7.6
1	.768	.910	.669	.241	93.8	97.7	90.4	7.3
2	.737	.872	.645	.227	94.6	99.4	91.0	8.4
3	.709	.857	.617	.240	94.8	99.5	90.4	9.1
4	.693	.842	.592	.250	94.2	99.5	88.8	10.7
5	.686	.839	.530	.309	92.7	99.0	86.7	12.3
6	.691	.821	.534	.287	90.3	97.4	85.5	11.9
7	.713	.830	.588	.242	87.6	92.5	84.4	8.1
8	.734	.837	.620	.217	86.0	91.0	83.7	7.3
9	.755	.862	.631	.231	84.8	88.5	82.7	5.8
10	.770	.871	.645	.226	83.7	87.0	79.0	8.0
11	.768	.864	..645	.219	83.1	85.6	76.5	9.1

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	78.5	3.9	75.8	6.6	0.876	9.41	2.20	0.81
1	78.2	3.6	75.7	6.1	.873	.40	.00	.83
2	78.0	3.3	75.7	5.6	.873	.40	1.84	.84
3	77.9	3.0	75.8	5.1	.876	.44	.66	.85
4	77.8	2.7	75.9	4.6	.879	.47	.51	.86
5	77.6	2.7	75.7	4.6	.873	.41	.50	.86
6	77.6	2.6	75.8	4.4	.876	.46	.42	.87
7	77.9	3.2	75.7	5.4	.873	.41	.76	.84
8	78.4	5.0	74.9	8.5	.851	.11	2.85	.76
9	78.8	7.2	73.8	12.2	.822	8.76	4.15	.68
10	78.9	9.6	73.1	15.4	.803	.53	5.35	.62
11	78.8	12.1	71.5	19.4	.763	.06	6.83	.54
Noon.	78.8	13.7	70.6	21.9	.741	7.79	7.80	.50
1	78.9	14.9	70.0	23.8	.727	.62	8.56	.47
2	79.0	15.6	69.6	25.0	.717	.51	9.00	.46
3	78.8	16.0	69.2	25.6	.708	.41	.24	.45
4	78.8	15.4	69.6	24.6	.717	.51	8.85	.46
5	78.6	14.1	70.1	22.6	.729	.66	.02	.49
6	78.7	11.6	71.7	18.6	.768	8.11	6.52	.55
7	78.6	9.0	73.2	14.4	.806	.57	4.95	.63
8	78.5	7.5	73.2	12.8	.806	.59	.32	.67
9	78.6	6.2	74.3	10.5	.835	.92	3.54	.72
10	78.4	5.3	74.7	9.0	.846	9.06	.01	.75
11	78.6	4.5	75.4	7.7	.865	.28	2.58	.78

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	131.6	...	S. S. W. & S. W.	...	157.2	Clear.
2	134.0	...	S. W. & S. S. W.	0.6	126.1	Chiefly clear. Thunder at $7\frac{1}{2}$ A. M. Slight rain at 8 A. M.
3	135.5	...	S. W. & S. S. W.	...	115.6	Clear.
4	133.0	...	S. S. W. & S. W.	...	69.0	Clear.
5	135.0	...	S. W.	...	107.2	Clear.
6	135.0	...	S. W.	...	127.3	Clear.
7	127.4	...	S. S. W.	...	126.3	Clear to 5 A. M., \i to 10 A. M., stratoni to 5 P. M., clear afterwards.
8	130.0	...	S. W. & S.	0.4	123.5	Chiefly clear.
9	130.0	...	S. & S. S. W.	0.2	180.3	\i to 6 P. M., clear afterwards.
10	129.5	...	S.S.W.& variable	1.0	240.4	Clear to 5 A. M., ⌒i to 10 A. M., clear to 2 P. M., \⌒i to 7 P. M., clear afterwards. Drizzled at 4 P. M.
11	128.5	...	S. W. & S. S. W.	3.5	166.9	Clear to 6 A. M., clouds of different kinds to 6 P. M., clear afterwards. Brisk wind from $8\frac{1}{2}$ to $9\frac{1}{2}$ A. M. Drizzled at 9 A. M.
12	135.5	...	S. W. & S. S. W.	...	125.1	Clear to noon, stratoni to 7 P. M., clear afterwards.
13	130.0	...	S. S. W. & S.	1.1	154.0	⌒i to 4 P. M., clear afterwards.
14	124.0	...	S. S. W.	2.8	303.8	Clear to 6 A. M., ⌒i to 6 P. M., stratoni afterwards. Brisk wind from $7\frac{1}{2}$ A. M. to $10\frac{1}{2}$ P. M. Lightning to N. at 8 P. M.
15	124.0	...	S. S. W. & S.S.E.	11.0	396.2	Chiefly stratoni. High wind from 8 A. M. to 11 P. M. Thunder at 7 P. M. Lightning at 7 & 8 P. M. Drizzled at $6\frac{1}{2}$ A. M.
16	129.8	0.08	S. S. E. & S. S.W.	19.0	480.5	Stratoni to 9 A. M., ⌒i to 3 P. M. overcast afterwards. Strong wind from $8\frac{1}{2}$ A. M. to 11 P. M. Thunder at 5 P. M. Lightning at 8 & 9 P. M. Rain at $6\frac{1}{2}$ P. M.
17	135.4	...	S. W. & S. S. W.	2.6	328.1	Clear to 7 P. M. Stratoni afterwards. Brisk wind from $1\frac{1}{4}$ to 11 P. M.
18	131.4	...	S.S. W., S.W.&S.	1.8	446.6	Stratoni to 7 A. M., ⌒i to 3 P. M., scuds afterwards. Brisk wind from $7\frac{1}{2}$ to 10 A. M. & from $7\frac{1}{2}$ to 11 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
19	128.3	...	S.S.W.& S by W.	4.1	379.8	Scuds to 9 A. M. ⌒i to 3 P. M., scuds to 8 P. M., stratoni afterwards. Brisk wind from $7\frac{1}{2}$ A. M. to $8\frac{1}{2}$ P. M.
20	126.8	...	S. & S. S. W.	1.5	350.6	Stratoni to 11 A. M., ⌒i to 8 P. M., clear afterwards. Brisk wind from 8 to $9\frac{1}{2}$ A. M.
21	131.4	...	S. by W. & SSW.	1.0	269.2	Clear to 2 A. M., scuds to 9 A. M., ⌒i to 4 P. M., scuds afterwards. Brisk wind from $9\frac{1}{4}$ A. M. to $1\frac{1}{4}$ P. M.
22	136.0	...	S. S. W. & S. W.	1.8	265.6	Clear to 6 A. M., scuds to 11 A. M., clear to 5 P. M., stratoni afterwards. Brisk wind from 1 to $4\frac{1}{2}$ P. M. Thunder at 7 P. M. Lightning at 7 & 8 P. M. Drizzled at $7\frac{1}{2}$ P. M.
23	129.0	...	S.S.W,S.W. & S.	2.6	340.0	Stratoni to 3 A. M., clear afterwards. Brisk wind from $8\frac{1}{4}$ to $12\frac{1}{2}$ A. M.
24	129.2	...	S.by W,S.S.W&S.	3.2	369.4	Clear to 3 A. M., ⌒i to 10 A.M., clear to 8 P. M., scuds afterwards. Brisk wind from $7\frac{1}{2}$ A. M. to $1\frac{1}{4}$ P. M.
25	130.7	0.12	S. & S. by E.	7.0	321.9	Chiefly ⌒i. High wind. Thunder & rain at 10 P. M.
26	134.0	...	S. by W.& S.	...	225.6	Clouds of different kinds.
27	134.8	...	S.byE.,S.by W&S	...	151.7	\i to 5 A. M., stratoni to 10 A. M., \i to 5 P. M., clear afterwards.
28	134.0	...	S. by W.&S.S.W.	3.5	139.1	Clouds of different kinds. Brisk wind from 5 to $5\frac{1}{2}$ P. M. Thunder at 6 P. M.
29	137.0	...	S.by W.&S.S.W.	...	124.5	Chiefly \i.
30	137.5	...	S.S.W.&S.E.	...	90.7	Clear to 3 P. M., \i to 7 P. M., clear afterwards.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒-i Cumulo strati, ⌒-i Nimbi
\i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

MONTHLY RESULTS.

		Inches.
Mean height of the Barometer for the month...	...	... 29.756
Max. height of the Barometer occurred at 9 A. M. on the 1st.		... 22.968
Min. height of the Barometer occurred at 5 P. M. on the 16th.		... 29.530
Extreme range of the Barometer during the month	...	... 0.438
Mean of the daily Max. Pressures	...	... 29.834
Ditto ditto Min. ditto	...	... 29.680
Mean daily range of the Barometer during the month	...	... 0.154

			o
Mean Dry Bulb Thermometer for the month ...	...	...	86.5
Max. Temperature occurred at 3 & 4 P. M. on the 6th.	...	...	99.5
Min. Temperature occurred at 3 A. M. on the 16th	...	...	75.0
Extreme range of the Temperature during the month	...	...	24.5
Mean of the daily Max. Temperature	...	...	95.2
Ditto ditto Min. ditto, ...	...	...	79.6
Mean daily range of the Temperature during the month...		...	15.6

Mean Wet Bulb Thermometer for the month	78.5
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	8.0
Computed Mean Dew-point for the month	73.7
Mean Dry Bulb Thermometer above computed mean Dew-point ...	12.8
	Inches.
Mean Elastic force of Vapour for the month	0.819

	Troy grain.
Mean Weight of Vapour for the month	8.73
Additional Weight of Vapour required for complete saturation ...	4.37
Mean degree of humidity for the month, complete saturation being unity	0.67
	o
Mean Max. Solar radiation Thermometer for the month.	131.6

	Inches.
Rained 7 days,—Max. fall of rain during 24 hours	0.12
Total amount of rain during the month	0.20
Total amount of rain indicated by the Gauge attached to the anemometer during the month	0.11
Prevailing direction of the Wind... ... S. S. W., & S. W.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Midnight																					2		2	
1													1						1				2	
2																					3		1	
3																					4			
4																					3		2	
5																					2		2	
6																					2		1	
7																					1		1	
8	1	1																			1		1	
9							1																1	
10	1																						1	
11							1								1								1	
Noon.							1										1				1		1	
1							1												1					
2															1		2							
3											1						1		1		1		1	
4																	2	1	1		1			
5																	1		1		3			
6																			1		4		2	
7																			2		1		3	
8																			1		1		2	
9													1										2	
10																			1				2	
11																			1		1		2	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Midnight	4		5		11		6																	
1	4		4		12		6																	
2	3		5		11		7																	
3	3		4		11		8																	
4	1		6		9		7		1										1					
5	2		6		9		7		1										1					
6	2		7		8		8						1		1									
7	5	1	4		6		9		1				1				2							
8	2		3		7		12		2								1							
9	2		2		9		9		4	1					1		1							
10	1		2		9		11		1		1		2						1					
11	1		2		7		9		2		1				2		1		1		1			
Noon.	3		2		8		7		1				2				2		1					
1	3		4		9		8		1		1		1				1							
2	4		5		8		5		1				3						1					
3	5		1		9		6		2		1		1											
4	4		3		9		6		1		3													
5	4		3		9		8						1											
6	3		2		12		5						1											
7	9				12	1	3																	
8	12	1	4		8		2																	
9	9		5		11		2														1	1		
10	5		3		16		2																	
11	6		8		13		4																	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.796	29.859	29.733	0.126	85.9	92.0	81.0	11.0
2	.836	.918	.772	.146	87.6	97.0	80.0	17.0
3	.825	.911	.721	.190	86.4	95.1	75.5	19.6
4	.736	.805	.663	.142	84.6	92.7	76.3	16.4
5	.755	.810	.677	.133	85.8	94.5	76.9	17.6
6	.777	.847	.723	.124	87.5	95.0	76.6	18.4
7	.779	.890	.708	.182	86.3	95.5	77.2	18.3
8	.729	.798	.641	.157	88.7	98.0	82.0	16.0
9	.674	.726	.611	.115	88.7	96.0	83.0	13.0
10	.665	.723	.616	.107	88.8	96.0	83.0	13.0
11	.671	.720	.619	.101	89.8	98.7	84.0	14.7
12	.668	.729	.586	.143	89.7	100.0	83.5	16.5
13	.685	.765	.617	.148	89.6	99.0	82.0	17.0
14	.737	.808	.645	.163	89.4	97.4	82.3	15.1
15	.678	.779	.572	.207	89.3	97.3	82.5	14.8
16	.486	.614	.317	.297	80.1	86.8	75.9	10.9
17	.603	.666	.465	.201	82.6	93.5	77.5	16.0
18	.599	.659	.534	.125	85.8	91.7	77.7	14.0
19	.536	.590	.458	.132	87.5	92.2	84.5	7.7
20	.591	.643	.548	.095	88.0	93.6	84.5	9.1
21	.595	.708	.492	.216	86.8	94.0	76.4	17.6
22	.594	.674	.511	.163	81.1	89.2	75.5	13.7
23	.594	.662	.522	.140	86.0	93.0	79.0	14.0
24	.627	.690	.519	.171	85.6	93.0	79.0	14.0
25	.625	.694	.563	.131	86.3	94.0	79.0	15.0
26	.629	.725	.535	.190	87.1	94.3	80.6	13.7
27	.659	.714	.596	.118	87.6	94.0	80.6	13.4
28	.634	.689	.555	.134	88.5	95.0	83.5	11.5
29	.555	.637	.453	.184	87.7	96.1	77.5	18.6
30	.552	.623	.475	.148	88.4	96.0	82.8	13.2
31	.626	.715	.572	.143	88.5	95.0	84.0	11.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	79.7	6.2	75.4	10.5	0.865	9.22	3.65	0.72
2	79.6	8.0	74.8	12.8	.849	.02	4.50	.67
3	79.2	7.2	74.2	12.2	.832	8.87	.19	.68
4	77.7	6.9	72.9	11.7	.797	.52	3.87	.69
5	78.9	6.9	74.1	11.7	.830	.85	.98	.69
6	80.9	6.6	76.9	10.6	.908	9.64	8.5	.72
7	78.3	8.0	72.7	13.6	.792	8.44	4.58	.65
8	82.0	6.7	78.0	10.7	.940	9.97	3.99	.71
9	83.0	5.7	79.6	9.1	.989	10.50	.46	.75
10	82.6	6.2	78.9	9.9	.967	.26	.74	.73
11	82.8	7.0	78.6	11.2	.958	.15	4.27	.70
12	82.6	7.1	78.3	11.4	.949	.05	.32	.70
13	82.1	7.5	77.6	12.0	.928	9.83	.50	.69
14	81.4	8.0	76.6	12.8	.899	.52	.73	.67
15	80.8	8.5	75.7	13.6	.873	.24	.97	.65
16	76.5	3.6	74.0	6.1	.827	8.93	1.91	.82
17	76.6	6.0	72.4	10.2	.785	.43	3.25	.72
18	82.2	3.6	79.7	6.1	.992	10.59	2.24	.83
19	83.1	4.4	80.5	7.0	1.017	.83	.66	.80
20	83.5	4.5	80.8	7.2	.027	.92	.76	.80
21	82.2	4.6	79.4	7.4	0.983	.47	.74	.79
22	76.7	4.7	73.4	8.0	.811	8.73	.54	.78
23	80.1	5.9	76.0	10.0	.882	9.41	3.50	.73
24	80.3	5.3	76.6	9.0	.899	.59	.17	.75
25	80.9	5.4	77.1	9.2	.913	.74	.28	.75
26	81.0	6.1	77.3	9.8	.919	.78	.55	.73
27	81.5	6.1	77.8	9.8	.934	.93	.59	.73
28	82.2	6.3	78.4	10.1	.952	10.10	.78	.73
29	81.8	5.9	78.3	9.4	.949	.09	.47	.74
30	82.9	5.5	79.6	8.8	.989	.50	.34	.76
31	82.4	6.1	78.7	9.8	.961	.20	.68	.74

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.672	29.905	29.465	0.440	82.7	86.8	76.3	10.5
1	.656	.871	.485	.386	82.6	86.3	77.0	9.3
2	.645	.838	.476	.362	82.4	85.4	76.2	9.2
3	.640	.807	.475	.332	82.2	84.5	75.6	8.9
4	.643	.816	.521	.295	82.1	84.7	75.5	9.2
5	.657	.843	.533	.310	82.0	85.0	76.0	9.0
6	.673	.859	.532	.327	82.2	85.2	76.0	9.2
7	.696	.877	.563	.314	83.5	86.0	76.6	9.4
8	.715	.890	.582	.308	85.7	88.3	77.5	10.8
9	.721	.911	.587	.324	87.9	90.5	78.6	11.9
10	.721	.889	.590	.299	89.8	93.0	80.4	12.6
11	.712	.871	.561	.310	91.4	96.0	79.5	16.5
Noon.	.696	.858	.539	.319	92.5	97.1	77.7	19.4
1	.671	.830	.481	.349	93.4	98.7	77.7	21.0
2	.647	.811	.441	.370	94.0	99.7	77.0	22.7
3	.622	.795	.403	.392	94.0	100.0	76.6	23.4
4	.601	.778	.353	.425	93.3	98.5	75.9	22.6
5	.590	.772	.325	.447	91.9	97.0	77.0	20.0
6	.599	.794	.317	.477	89.6	94.5	76.6	17.9
7	.620	.802	.330	.472	87.4	91.3	76.5	14.8
8	.649	.822	.351	.471	85.6	89.6	76.4	13.2
9	.667	.857	.389	.468	84.7	88.7	77.3	11.4
10	.684	.887	.419	.468	83.6	87.7	76.6	11.1
11	.684	.918	.444	.474	82.8	87.5	75.5	12.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	79.0	3.7	76.4	6.3	0.893	9.60	2.12	0.82
1	79.0	3.6	76.5	6.1	.896	.63	.05	.82
2	79.0	3.4	76.6	5.8	.899	.65	1.96	.83
3	79.0	3.2	76.8	5.4	.905	.73	.81	.84
4	79.2	2.9	77.2	4.9	.916	.85	.66	.86
5	79.4	2.6	77.6	4.4	.928	.99	.48	.87
6	79.6	2.6	77.8	4.4	.934	10.05	.49	.87
7	80.5	3.0	78.4	5.1	.952	.21	.79	.85
8	81.2	4.5	78.0	7.7	.940	.03	2.77	.78
9	81.7	6.2	78.0	9.9	.940	9.99	3.65	.73
10	82.2	7.6	77.6	12.2	.928	.83	4.59	.68
11	82.6	8.8	77.3	14.1	.919	.70	5.40	.64
Noon.	82.7	9.8	76.8	15.7	.905	.52	6.07	.61
1	82.9	10.5	76.6	16.8	.899	.44	.55	.59
2	82.8	11.2	76.1	17.9	.885	.28	.99	.57
3	82.6	11.4	75.8	18.2	.876	.20	7.07	.57
4	82.5	10.8	76.0	17.3	.882	.27	6.68	.58
5	82.2	9.7	76.4	15.5	.893	.41	5.91	.61
6	81.7	7.9	77.0	12.6	.910	.63	4.70	.67
7	81.0	6.4	77.2	10.2	.916	.75	3.70	.73
8	80.4	5.2	76.8	8.8	.905	.65	.11	.76
9	80.1	4.6	76.9	7.8	.908	.70	2.72	.78
10	79.3	4.3	76.3	7.3	.890	.55	.48	.79
11	79.0	3.8	76.3	6.5	.890	.55	.20	.81

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	128.5	...	S. S. W. & variable.	...	100.7	\i to 4 A. M., stratoni afterwards.
2	137.7	0.24	S. S. W. & S.	0.8	116.4	Clear to 10 A. M., ⌒i afterwards. Lightning at 8 & 11 P. M. Thunder & rain at 11 P. M.
3	130.5	0.66	S. by E. & S.	6.6	242.6	Stratoni to 3 A. M., \⌒i to 9 A. M., clear to 6 P. M., clouds of different kinds afterwards. High wind from $9\frac{3}{4}$ to $10\frac{1}{4}$ P. M. Lightning at midnight & from 8 to 11 P. M. Thunder at 11 P. M. Rain at 10 & 11 P. M.
4	129.0	0.02	S, S. by E. & S. S. E.	3.0	318.0	\⌒i to 7 A. M., ⌒i to 5 P. M., stratoni afterwards. Brisk wind from $6\frac{3}{4}$ A. M. to $5\frac{1}{2}$ P. M. Lightning at 7, 8 & 11 P. M. Thunder & light rain at 8 P. M.
5	131.0	...	Variable.	1.0	248.0	Clouds of different kinds. Lightning at midnight & 8 P. M.
6	131.3	...	S.	8.8	282.7	Chiefly ⌒i. High wind & drizzled at 9h. 20m. P. M. Lightning from 9 to 11 P. M.
7	131.0	...	S. by E. & S.	...	194.3	Chiefly clear.
8	133.5	...	S. by W. & S.	1.6	242.9	Chiefly clear. Brisk wind from 8 A. M. to $6\frac{1}{2}$ P. M.
9	132.5	...	S. by W. & S.	2.8	335.9	Clear to 4 A. M., scuds to 11 A. M., clear to 5 P. M., stratoni afterwards. Brisk wind at $12\frac{1}{2}$ & from $5\frac{1}{2}$ to 8 P. M. & at $11\frac{3}{4}$ P. M.
10	132.0	...	S. S. W.	1.1	355.0	Chiefly clear. Brisk wind from 8 to 11 A. M.
11	134.0	...	S. S. W. & S. by W.	...	287.5	Clear.
12	134.3	...	S. S. W. & S.	1.5	224.0	Chiefly clear. Brisk wind from $6\frac{3}{4}$ to $8\frac{1}{4}$ P. M.
13	131.5	...	S. & S. S. W.	...	251.8	Chiefly clear.
14	134.0	...	S. & S. by W.	...	188.7	Clear to 7 A. M., ⌒i to 2 P. M., clear afterwards. Lightning to N. W. at 9 & 10 P. M.
15	135.0	...	S. & S. by E.	...	167.8	Clouds of different kinds. Lightning to W at 11 P. M.
16	...	2.09	ESE, E. & N. N. W.	17.5	237.7	Overcast. Strong wind from $8\frac{1}{4}$ A. M. to $11\frac{1}{2}$ P. M. Rain at 1 A. M. & from $4\frac{1}{2}$ A. M. to 11 P. M.
17	132.0	...	W. S. W. & S. W.	2.5	488.7	Overcast to 6 A. M., clouds of different kinds afterwards. Brisk wind & slight rain at midnight & 1 A. M. Lighining to S E at 7 & 8 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
18	132.2	...	S. S. W.	3.8	234.1	Chiefly scuds. High wind from $7\frac{1}{4}$ A. M. to 11 P. M.
19	127.0	...	S. S. W. & S.	4.6	435.9	Scuds to 7 P. M. Stratoni afterwards. High wind from $8\frac{1}{2}$ A. M. to 7 P. M.
20	128.0	...	S. & S. S. E.	1.5	367.6	Stratoni to noon, ⌒i to 6 P. M., ⌣i to 9 P. M. Stratoni afterwards. Brisk wind at $9\frac{1}{4}$ A. M. Slight rain at 9 P. M.
21	127.7	0.02	S. by E. & S.	3.4	197.9	Stratoni to 8 A. M., ⌒i to 7 P. M., overcast afterwards. Brisk wind at $7\frac{1}{2}$ P. M. Lightning at 8 & 10 P. M. Thunder & light rain at 8 P. M.
22	124.3	...	S.S.W, & S. by W.	1.1	327.4	Stratoni to 2 A. M., overcast to 9 A. M., clouds of different kinds to 7 P. M., clear afterwards. Brisk wind at $2\frac{1}{2}$ A. M. Slight rain at $6\frac{1}{2}$ A. M.
23	130.2	0.05	S. by W, & S.	9.0	73.1	Clear to 5 A. M., ⌒i afterwards. Brisk wind from $12\frac{3}{4}$ to $3\frac{1}{4}$ P. M. Strong wind at $8\frac{3}{4}$ P. M. Light rain at 9 & 11 P. M.
24	131.5	0.03	S. & W. S. W.	3.3	377.3	⌒i & scuds. Brisk wind at 2 A. M. & from 5 to $5\frac{3}{4}$ P. M. Lightning to W at 8 P. M. Slight rain at midnight & at $9\frac{1}{2}$ P. M.
25	132.0	...	S.S.W, S. & S. by E.	...	271.6	⌒i to 6 P. M., clear afterwards.
26	131.0	...	S. & S. by W.	2.2	343.9	Chiefly clear. Brisk wind from 9 A. M. to $5\frac{1}{2}$ P. M. Lightning at $8\frac{1}{2}$, $9\frac{1}{2}$ & 11 P. M. Slight rain at $9\frac{1}{4}$ P. M.
27	131.2	...	S. by E. & S.	2.5	348.7	Clouds of different kinds to 11 A. M., ⌒i to 3 P. M., clear afterwards. Brisk wind at $2\frac{1}{2}$ & from $7\frac{3}{4}$ to $9\frac{1}{2}$ A. M. & at $1\frac{1}{2}$ P. M. Lightning to N W at midnight. Slight rain at 1 A. M.
28	130.5	...	S. & S. by W.	2.2	373.1	Clear to 6 A. M., scuds to noon, clear afterwards.

Abstract of the Result of the Hourly Meterological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1868.

Solar Radiation, Weather, &c.,

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
29	130.3	0.21	S. & S. by W.	14.0	409.5	Scuds to 6 A. M., clear to 6 P. M., overcast afterwads. Brisk wind nearly the whole day, strong wind at $7\frac{1}{4}$ & $9\frac{1}{2}$ P. M. Thunder at 8 P. M. Lightning from 8 to 10 P. M. Rain at $7\frac{1}{2}$ & 9 P. M.
30	130.0	...	S. by W. & S.	2.4	373.2	Overcast to 4 A. M., scuds to 4 P. M., clear afterwards. Brisk wind at $2\frac{3}{4}$ P. M. Lightning to N at 9 P. M.
31	134.0	...	S. & S. by E.	1.8	349.9	Scuds to 10 A. M., ⌒i to 5 P. M., clear afterwards. Brisk wind at $9\frac{3}{4}$, $11\frac{1}{4}$ A. M. & at $2\frac{1}{2}$ P. M. Lightning at 9 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, ⌞i Cirro-strati, ⌒i Cumulo strati, ⌞i Nimbi
⌝i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.662
Max. height of the Barometer occurred at 11 P. M. on the 2nd. ...	29.918
Min. height of the Barometer occurred at 6 P. M. on the 16th. ...	29.317
Extreme range of the Barometer during the month	0.601
Mean of the daily Max. Pressures	29.735
Ditto ditto Min. ditto	29.581
Mean daily range of the Barometer during the month	0.154

	o
Mean Dry Bulb Thermometer for the month	87.0
Max. Temperature occurred at 3 P. M. on the 12th.	100.0
Min. Temperature occurred at 4 A. M. & 11 P. M, on the 3rd. & 22nd.	75.5
Extreme range of the Temperature during the month	24.5
Mean of the daily Max. Temperature	94.7
Ditto ditto Min. ditto, ...	80.1
Mean daily range of the Temperature during the month... ...	14.6

Mean Wet Bulb Thermometer for the month	80.8
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.2
Computed Mean Dew-point for the month	77.1
Mean Dry Bulb Thermometer above computed mean Dew-point ...	9.9
	Inches.
Mean Elastic force of Vapour for the month	0.913

	Troy grain.
Mean Weight of Vapour for the month	9.72
Additional Weight of Vapour required for complete saturation ...	3.57
Mean degree of humidity for the month, complete saturation being unity	0.73
	o
Mean Max. Solar radiation Thermometer for the month.	131.3

	Inches.
Rained 14 days,—Max. fall of rain during 24 hours	2.09
Total amount of rain during the month	3.32
Total amount of rain indicated by the Gauge attached to the anemometer during the month	2.43
Prevailing direction of the Wind... ...	S,S. S. W. & S. by W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
																					No. of days																											
Mid night							1												2		2		5		8	1	6		5												2	1						
1							1										1	1	1		1		4	1	11		4		5		1						1	1			1							
2							1										1		1		4		4		8		2		8						1								1					
3																	2		1		1		5		9		3		7				1		1				1									
4																	2						6		8		3		9				1		1						1							
5													1	1			1						4		6		6		9		1		2								1							
6													1	1					1		1		3		8		5		9		1								1									
7													1	1					2		1		4		7		6		7		1								1	1								
8													1	1							2		3		9		6		6		1		1						1									
9													1	1			1						3		10		6		5		1		1				2											
10							1	1			1						1						2		4		10		8		1		2						1									
11							1	1					1		1						1		4		6		7		9				1															
Noon.			1	1											1				1		2				15		3		7		1																	
1					1	1									1				1				1		11		4		10		1		1															
2					1	1													1		1		2		13		5		6		1		1															
3					1	1									1		1		1				3		11		7		6																			
4															1		1		1		2		1		15		4		5																		1	1
5	1	1											1								4		5		12		4		4																			
6																	1				3		10		11		5																		1	1		
7																			1		3		12		9		5																		1	1		
8																			1		2		10		11	1	4				1	1					1	1							1	1		
9																	1		1		4	1	7		7	1	5		2				1				2	1							1	1		
10																			2		3		9		6		3		2		1	1	1	1					1	1	1		1	1	1	1		
11	1												1						1		1		8		9	1	4		3								2	2							1	1		

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.663	29.729	29.601	0.128	88.7	95.8	83.8	12.0
2	.655	.717	.579	.138	88.6	94.5	82.6	11.9
3	.583	.635	.498	.137	88.5	96.0	83.0	13.0
4	.559	.618	.498	.120	89.1	96.5	82.6	13.9
5	.565	.627	.491	.136	89.8	98.0	83.4	14.6
6	.512	.575	.416	.159	89.7	97.0	83.5	13.5
7	.436	.504	.374	.130	85.4	87.4	82.0	5.4
8	.334	.437	.220	.217	86.8	95.2	83.0	12.2
9	.022	.287	28.713	.574	79.5	84.0	77.5	6.5
10	.395	.496	29.272	.224	83.1	86.0	79.5	6.5
11	.531	.598	.466	.132	87.9	93.5	84.0	9.5
12	.557	.596	.498	.098	89.3	95.7	85.0	10.7
13	.567	.616	.527	.089	89.8	97.0	85.7	11.3
14	.615	.677	.568	.109	89.1	94.8	83.6	11.2
15	.656	.722	.596	.126	88.6	94.9	84.0	10.9
16	.676	.724	.626	.098	85.7	89.7	82.5	7.2
17	.658	.714	.591	.123	86.5	92.2	81.5	10.7
18	.661	.708	.593	.115	87.1	92.5	82.5	10.0
19	.640	.699	.577	.122	86.3	91.7	82.0	9.7
20	.604	.657	.530	.127	87.4	93.2	83.0	10.2
21	.570	.619	.490	.129	87.6	94.0	82.5	11.5
22	.533	.571	.469	.102	88.0	94.0	83.0	11.0
23	.462	.519	.384	.135	86.4	92.5	83.4	9.1
24	.367	.432	.305	.127	83.8	89.3	82.4	6.9
25	.379	.428	.339	.089	81.9	85.5	80.5	5.0
26	.415	.456	.373	.083	82.8	87.0	79.5	7.5
27	.456	.494	.409	.085	83.2	88.0	79.5	8.5
28	.435	.486	.362	.124	80.4	83.5	77.5	6.0
29	.437	.515	.389	.126	85.0	89.4	83.2	6.2
30	.523	.574	.471	.103	84.0	87.5	81.0	6.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	82.1	6.6	78.1	10.6	0.943	10.00	3.96	0.72
2	82.0	6.6	78.0	10.6	.940	9.97	.95	.72
3	82.0	6.5	78.1	10.4	.943	10.02	.86	.72
4	82.2	6.9	78.1	11.0	.943	.00	4.12	.71
5	81.9	7.9	77.2	12.6	.916	9.69	.73	.67
6	82.2	7.5	77.7	12.0	.931	.86	.51	.69
7	81.7	3.7	79.1	6.3	.973	10.40	2.28	.82
8	81.5	5.3	78.3	8.5	.949	.09	3.12	.76
9	78.4	1.1	77.6	1.9	.928	.03	0.63	.94
10	80.5	2.6	78.7	4.4	.961	.33	1.53	.87
11	84.4	3.5	82.3	5.6	1.077	11.44	2.20	.84
12	86.3	3.0	84.5	4.8	.153	12.23	1.98	.86
13	85.7	4.1	83.2	6.6	.108	11.72	2.70	.81
14	84.6	4.5	81.9	7.2	.063	.28	.84	.80
15	83.2	5.4	80.0	8.6	.001	10.62	3.30	.76
16	81.1	4.6	77.9	7.8	0.937	.00	2.80	.78
17	80.9	5.6	77.5	9.0	.925	9.86	3.24	.75
18	81.3	5.8	77.8	9.3	.934	.95	.38	.75
19	81.0	5.3	77.8	8.5	.934	.95	.07	.76
20	82.1	5.3	78.9	8.5	.967	10.28	.17	.76
21	81.6	6.0	78.0	9.6	.940	9.99	.53	.74
22	82.2	5.8	78.7	9.3	.961	10.22	.46	.75
23	82.2	4.2	79.3	7.1	.979	.44	2.62	.80
24	81.6	2.2	80.1	3.7	1.005	.75	1.35	.89
25	80.4	1.5	79.3	2.6	0.979	.53	0.91	.92
26	80.5	2.3	78.9	3.9	.967	.39	1.36	.88
27	80.1	3.1	77.9	5.3	.937	.06	.83	.85
28	79.1	1.3	78.2	2.2	.946	.21	0.73	.93
29	82.3	2.7	80.4	4.6	1.014	.83	1.70	.86
30	81.3	2.7	79.4	4.6	0.983	.51	.66	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.538	29.713	29.233	0.480	84.1	87.0	79.6	7.4
1	.529	.699	.199	.500	83.7	86.8	79.0	7.8
2	.517	.694	.156	.538	83.4	86.6	80.0	6.6
3	.506	.675	.117	.558	83.1	86.4	79.5	6.9
4	.499	.661	.079	.582	82.9	86.2	79.5	6.7
5	.505	.667	.034	.633	82.8	85.8	79.5	6.3
6	.521	.691	.007	.684	82.9	85.7	79.5	6.2
7	.533	.714	28.977	.737	83.9	86.6	79.3	7.3
8	.544	.725	.909	.816	85.3	88.5	79.0	9.5
9	.550	.720	.846	.874	86.7	90.6	79.2	11.4
10	.548	.729	.759	.970	88.0	93.3	77.5	15.8
11	.541	.712	.713	.999	89.4	94.6	77.5	17.1
Noon.	.530	.690	.761	.929	90.1	95.5	77.6	17.9
1	.513	.670	.821	.849	90.7	97.0	78.2	18.8
2	.495	.659	.870	.789	90.9	97.5	78.2	19.3
3	.477	.638	.917	.721	90.5	98.0	78.3	19.7
4	.462	.628	.959	.669	90.2	98.0	78.2	19.8
5	.461	.626	29.011	.615	89.0	96.0	78.2	17.8
6	.473	.641	.073	.568	87.8	94.4	78.3	16.1
7	.493	.656	.115	.541	86.7	92.6	78.0	14.6
8	.514	.664	.186	.478	85.9	91.0	79.7	11.3
9	.531	.691	.238	.453	85.2	88.9	79.6	9.3
10	.546	.722	.271	.451	84.6	87.7	79.5	8.2
11	.546	.718	.259	.459	84.2	87.0	79.5	7.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	81.3	2.8	79.3	4.8	0.979	10.48	1.73	0.86
1	81.2	2.5	79.4	4.3	.983	.54	.53	.87
2	81.2	2.2	79.7	3.7	.992	.63	.33	.89
3	81.1	2.0	79.7	3.4	.992	.66	.20	.90
4	80.9	2.0	79.5	3.4	.986	.60	.19	.90
5	80.9	1.9	79.6	3.2	.989	.63	.12	.91
6	81.0	1.9	79.7	3.2	.992	.66	.13	.90
7	81.5	2.4	79.8	4.1	.995	.66	.47	.88
8	81.8	3.5	79.3	6.0	.979	.46	2.18	.83
9	82.0	4.7	79.2	7.5	.976	.39	.79	.79
10	82.3	5.7	78.9	9.1	.967	.28	3.40	.75
11	82.6	6.8	78.5	10.9	.955	.12	4.13	.71
Noon.	82.8	7.3	78.4	11.7	.952	.06	.48	.69
1	83.0	7.7	78.4	12.3	.952	.06	.74	.68
2	83.0	7.9	78.3	12.6	.949	.01	.88	.67
3	82.8	7.7	78.2	12.3	.946	.00	.72	.68
4	82.9	7.3	78.5	11.7	.955	.10	.49	.69
5	82.7	6.3	78.9	10.1	.967	.26	3.82	.73
6	82.3	5.5	79.0	8.8	.970	.31	.29	.76
7	81.7	5.0	78.7	8.0	.961	.24	2.94	.78
8	81.7	4.2	78.8	7.1	.964	.29	.58	.80
9	81.7	3.5	79.2	6.0	.976	.43	.18	.83
10	81.3	3.3	79.0	5.6	.970	.37	.02	.84
11	81.3	2.9	79.3	4.9	.979	.48	1.76	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June* 1869.**

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	129.5	...	S. & S. by E.	...	281.8	Clear to 5 A.M., ⌒i to 6 P.M., clear afterwards.
2	133.5	...	S. S.E. & S. by E.	...	221.0	Clear to 5 A. M., ⌒i to 7 P.M., clear afterwards.
3	139.0	...	S. S. E. & S. by E.	...	201.5	Clear to 8 A. M., ⌒i to 5 P. M., clear afterwards.
4	133.0	...	S, S. E. & S.	...	211.2	Clear to 6 A. M., ⌒i to 6 P. M., clear afterwards.
5	136.4	...	S. S. E. & S. by E.	...	233.6	Clear to 6 A. M., ⌒i to 4 P. M., clear afterwards.
6	134.0	...	S. S .E. & S. by E.	...	194.2	Clear to 7 A. M., ⌒i afterwards. Lightning from 7 to 9 P. M.
7		0.46	S. S. E. & E. S. E.	...	140.7	Clear to 5 A. M., clouds of different kinds to 10 A. M., overcast to 4 P. M., stratoni afterwards. Rain at 8 and 9 A. M.
8		0.12	N. N E. & N. E.	5.8	144.4	Clear to 3 A. M., stratoni to 1 P. M., overcast afterwards. High wind from $10\frac{1}{2}$ to 11 P. M. Lightning from 7 to 9 P. M. Slight rain at $2\frac{1}{2}$, $4\frac{1}{2}$, 6 & 10 P. M.
9		10.99	N. N. W. & S. W.	50.0	721.7	Overcast. Heavy gale from 1 A. M., to $7\frac{1}{2}$ P. M. Strong wind from $7\frac{1}{2}$ to 10 P. M. Rain from 1 A. M. to 11 P. M.
10	Broken	0.22	SSW, SW & S by W	4.0	636.7	Overcast. Brisk wind at $3\frac{1}{2}$, $6\frac{1}{2}$ & $10\frac{1}{2}$ A. M. Light rain from midnight to 8 A. M.
11		...	S. S. W. & S.	...	292.3	Stratoni.
12		...	S. by E. & S.	...	188.0	Stratoni to 9. A. M., ⌒i to 2 P. M. Stratoni afterwards.
13		0.02	S. by W. & S.S.E.	...	150.0	Stratoni to 5 A. M., ⌒i to 10 A. M., clear to 2 P. M., clouds of different kinds afterwards. Thunder at 5 P. M. Slight rain at 4 P. M.
14		...	S. E. & S.	1.0	190.0	\⌒i to 4 A. M., stratoni & \⌒i to noon, ⌒i afterwards.
15		...	E.N.E, S.S.E. & S.	...	164.0	Stratoni to 5 P. M., ⌒i afterwards.
16		...	S. S. E. & S. E.	...	208.0	\⌒i to 4 A. M., stratoni afterwards.
17		...	S.S.E, S.&S. by E.	...	233.8	Stratoni to 4 A. M., ⌒i to 6 P. M., clear afterwards.
18		...	S.S.E, S. by E.&S.	...	242.7	Stratoni to 2 A. M., ⌒i to 7 P. M., clear afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind.			General aspect of the Sky.
			Prevailing direction.	Max. Pressure	Daily Velocity.	
	o	Inches		lb	Miles	
19		...	S.S.E,S.E&SbyE.	...	138.5	Clear to 7 A. M., ⌒i to 6 P. M., clear afterwards. Thunder at $4\frac{3}{4}$ P. M. Light rain at $12\frac{1}{2}$ A. M.
20		...	S. by E. & S.	...	207.7	Chiefly ⌒i. Light rain at $10\frac{1}{2}$ A. M.
21		...	S. & S. by E.	...	221.8	Clear to 4 A. M., ⌒i to 6 P. M., clear afterwards.
22		...	S. by E. & S.	...	234.5	Clear to 6 A. M., ⌒i to 7 P. M., \i afterwards.
23		0.24	S.byE, & variable.	...	185.2	\i to 4 A. M., ⌒i afterwards. Thunder at 2 P. M. Rain at 2 & 3 P. M.
24		1.98	Variable.	0.2	145.4	⌒i to 11 A. M., overcast afterwards. Thunder at $9\frac{1}{2}$ P. M. Rain at $2\frac{1}{2}$ A. M., noon, & at 2, 3 & 11 P. M.
25	Broken	0.99	W.byN.&S. by W.	...	125.9	Overcast. Thunder at 3 P. M. Rain from midnight to 8 A. M., and from 3 to 7 P. M., & at 9 P. M.
26		1.62	S.S.W.&S.W.	...	136.8	Chiefly overcast. Thunder at 6 P. M. Rain from midnight to 3 A. M., & at $6\frac{1}{2}$ A. M., & at $3\frac{1}{2}$, 6, & 7 P. M.
27		0.31	S. W.	...	132.9	Stratoni to 5 P. M., overcast afterwards. Rain from 6 to 9 P. M.
28		1.43	S. by W.&S.S.W.	2.4	194.2	Overcast. Brisk wind from $8\frac{1}{2}$ to $9\frac{3}{4}$ A. M. Rain from 2 to 4 A. M., & from $8\frac{1}{2}$ A. M. to 3 P.M.
29		...	S. S. W. & S.	...	226.6	Overcast to 5 A. M., stratoni afterwards. Lightning to N. W. at 9 P. M. Drizzled at 1 P. M.
30		...	S,S.S.E.&S.byW.	...	128.6	Clouds of different kinds.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒—i Cumulo strati, \\⌒—i Nimbi `⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.516
Max. height of the Barometer occurred at 10 A. M. on the 1st. ...	29.729
Min. height of the Barometer occurred at 11 A. M. on the 9th. ...	28.713
Extreme range of the Barometer during the month	1.016
Mean of the daily Max. Pressures	29.581
Ditto ditto Min. ditto	29.441
Mean daily range of the Barometer during the month	0.140

	o
Mean Dry Bulb Thermometer for the month	86.3
Max. Temperature occurred at 3 & 4 P. M. on the 5th.	98.0
Min. Temperature occurred at 10 & 11 A. M, on the 9th. & 28th.	77.5
Extreme range of the Temperature during the month	20.5
Mean of the daily Max. Temperature	91.9
Ditto ditto Min. ditto, ...	82.2
Mean daily range of the Temperature during the month... ...	9.7

Mean Wet Bulb Thermometer for the month	81.9
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	4.4
Computed Mean Dew-point for the month	78.8
Mean Dry Bulb Thermometer above computed mean Dew-point ...	7.5
	Inches.
Mean Elastic force of Vapour for the month	0.964

	Troy grain.
Mean Weight of Vapour for the month	10.27
Additional Weight of Vapour required for complete saturation ...	2.75
Mean degree of humidity for the month, complete saturation being unity	0.79
	o
Mean Max. Solar radiation Thermometer for 6 days (broken) ...	134.2

	Inches.
Rained 14 days,—Max. fall of rain during 24 hours	10.99
Total amount of rain during the month	18.38
Total amount of rain indicated by the Gauge attached to the anemometer during the month	13.89
Prevailing direction of the Wind... ...	S.S.E, S. & S. by E.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
																					No. of days			
Mid night					1												1				9		6	
1					1	1			1				1				1		1		9		5	
2					1	1			2								1		1		9		5	
3	1	1							2										2		9		6	
4	1	1					1		1										2		9		5	
5	1	1			1				1								1		1		9		5	
6					1				1								1		1		8		4	
7					1						1								2		11		3	
8					1		1	1	1										1		11		4	
9					1		1												1		10		4	
10					2	1			1										2		7		6	
11	1		1						1								1		3	1	5		5	
Noon.	1						1	1					1						1		4		3	
1					1		1								1		1		2	1	4		3	
2					1		1	1							1		1	1	1		4		4	
3	1	1											3	2					2		2		8	
4					1				2				1						3		3		2	
5							1	1			1		1				1		1		2		6	
6					1		1	1									1		3		2		7	
7							1										1		2		2		7	
8							1										1				3		8	
9							1										1				6		6	
10					1	1											1				9		5	
11					1												1				8		5	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W.N.W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	4		3	1	4		1	1							1	1								
1	3		2		4	1									1	1								
2	3		2	1	3	1	1								1	1								
3	2		2	1	3	1	1								1	1								
4	3		1		4	2	1								1	1								
5	3		1		3		2	1							1	1								
6	5		1		3		3	1	1	1											1	1		
7	1		3		2		4	2	1	1											1	1		
8	2		2		1		3	1	1		1	1									1	1		
9	3		1		3		1		1	1	1								2	2	1	1		
10	2		2		2		2		1		1								2	2				
11	5				2		2		1		1		1	1					1	1				
Noon.	11				3	1	3		1				1	1										
1	9		1		1	1	3		3	2														
2	11	1	1				4		1	1														
3	7	1	1		1		3		1	1							1	1						
4	9	1	4		2	1	2	1							1	1								
5	6		4		4		2	1							1	1								
6	7		1		3		2	2			1	1					1	1						
7	8		5	1	1	1	1	1									1	1	1					
8	8		5		1		1	1									2	1						
9	7		5	1	1		1	1					1	1	1									
10	5		5				1	1	1				1		1									
11	5		1		5		2	1	1						1	1								

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature during the day. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.556	29.610	29.499	0.111	85.0	89.5	81.2	8.3
2	.541	.595	.469	.126	86.5	92.0	81.4	10.6
3	.502	.549	.448	.101	84.7	90.5	80.8	9.7
4	.448	.492	.383	.109	85.0	89.8	81.0	8.8
5	.421	.470	.370	.100	84.6	89.1	82.0	7.1
6	.452	.493	.409	.084	83.8	89.2	81.5	7.7
7	.461	.527	.399	.128	82.4	87.5	78.4	9.1
8	.563	.648	.490	.158	82.1	86.0	79.5	6.5
9	.676	.744	.618	.126	84.1	89.0	80.3	8.7
10	.646	.710	.565	.145	85.0	90.0	81.5	8.5
11	.563	.617	.487	.130	85.1	89.6	81.7	7.9
12	.554	.603	.510	.093	84.7	89.2	81.0	8.2
13	.573	.610	.522	.088	82.7	86.5	80.2	6.3
14	.574	.604	.525	.079	81.7	86.0	79.5	6.5
15	.498	.564	.416	.148	83.4	87.5	78.5	9.0
16	.456	.502	.387	.115	82.4	85.4	79.5	5.9
17	.468	.509	.408	.101	83.2	87.8	80.5	7.3
18	.431	.481	.358	.123	83.2	88.0	81.0	7.0
19	.485	.564	.429	.135	82.9	86.7	80.0	6.7
20	.536	.595	.475	.120	80.9	84.7	79.0	5.7
21	.555	.600	.491	.109	79.9	83.5	77.5	6.0
22	.567	.613	.509	.104	83.5	87.7	80.0	7.7
23	.561	.604	.495	.109	82.9	88.0	80.0	8.0
24	.549	.599	.473	.126	82.6	87.4	79.8	7.6
25	.561	.628	.506	.122	83.3	88.0	80.0	8.0
26	.626	.672	.574	.098	84.6	89.8	79.5	10.3
27	.610	.657	.548	.109	86.3	91.6	82.0	9.6
28	.607	.655	.530	.125	87.2	92.7	83.0	9.7
29	.632	.672	.578	.094	87.0	92.6	82.7	9.9
30	.647	.700	.585	.115	85.8	88.7	83.0	5.7
31	.654	.685	.603	.082	84.0	87.6	82.4	5.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	82.0	3.0	79.9	5.1	0.998	10.67	1.86	0.85
2	82.6	3.9	80.3	6.2	1.011	.78	2.32	.82
3	82.2	2.5	80.4	4.3	.014	.85	1.57	.87
4	81.0	4.0	78.2	6.8	0.946	.11	2.42	.81
5	81.9	2.7	80.0	4.6	1.001	.70	1.69	.86
6	81.7	2.1	80.2	3.6	.008	.79	.31	.89
7	80.3	2.1	78.8	3.6	0.964	.36	.25	.89
8	79.7	2.4	78.0	4.1	.940	.11	.40	.88
9	81.4	2.7	79.5	4.6	.986	.55	.66	.86
10	82.2	2.8	80.2	4.8	1.008	.77	.76	.86
11	82.1	3.0	80.0	5.1	.001	.70	.87	.85
12	81.0	3.7	78.4	6.3	0.952	.19	2.23	.82
13	80.8	1.9	79.5	3.2	.986	.60	1.12	.90
14	80.0	1.7	78.8	2.9	.964	.38	0.99	.91
15	80.8	2.6	79.0	4.4	.970	.42	1.54	.87
16	80.6	1.8	79.3	3.1	.979	.53	.08	.91
17	81.0	2.2	79.5	3.7	.986	.57	.32	.89
18	80.8	2.4	79.1	4.1	.973	.45	.44	.88
19	80.6	2.3	79.0	3.9	.970	.42	.37	.88
20	79.3	1.6	78.2	2.7	.946	.19	0.91	.92
21	78.5	1.4	77.5	2.4	.925	.00	.78	.93
22	80.0	3.5	77.5	6.0	.925	9.92	2.08	.83
23	79.8	3.1	77.6	5.3	.928	.97	1.82	.85
24	79.6	3.0	77.5	5.1	.925	.94	.74	.85
25	80.1	3.2	77.9	5.4	.937	10.06	.87	.84
26	79.9	4.7	76.6	8.0	.899	9.61	2.78	.78
27	81.7	4.6	78.5	7.8	.955	10.18	.84	.78
28	82.8	4.4	80.2	7.0	1.008	.73	.64	.80
29	82.0	5.0	79.0	8.0	0.970	.33	.96	.78
30	81.9	3.9	79.2	6.6	.976	.41	.42	.81
31	81.1	2.9	79.1	4.9	.973	.42	1.75	.86

All the Hygrometrical elements are computed by the Greenwich **Constants.**

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.567	29.684	29.446	0.238	82.2	85.0	79.0	6.0
1	.556	.669	.434	.235	82.0	84.5	78.8	5.7
2	.545	.664	.418	.246	81.7	84.3	78.5	5.8
3	.536	.658	.395	.263	81.5	84.0	78.0	6.0
4	.529	.646	.385	.261	81.3	84.0	77.5	6.5
5	.535	.664	.389	.275	81.0	83.5	78.0	5.5
6	.548	.679	.399	.280	81.1	83.5	78.0	5.5
7	.564	.700	.432	.268	81.9	84.5	78.7	5.8
8	.578	.714	.451	.263	83.1	86.0	79.5	6.5
9	.586	.728	.460	.268	84.0	87.5	79.0	8.5
10	.588	.744	.458	.286	85.0	89.7	78.5	11.2
11	.581	.736	.452	.284	86.0	90.7	78.5	12.2
Noon.	.568	.716	.441	.275	86.6	91.0	78.2	12.8
1	.548	.694	.409	.285	87.2	92.0	78.2	13.8
2	.527	.667	.403	.264	87.0	92.3	80.0	12.3
3	.508	.641	.380	.261	86.5	92.6	80.6	12.0
4	.494	.628	.368	.260	86.6	92.7	80.7	12.0
5	.492	.628	.358	.270	86.3	92.0	80.5	11.5
6	.503	.647	.370	.277	85.5	90.5	80.0	10.5
7	.525	.676	.396	.280	84.4	87.9	79.5	8.4
8	.545	.700	.409	.291	83.7	87.0	80.0	7.0
9	.565	.706	.421	.285	83.3	86.5	79.5	7.0
10	.578	.712	.453	.259	83.0	85.5	79.0	6.5
11	.576	.692	.451	.241	82.5	85.2	79.0	6.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	80.4	1.8	79.1	3.1	0.973	10.47	1.07	0.91
1	80.3	1.7	79.1	2.9	.973	.47	.00	.91
2	80.1	1.6	79.0	2.7	.970	.44	0.93	.92
3	80.0	1.5	78.9	2.6	.967	.41	.90	.92
4	79.8	1.5	78.7	2.6	.961	.35	.89	.92
5	79.7	1.3	78.8	2.2	.964	.40	.74	.93
6	79.8	1.3	78.9	2.2	.967	.43	.74	.93
7	80.4	1.5	79.3	2.6	.979	.53	.91	.92
8	80.9	2.2	79.4	3.7	.983	.54	1.32	.89
9	81.2	2.8	79.2	4.8	.976	.45	.72	.86
10	81.4	3.6	78.9	6.1	.967	.34	2.19	.83
11	81.8	4.2	78.9	7.1	.967	.32	.59	.80
Noon.	81.9	4.7	79.1	7.5	.973	.36	.78	.79
1	82.3	4.9	79.4	7.8	.983	.45	.92	.78
2	82.1	4.9	79.2	7.8	.976	.39	.90	.78
3	81.8	4.7	79.0	7.5	.970	.33	.77	.79
4	81.7	4.9	78.8	7.8	.964	.27	.87	.78
5	81.7	4.6	78.5	7.8	.955	.18	.84	.78
6	81.5	4.0	78.7	6.8	.961	.26	.46	.81
7	81.1	3.3	78.8	5.6	.964	.31	.00	.84
8	80.9	2.8	78.9	4.8	.967	.37	1.70	.86
9	80.8	2.5	79.0	4.3	.970	.42	.51	.87
10	80.8	2.2	79.3	3.7	.979	.51	.31	.89
11	80.6	1.9	79.3	3.2	.979	.53	.11	.91

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind.			General aspect of the Sky.
			Prevailing direction.	Max. Pressure	Daily Velocity.	
	o	Inches		lb	Miles	
1		...	S. S. W. & S.	...	162.6	Stratoni to 3 A. M. \i to 8 A. M. stratoni to 6 P. M., clear afterwards.
2		...	S. by W. & S.S.W.	1.2	219.2	Clear to 6 A. M. ⌒i to 6 P. M., clear afterwards.
3		0.28	S. by W. & S. by E.	1.2	221.4	Clear to 5 A. M. ⌒i to 1 P. M. overcast to 7 P. M., clear afterwards. Rain at 8 A. M. & from $1\frac{1}{2}$ to 3 P. M.
4		...	S. by W. & S. S. W,	1.3	131.0	Clear to 3 A. M. \i to 9 A. M. ⌒i to 3 P. M., clouds of different kinds afterwards. Lightning from W at 9 P. M.
5		0.15	S.S.W. & W.S.W.	...	179.5	Clouds of different kinds. Thunder at 2 P. M Light rain at $3\frac{1}{2}$ A. M. & from $1\frac{1}{2}$ to 3 P. M.
6		0.84	W. by S. & S. S .E.	...	93.7	Stratoni to 9 A. M. ⌒i to 1 P. M., overcast afterwards. Thunder at 2 & 3 P. M. Lightning visible at 8, 9, 10 & 11 P. M. Rain at $2\frac{1}{2}$ A. M. & from $2\frac{1}{2}$ to 5 P. M.
7	Broken	0.29	S. by E. & S.	...	90.5	⌒i to 7 P. M., overcast afterwards. Thunder & Lightning at 4 P. M., Slight rain at 5 & 6 A. M. & at 2, 4, 8 & 11 P.M.
8		0.90	S. & S, S. E.	1.1	149.5	Overcast to 2 P. M. ⌒i to 7 P. M., clear afterwards. Rain at midnight & from $7\frac{1}{2}$ to 11 A. M. & at 1 & 2 P. M.
9		0.28	S.S.E, S. & S. by E.	...	206.5	Clouds of different kinds. Rain at $8\frac{1}{2}$ A. M. & at 1 & 6 P.M.
10		...	S.S.W. & S. by W.	...	189.9	Clear to 4 A. M., clouds of different kinds afterwards. Light rain at $3\frac{1}{2}$ A. M.
11		...	S. S. W. & S.	0.6	215.0	Stratoni to 5 A. M. ⌒i to noon, stratoni to 6 P. M., overcast afterwards. Lightning from W at 9 P.M. Light rain to 3 P.M.
12		0.12	S. by W. & S.	0.4	223.6	Stratoni to 1 P. M. ⌒i to 7 P. M. stratoni afterwards. Lightning at 8 & 11 P. M. Thunder at 11 P. M. Slight rain at 12 A. M. & 1 & 11 P. M.
13		2.89	S. W, S. & S. by E.	1.0	181.5	Overcast. Thunder & lightning at midnight & 1 A.M. Rain nearly the whole day,

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	Wind.			General aspect of the Sky.
			Prevailing direction.	Max. Pressure	Daily Velocity.	
	o	Inches		℔	Miles	
14		2.59	S. & S. S. W.	0.2	146.7	Overcast to 2 P. M., stratoni afterwards. Rain from midnight to 9 A. M. & at 1 & 2 P. M.
15		0.18	S. & S. S. W.	0.5	194.6	Overcast to 8 A. M., stratoni afterwards. Slight rain from 4 to 6 A. M. & at 1½ & 2½ P. M.
16		1.34	S. by E. & S. S. E.	1.0	164.2	_i to 3 A. M., Overcast to 2 P. M, ⌒i & \i afterwards. Rain at 4½ A.M. & from 7 to 12 A. M. & at 6 P. M.
17		1.38	E.S.E. & variable.	...	138.6	Stratoni to 5 A. M. ⌒i to 12 A. M., overcast afterwards. Thunder & Lightning to 7 P. M. Rain from 1 to 3 P. M. & from 6½ to 8 P. M.
18		0.49	E. & variable.	...	145.3	Chiefly stratoni. Rain at 4½ 5¾ & 9½ A. M. & at 2, 3 & 10½ P. M.
19		0.24	S. E. & S. S. E.	...	223.6	Chiefly Stratoni. Thunder at 2 P. M. Slight rain after intervals.
20		0.38	E by S, E. S. E. & S.	...	186.0	Stratoni to 6 A. M., overcast afterwards. Slight rain after intervals.
21	Broken.	1.77	S.S.E, S.&S. by E.	...	198.5	Overcast to 12 A. M. clouds of different kinds afterwards. Rain from 2 A. M. to 2 P. M. & at 6½ P. M.
22		...	SSE, S.E.&S.by E.	...	182.6	⌒i to 12 A. M. \i afterwards.
23		0.27	S.S.E, S.E. & ESE.	...	208.5	Chiefly \i. Slight rain after intervals.
24		0.05	E. S. E, E. & S.E.	3.0	244.9	Clouds of different kinds. Slight rain at noon 3½ & 11½ P M.
25		...	E. S.E, S.&S.by E.	...	270.2	Clouds of different kinds. Light rain after intervals.
26		0.10	S. by E. & S.	...	175.0	_i to 5 A. M. ⌒i to 5 P. M. clouds of different kinds afterwards. Slight rain at 1 A. M.
27		...	S.by E, S.by W.&S.	...	151.8	⌒i to 7 P.M. clear afterwards.
28		...	S. & S. by E.	...	112.0	\⌒i to 7 A. M. ⌒i afterwards. Thunder at 6 P. M. Lightning from 9 to 11 P. M.
29		...	S by E, S.&S.by W.	...	163.4	Chiefly ⌒i Drizzled at 5½ P. M.
30		...	S.	...	159.6	\i to 5 A. M. ⌒i to 7 P. M. clear afterwards.
31		...	S. by E. & S.	...	151.2	\⌒i to 6 A. M. ⌒i to 11 A. M., stratoni to 3 P. M. \i to 8 P. M. clear afterwards. Thunder at noon. Drizzled at 1½ & 6 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒-i Cumulo-strati, \⌒-i Nimbi \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.547
Max. height of the Barometer occurred at 10 A. M. on the 9th. ...	29.744
Min. height of the Barometer occurred at 5 P. M. on the 18th. ...	29.358
Extreme range of the Barometer during the month	0.386
Mean of the daily Max. Pressures	29.599
Ditto ditto Min. ditto	29.486
Mean daily range of the Barometer during the month	0.113

	o
Mean Dry Bulb Thermometer for the month	83.9
Max. Temperature occurred at 4 P. M. on the 28th.	92.7
Min. Temperature occurred at 4 A. M, on the 21st.	77.5
Extreme range of the Temperature during the month	15.2
Mean of the daily Max. Temperature	88.4
Ditto ditto Min. ditto, ...	80.6
Mean daily range of the Temperature during the month... ...	7.8

Mean Wet Bulb Thermometer for the month	80.9
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	3.0
Computed Mean Dew-point for the month	78.8
Mean Dry Bulb Thermometer above computed mean Dew-point ...	5.1
	Inches.
Mean Elastic force of Vapour for the month	0.964

	Troy grain.
Mean Weight of Vapour for the month	10.34
Additional Weight of Vapour required for complete saturation ...	1.79
Mean degree of humidity for the month, complete saturation being unity	0.85
	o
Mean Max. Solar radiation Thermometer for the month ...	(broken)

	Inches.
Rained 24 days,—Max. fall of rain during 24 hours	2.89
Total amount of rain during the month	14.54
Total amount of rain indicated by the Gauge attached to the anemometer during the month	13.22
Prevailing direction of the Wind... ... S, S. by E. & S by W.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
																					No.of days			
Mid night															1		2				6	1	6	
1																	3		1		4		9	1
2													1	1			2	1	1		6	1	8	2
3													3	1			1		2	1	4	1	8	
4													3				1		3	2	3		6	
5									1	1			1		1		2		2		3	1	4	
6									1	1			1		1		2		2		3	1	4	
7													2		2		1		1		3		6	
8													2		1		2	1	2	1	3	1	3	
9													1		1		1	1	4	1	1		3	1
10															1		3	2	2	1	3	2	3	
11											1		1				2				5	2	1	
Noon.													4	1					3	2			3	1
1											2		2	1	1	1			2	1	2	1	2	
2							1	1			1				1		1		1	1	4	1	3	3
3							1	1					1						3	1	4	1	5	2
4							1	1									1		4	1	2		4	2
5							1								2				2		2	1	3	
6													1						1		4		2	1
7																	1	1	1		3	1	7	2
8																	2		1		4	1	7	1
.9															1		2		1		3	1	6	
10															1		1		2		3		7	1
11															1				2	1	7	1	7	2

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	9	2	4		2						1													
1	6	1	4		2		1	1			1													
2	5		4		3	1					1													
3	5	1	4		2		1	1			1	1												
4	6	3	4	1	3	1	1	1			1													
5	5	1	4		5	2	1	1			2	1												
6	5	1	4		5	1	1	1			2	1												
7	5	1	3		4		2	1	2															
8	5	2	5	1	4		2	1	2															
9	7	3	4		4		3	1	2															
10	4		4	1	6		4	1	1															
11	9	1	3		7		1						1											
Noon.	7	2	7	1	4		1		1				1											
1	8	3	4	1	5	1	1		1						1									
2	8	3	6	2	4	1					1													
3	8	2	5	2	2		2																	
4	7		6		6	1																		
5	8	1	7		6	1																		
6	12	2	6	1	4				1															
7	9	3	6		2		1		1															
8	9	1	4	1	3				1															
.9	9		5		3						1													
10	7		5		4						1													
11	6	1	3		3		1	1			1													

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.648	29.686	29.604	0.082	82.2	83.5	80.3	3.2
2	.686	.728	.646	.082	82.5	85.3	79.2	6.1
3	.728	.798	.672	.126	84.8	89.8	81.0	8.8
4	.730	.793	.654	.139	85.7	90.6	82.2	8.4
5	.655	.738	.569	.169	85.4	90.5	81.8	8.7
6	.583	.640	.500	.140	84.1	89.8	79.5	10.3
7	.604	.678	.534	.144	83.1	88.5	79.5	9.0
8	.680	.738	.625	.113	83.6	88.2	80.0	8.2
9	.710	.776	.652	.124	83.3	85.5	81.3	4.2
10	.678	.724	.619	.105	84.9	89.0	82.0	7.0
11	.713	.757	.667	.090	84.9	90.4	82.0	8.4
12	.747	.803	.683	.120	81.1	84.4	77.3	7.1
13	.776	.834	.719	.115	84.4	89.5	80.0	9.5
14	.756	.836	.676	.160	85.4	90.7	82.0	8.7
15	.691	.760	.602	.158	85.7	91.6	81.3	10.3
16	.646	.699	.567	.132	86.1	91.5	82.0	9.5
17	.604	.667	.525	.142	85.8	89.5	83.6	5.9
18	.561	.618	.481	.137	85.7	93.4	81.6	11.8
19	.622	.676	.574	.102	85.0	91.0	82.7	8.3
20	.672	.726	.611	.115	85.9	90.6	81.5	9.1
21	.684	.738	.617	.121	84.3	89.2	81.7	7.5
22	.608	.695	.516	.179	84.9	90.4	81.6	8.8
23	.511	.575	.420	.155	84.7	89.5	81.8	7.7
24	.503	.560	.446	.114	84.2	88.5	82.2	6.3
25	.571	.636	.523	.113	84.1	88.2	81·7	6.5
26	.633	.677	.581	.096	85.1	90.0	81.5	8.5
27	.641	.706	.563	.143	85.7	90.7	81.6	9.1
28	.609	.666	.527	.139	86.0	91.2	82.0	9.2
29	.592	.633	.541	.092	84.5	89.0	82.0	7.0
30	.614	.653	.567	.086	83.2	85.8	80.7	5.1
31	.643	.693	.594	.099	83.4	87.5	80.0	7.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.8	1.4	79.8	2.4	0.995	10.71	0.83	0.93
2	80.2	2.3	78.6	3.9	.958	.30	1.34	.89
3	80.9	3.9	78.2	6.6	.946	.11	2.35	.81
4	81.5	4.2	78.6	7.1	.958	.23	.57	.80
5	81.5	3.9	78.8	6.6	.964	.29	.39	.81
6	81.1	3.0	79.0	5.1	.970	.40	1.81	.85
7	80.2	2.9	78.2	4.9	.946	.15	.71	.86
8	80.5	3.1	78.3	5.3	.949	.18	.85	.85
9	81.3	2.0	79.9	3.4	.998	.72	.21	.90
10	81.9	3.0	79.8	5.1	.995	.64	.85	.85
11	81.4	3.5	78.9	6.0	.967	.34	2.15	.83
12	78.9	2.2	77.4	3.7	.922	9.93	1.24	.89
13	80.4	4.0	77.6	6.8	.928	.93	2.38	.81
14	81.2	4.2	78.3	7.1	.949	10.14	.54	.80
15	81.7	4.0	78.9	6.8	.967	.32	.48	.81
16	82.5	3.6	80.0	6.1	1.001	.68	.27	.83
17	83.0	2.8	81.0	4.8	.034	11.03	1.80	.86
18	82.0	3.7	79.4	6.3	0.983	10.49	2.31	.82
19	82.1	2.9	80.1	4.9	1.005	.73	1.80	.86
20	81.9	4.0	79.1	6.8	0.973	.38	2.49	.81
21	81.6	2.7	79.7	4.6	.992	.61	1.67	.86
22	81.9	3.0	79.8	5.1	.995	.64	.85	.85
23	81.8	2.9	79.8	4.9	.995	.64	.78	.86
24	81.8	2.4	80.1	4.1	1.005	.75	.49	.88
25	81.6	2.5	79.8	4.3	0.995	.66	.55	.87
26	81.8	3.3	79.5	5.6	.986	.53	2.04	.84
27	81.9	3.8	79.2	6.5	.976	.41	.39	.81
28	82.0	4.0	79.2	6.8	.976	.41	.50	.81
29	80.9	3.6	78.4	6.1	.952	.19	.16	.83
30	80.5	2.7	78.6	4.6	.958	.28	1.61	.87
31	80.6	2.8	78.6	4.8	.958	.28	.68	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.664	29.776	29.516	0.260	82.8	85.0	79.4	5.6
1	.653	.768	.493	.275	82.5	84.6	79.8	4 8
2	.644	.760	.472	.288	82.3	84.3	79.8	4.5
3	.636	.751	.450	.301	82.0	84.0	79.6	4.4
4	.630	.764	.446	.318	81.8	83.8	79.5	4.3
5	.639	.776	.477	.299	81.6	83.8	78.7	5.1
6	.654	.791	.492	.302	81.5	83.6	77.3	6.3
7	.671	.809	.515	.294	82.2	84.5	78.0	6.5
8	.686	.823	.531	.292	83.6	85.6	78.3	7.3
9	.696	.832	.543	.289	85.2	87.2	81.0	6.2
10	.697	.836	.550	.286	86.2	89.5	80.5	9.0
11	.690	.831	.551	.280	87.0	90.0	80.5	9.5
Noon.	.674	.812	.526	.286	87.5	91.5	81.5	10.0
1	.649	.792	.494	.298	87.9	92.3	81.0	11.3
2	.624	.767	.476	.291	88.1	93.0	80.5	12.5
3	.603	.752	.449	.303	87.8	93.4	82.0	11.4
4	.590	.734	.437	.297	87.4	93.2	83.0	10.2
5	.587	.719	.420	.299	86.7	90.5	82.0	8.5
6	.597	.731	.429	.302	85.7	89.6	80.3	9.3
7	.616	.737	.465	.272	84.6	87.5	80.0	7.5
8	.642	.758	.494	.264	83.9	86.0	79.5	6.5
9	.664	.773	.515	.258	83.5	86.0	79.5	6.5
10	.676	.786	.521	.265	83.3	85.5	80.0	5.5
11	.676	.783	.522	.261	83.1	85.3	79.7	5.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	80.8	2.0	79.4	3.4	0.983	10.56	1.19	0.90
1	80.6	1.9	79.3	3.2	.979	.53	.11	.91
2	80.5	1.8	79.2	3.1	.976	.50	.08	.91
3	80.4	1.6	79.3	2.7	.979	.53	0.94	.92
4	80.3	1.5	79.2	2.6	.976	.50	.90	.92
5	80.2	1.4	79.2	2.4	.976	.52	.82	.93
6	80.2	1.3	79.3	2.2	.979	.55	.76	.93
7	80.7	1.5	79.6	2.6	.989	.63	.91	.92
8	81.1	2.5	79.3	4.3	.979	.51	1.52	.87
9	81.8	3.4	79.4	5.8	.983	.49	2.12	.83
10	82.1	4.1	79.2	7.0	.976	.41	.58	.80
11	82.1	4.9	79.2	7.8	.976	.39	.90	.78
Noon.	82.3	5.2	79.2	8.3	.976	.39	3.10	.77
1	82.4	5.5	79.1	8.8	.973	.34	.30	.76
2	82.6	5.5	79.3	8.8	.979	.40	.32	.76
3	82.6	5.2	79.5	8.3	.986	.49	.11	.77
4	82.5	4.9	79.6	7.8	.989	.52	2.93	.78
5	82.2	4.5	79.5	7.2	.986	.51	.67	.80
6	81.7	4.0	78.9	6.8	.967	.32	.48	.81
7	81.4	3.2	79.2	5.4	.976	.45	1.94	.84
8	81.0	2.9	79.0	4.9	.970	.40	.73	.86
9	80.7	2.8	78.7	4.8	.961	.31	.69	.86
10	80.9	2.4	79.2	4.1	.976	.48	.45	.88
11	80.9	2.2	79.4	3.7	.983	.54	.32	.89

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1		0.24	S. S. W. & S.	...	225.8	Overcast. Rain from 2 to 4 A. M., and from 11 A. M. to 2 P. M.
2		0.31	S, S by W. & S. by E.	...	112.6	Chiefly stratoni. Rain at 3, 5, 7, 8 & 10 A. M.
3		...	S, S. by E & S. by W.	...	322.4	\i & ⌒i to 6 P. M., clear afterwards.
4		...	S. S. W. & S.	...	227.1	\i & ⌒i nearly the whole day
5		...	S.S.W. & S. by W.	0.6	260.9	\i & ⌒i to 6 P. M., overcast afterwards. Thunder at 8 P. M. Lightning at 8 & 9 P. M. Drizzled at 6¾ P. M.
6		0.76	S. S. W. & S. by W.	2.0	256.0	Stratoni to 5 P. M. Overcast afterwards. Brisk wind at 5½ P. M. Thunder at 6, 8½ & 11 P. M. Lightning at 8½ P. M., Rain from 3½ to 11 P. M.
7	Broken	0.21	S. & S. by E.	...	161.5	Overcast to 6 A. M., stratoni to 11 A.M. ⌒i afterwards. Lightning at 8 & 9 P. M. Rain at midnight & 1 A. M. & at 9½ P. M.
8		...	S, S.S.W & S. by W.	...	129.5	Stratoni to 6 A. M., overcast to 10 A. M., stratoni afterwards. Lightning from N W at 8 P. M.
9		...	S.S.W, S by W. & S.	...	152.4	Stratoni to 7 A. M., overcast to 7 P.M., clear afterwards. Drizzled at 8, 10 & 12½ A. M.
10		...	S. S. W. & S.	...	212.1	Clear to 4 A. M., \⌒i & \i to 10 A. M. ⌒i to 4. P. M., overcast afterwards. Drizzled at 9 P. M.
11		...	S, S. by E. & S.S.E.	...	207.5	Stratoni to 6 A. M. ⌒i to 3 P. M. \i afterwards. Drizzled at 12½ A. M.
12		1.73	S. S. E. & S.	...	155.0	Overcast to 2 P. M., clouds of different kinds afterwards. Rain from 3 to 7 & Drizzled from 9 A. M. to 2 P. M.
13	111.5	...	S, S by W. & S.S.W.	...	162.0	Clear to 7 A. M. ⌒i afterwards. Lightning from W at 8 P. M.
14	113.0	...	S. S. W. & S.	...	230.0	Stratoni to 6 P. M. \i afterwards. Lightning to W from 8 to 10 P. M.
15	114.5	...	W. & S.	...	103.4	Clear to 4 A.M. ⌒i afterwards. Lightning at 9 P. M.
16	108.0	...	S.S.W. & W.S.W.	...	111.3	Clear to 5 A. M. \i to 9 A.M. ⌒i afterwards. Lightning at 7 & 8 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
17	122.7	0.11	S. by W. & SbyE.	...	100.7	\i to 6 A. M. ⌒i to 7 P. M. \i afterwards. Thunder at 12 A. M. Lightning at $7\frac{1}{2}$ & 9 P. M. Rain at 12 A. M. & 3 P. M.
18	134.0	1.61	W.S.W, S.S.E. & E. S. E.	0.8	80.0	\i to 8 A. M. ⌒i afterwards. Thunder at $4\frac{1}{4}$ P. M. Lightning at $4\frac{1}{4}$ & 10 P. M., Rain at $2\frac{1}{2}$ & 5 P. M.
19	128.0	0.24	S. E. & E. S. E.	...	124.8	\i to 4 A. M., stratoni to 9 A. M. ⌒i to 6 P. M., stratoni afterwards. Thunder at $2\frac{3}{4}$ P. M. Lightning at $7\frac{1}{2}$ P. M., Rain at 3 P. M.
20	129.4	...	S. & E. S. E.	...	74.5	Chiefly ⌒i Drizzled at 4 A.M.
21	120.0	0.05	S.	...	128.3	Clear to 3 A. M., \i to 8 A. M. ⌒i to 12 A. M., stratoni afterwards. Thunder at 1 P. M. Light rain at 6 A. M. & at $1\frac{1}{2}$, 3 & 11 P. M.
22	135.5	0.18	S. & S. by W.	...	86.1	Chiefly ⌒i Thunder at 2 & $3\frac{1}{2}$ P. M., Rain at $3\frac{1}{2}$ P. M.
23	113.0	0.16	S.S.W, S. & S.S.E.	...	93.2	Chiefly ⌒i, Rain at $8\frac{1}{2}$ & $9\frac{1}{2}$ A. M.
24	133.6	0.16	S. S. E, S. E. & S.	...	101.9	Chiefly ⌒i Thunder & Lightning at $9\frac{1}{4}$ P. M., Slight rain at $5\frac{1}{2}$ & 11 A. M. & at 3 & $4\frac{1}{2}$ P. M.
25	124.6	0.17	S.S.W, S. & S. by E.	...	90.7	⌒i to 6 P. M., clear afterwards. Rain at $11\frac{1}{2}$ A. M. & at $5\frac{1}{2}$ P. M.
26	132.0	0.04	S. by E, S.S.E. & S.	...	173.6	Clear to 6 A. M. ⌒i to 6 P. M. clear afterwards. Light rain at $1\frac{1}{4}$, $2\frac{1}{2}$ & 5 P. M.
27	132.5	...	S. by E. & S.	...	161.2	Clear to 5 A. M. ⌒i to 8 P. M., clear afterwards. Drizzled at $1\frac{1}{2}$ P. M.
28	131.0	...	S. by E. & S. S. E.	...	130.3	Clear to 6 A. M., ⌒i afterwards Drizzled at 1 P. M.
29	128.4	0.05	S.	...	115.3	Stratoni to 3 A. M. \i to 7 A. M. ⌒i to 6 P. M., clear afterwards. Thunder at 1 P. M. Lightning at $7\frac{1}{4}$ P. M., Slight rain at $2\frac{1}{4}$ P. M.
30	...	...	E. S. E.	...	170.7	\i to 4 A. M., stratoni to 6 P. M., clear afterwards. Drizzled at $5\frac{1}{2}$ A. M. & at 1 P. M.
31	125.2	...	S. E. & S. S. E.	...	199.2	\⌒i to 3 A. M., overcast to 6 A. M., stratoni to 6 P. M., clear afterwards Drizzled at 4, 6 & 12 A. M. & at 3 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌢i Cumulo strati, \⌒i Nimbi
\⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.648
Max. height of the Barometer occurred at 10 A. M. on the 14th. ...	29.836
Min. height of the Barometer occurred at 5 P. M. on the 23rd. ...	29.420
Extreme range of the Barometer during the month	0.416
Mean of the daily Max. Pressures	29.707
Ditto ditto Min. ditto	29.583
Mean daily range of the Barometer during the month	0.124

	o
Mean Dry Bulb Thermometer for the month	84.5
Max. Temperature occurred at 3 P. M. on the 18th.	93.4
Min. Temperature occurred at 6 A. M, on the 12th.	77.3
Extreme range of the Temperature during the month	16.1
Mean of the daily Max. Temperature...	89.1
Ditto ditto Min. ditto, ...	81.2
Mean daily range of the Temperature during the month... ...	7.9

Mean Wet Bulb Thermometer for the month	81.3
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	3.2
Computed Mean Dew-point for the month	79.1
Mean Dry Bulb Thermometer above computed mean Dew-point ...	5.4
	Inches.
Mean Elastic force of Vapour for the month	0.973

	Troy grain.
Mean Weight of Vapour for the month	10.42
Additional Weight of Vapour required for complete saturation ...	1.93
Mean degree of humidity for the month, complete saturation being unity	0.84
	o
Mean Max. Solar radiation Thermometer for the month ...	124.3

	Inches.
Rained 24 days,—Max. fall of rain during 24 hours	1.73
Total amount of rain during the month	6.02
Total amount of rain indicated by the Gauge attached to the anemometer during the month	5.50

Prevailing direction of the Wind... ... S, S. S W. & S. by W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Augt. 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.
Mid night																		
1													1				1	
2													1				1	
3													1				1	
4															1	1	1	1
5															1		1	
6																	1	
7																	1	
8																	3	
9																	1	
10																	1	
11															2			
Noon.													1		2			
1													1		1		1	
2									1						2		1	
3											1	1			1	1	1	
4													1		1		2	
5																	1	
6													1				1	
7																	3	
8																	3	
9																	2	
10																	2	
11																	1	

No. of days

Hour.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.
Mid night	2		1		6		11	1	2		5			
1	1		3	1	4		9		3		5			
2	1		2		5	1	7		4		6			
3	1		2	1	4		7		4	1	7	1		
4	1		2		4		5		3		10	2		
5	1		2		4		8	2	2		9			
6	2		1		5	1	7	1	3	1	9			
7	2		2		4	1	8		3	1	9			
8	1		2		3	1	7		4	1	8		1	
9	4		2		4		6	1	5	1	7		1	
10	3		5	1	2		9	3	2		7		1	
11	3	1	4	1			8		3	1	9		1	
Noon.	3	1	2	1	4	1	7		6	1	6	1		
1	4	1	1	1	1	1	10		6	3	5			
2	3		2	1	1		8	3	6		5	1	1	
3	2	1	2	1	5	1	11	2	4	1	2		1	
4			1		5		14	1	4		2		1	
5	1		4		3	1	10		9	2	2			
6			3		4		10	1	8		2			
7			2		4		12		4		4			
8			3		4		10	1	5		3			
9	1		3	1	5		12	1	3		2			
10	1		3		6		10	1	5		1			
11	2		2		6		10	2	5		1			

Hour.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on
Mid night	2				1											
1	2				1											
2	2				1											
3	2				1											
4	2				1											
5	1				1											
6	2															
7	1															
8			1													
9																
10																
11																
Noon.																
1									1							
2									1							
3									1	1						
4																
5			1	1												
6					1	1										
7	1	1														
8					2											
9			1				1									
10	1		1	1												
11	2		1													

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.649	29.710	29.557	0.153	84.7	89.5	80.5	9.0
2	.611	.680	.541	.139	84.8	91.0	80.4	10.6
3	.629	.681	.579	.102	83.9	87.6	81.0	6.6
4	.664	.715	.612	.103	81.9	84.8	80.2	4.6
5	.685	.740	.626	.114	82.9	87.3	80.0	7.3
6	.670	.728	.595	.133	84.0	88.2	81.4	6.8
7	.643	.719	.584	.135	84.2	88.6	80.0	8.6
8	.639	.688	.574	.114	81.5	83.4	79.5	3.9
9	.630	.671	.570	.101	82.4	87.0	80.0	7.0
10	.653	.718	.590	.128	82.1	86.8	80.3	6.5
11	.649	.699	.565	.134	81.5	87.3	79.4	7.9
12	.678	.748	.610	.138	81.3	87.2	79.0	8.2
13	.741	.803	.677	.126	82.4	86.5	79.0	7.5
14	.753	.824	.661	.163	84.1	89.3	80.0	9.3
15	.723	.790	.647	.143	85.0	90.0	81.0	9.0
16	.683	.749	.604	.145	81.5	89.0	80.9	8.1
17	.670	.724	.593	.131	84.7	91.3	81.2	10.1
18	.683	.745	.611	.134	84.1	88.8	81.0	7.8
19	.667	.738	.591	.147	84.1	89.0	80.5	8.5
20	.660	.705	.612	.093	84.0	90.0	80.8	9.2
21	.691	.736	.628	.108	84.2	92.0	80.0	12.0
22	.697	.765	.633	.132	84.0	90.4	80.4	10.0
23	.718	.771	.657	.114	81.2	85.7	78.0	7.7
24	.726	.799	.660	.139	79.9	81.6	78.0	3.6
25	.733	.794	.678	.116	80.3	85.4	78.5	6.9
26	.727	.782	.664	.118	81.3	85.5	79.0	6.5
27	.768	.836	.716	.120	83.3	88.5	79.0	9.5
28	.760	.820	.701	.119	83.8	89.2	79.5	9.7
29	.753	.815	.686	.129	84.0	89.0	80.7	8.3
30	.783	.841	.706	.135	83.1	89.0	80.0	9.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	81.3	3.4	78.9	5.8	0.967	10.34	2.08	0.83
2	80.7	4.1	77.8	7.0	.934	9.99	.47	.80
3	81.0	2.9	79.0	4.9	.970	10.40	1.73	.86
4	79.9	2.0	78.5	3.4	.955	.29	.15	.90
5	80.6	2.3	79.0	3.9	.970	.42	.37	.88
6	81.1	2.9	79.1	4.9	.973	.42	.75	.86
7	81.6	2.6	79.8	4.4	.995	.66	.58	.87
8	80.3	1.2	79.5	2.0	.986	.62	0.69	.94
9	80.5	1.9	79.2	3.2	.976	.50	1.11	.90
10	80.0	2.1	78.5	3.6	.955	.27	.24	.89
11	79.5	2.0	78.1	3.4	.943	.16	.15	.90
12	79.6	1.7	78.4	2.9	.952	.25	0.99	.91
13	80.3	2.1	78.8	3.6	.964	.36	1.25	.89
14	80.8	3.3	78.5	5.6	.955	.23	.98	.84
15	81.2	3.8	78.5	6.5	.955	.21	2.32	.82
16	81.1	3.4	78.7	5.8	.961	.29	.06	.83
17	81.4	3.3	79.1	5.6	.973	.40	.02	.84
18	81.3	2.8	79.3	4.8	.979	.48	1.73	.86
19	81.2	2.9	79.2	4.9	.976	.45	.76	.86
20	80.9	3.1	78.7	5.3	.961	.31	.86	.85
21	80.9	3.3	78.6	5.6	.958	.26	.98	.84
22	81.1	2.9	79.1	4.9	.973	.42	.75	.86
23	79.2	2.0	77.8	3.4	.934	.07	.14	.90
24	78.6	1.3	77.7	2.2	.931	.06	0.72	.93
25	79.0	1.3	78.1	2.2	.943	.18	.73	.93
26	79.5	1.8	78.2	3.1	.946	.19	1.05	.91
27	79.9	3.4	77.5	5.8	.925	9.92	2.01	.83
28	80.5	3.3	78.2	5.6	.946	10.13	1.97	.84
29	80.4	3.6	77.9	6.1	.937	.04	2.13	.83
30	79.9	3.2	77.7	5.4	.931	.00	1.86	.84

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.707	29.813	29.605	0.208	81.5	83.4	79.2	4.2
1	.694	.788	.599	.189	81.3	83.2	79.2	4.0
2	.685	.775	.588	.187	81.0	83.0	79.0	4.0
3	.676	.766	.580	.186	80.7	82.4	78.8	3.6
4	.668	.760	.569	.191	80.4	82.4	78.5	3.9
5	.680	.780	.585	.195	80.2	82.0	78.0	4.0
6	.692	.799	.607	.192	80.2	81.7	78.0	3.7
7	.715	.821	.633	.188	80.9	83.0	78.0	5.0
8	.735	.836	.666	.170	82.4	84.7	78.5	6.2
9	.745	.839	.669	.170	83.9	86.5	79.5	7.0
10	.747	.841	.671	.170	85.5	87.8	80.2	7.6
11	.738	.825	.655	.170	86.1	89.3	79.0	10.3
Noon.	.716	.798	.641	.157	86.2	90.6	79.0	11.6
1	.687	.777	.609	.168	86.6	91.0	80.0	11.0
2	.657	.739	.572	.167	86.8	92.0	81.0	11.0
3	.638	.717	.549	.168	86.0	91.0	81.0	10.0
4	.629	.718	.546	.172	85.3	89.3	81.0	8.3
5	.631	.740	.541	.199	84.8	88.5	80.2	8.3
6	.645	.746	.561	.185	83.7	87.0	79.5	7.5
7	.663	.759	.576	.183	83.0	86.0	79.9	6.1
8	.692	.787	.595	.192	82.5	85.0	79.7	5.3
9	.712	.800	.615	.185	82.2	84.5	79.7	4.8
10	.718	.815	.605	.210	81.8	83.6	79.5	4.1
11	.716	.814	.608	.206	81.7	83.5	79.5	4.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	80.0	1.5	78.9	2.6	0.967	10.41	0.90	0.92
1	79.9	1.4	78.9	2.4	.967	.43	.81	.93
2	79.7	1.3	78.8	2.2	.964	.40	.74	.93
3	79.4	1.3	78.5	2.2	.955	.31	.73	.93
4	79.3	1.1	78.5	1.9	.955	.31	.63	.94
5	79.2	1.0	78.5	1.7	.955	.31	.57	.95
6	79.3	0.9	78.7	1.5	.961	.37	.51	.95
7	79.8	1.1	79.0	1.9	.970	.46	.64	.94
8	80.4	2.0	79.0	3.4	.970	.44	1.17	.90
9	80.9	3.0	78.8	5.1	.964	.34	.79	.85
10	81.3	4.2	78.4	7.1	.952	.17	2.55	.80
11	81.4	4.7	78.1	8.0	.943	.06	.89	.78
Noon.	81.5	4.7	78.2	8.0	.946	.09	.90	.78
1	81.4	5.2	78.3	8.3	.949	.12	3.02	.77
2	81.8	5.0	78.8	8.0	.964	.27	2.94	.78
3	81.5	4.5	78.3	7.7	.949	.12	.79	.78
4	81.2	4.1	78.3	7.0	.949	.14	.50	.80
5	80.9	3.9	78.2	6.6	.946	.11	.35	.81
6	80.6	3.1	78.4	5.3	.952	.21	1.86	.85
7	80.4	2.6	78.6	4.4	.958	.30	.52	.87
8	80.2	2.3	78.6	3.9	.958	.30	.34	.89
9	80.3	1.9	79.0	3.2	.970	.44	.10	.91
10	80.1	1.7	78.9	2.9	.967	.41	0.99	.91
11	80.1	1.6	79.0	2.7	.970	.44	.93	.92

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	121.1	0.25	E.S.E, E. & S.S.E,	...	149.9	Clear to 5 A. M., ⌒i to 4 P.M., clear afterwards. Lightning from W. at $9\frac{1}{4}$ P. M. Rain at $1\frac{1}{2}$ & $7\frac{1}{2}$ P. M.
2	130.0	0.26	S. S. E. & E.S.E.	...	121.1	Clear to 5 A. M.\i to 10 A. M. ⌒i to 6 P. M., clear afterwards. Rain at $2\frac{1}{2}$ P. M.
3	118.0	0.12	S. E. & S. S. E.	...	185.2	Clear to 5 A.M., ⌒i to 7 P.M., clear afterwards. Slight rain at $11\frac{1}{2}$ & $12\frac{1}{2}$ A. M. & at $2\frac{1}{2}$ P. M.
4	...	0.33	S. S. E. & S. by E.	...	150.4	Stratoni to 4 A. M., overcast to noon, \⌣i to 4 P. M., clouds of different kinds to 8 P. M., clear afterwards. Rain at 5, 7 & 11 A. M.
5	125.0	...	S.S.E, S.by W. & S.	...	97.6	Clear to 3 A. M. Stratoni to 9 A. M., ⌒i to 6 P. M., clear afterwards.
6	124.0	...	S. S. W. & S.	...	218.3	Clear to 4 A. M., ⌒i to noon, stratoni afterwards. Lightning to W. at 7 & 8 P. M.
7	123.0	...	S. & S. by E.	...	216.0	Chiefly stratoni. Thunder at 4 P. M. Lightning to S. W. at 8 P. M. Drizzled at $4\frac{1}{2}$ P. M.
8	...	1.70	S. by E. & S.	...	166.3	Stratoni to 2 A. M., overcast to 6 P. M., stratoni afterwards. Thunder at midnight 1, 2, 3 & 4 A. M. Lightning at midnight, 1, 2, 3 & 4 A. M. & at 10 P. M. Rain from $2\frac{1}{2}$ to 9 A. M. & drizzled at 4 & 5 P. M.
9	...	1.88	S. S. E. & S. E.	...	97.8	Overcast to 6 A. M., ⌒i to 1 P. M., overcast afterwards. Thunder at $5\frac{1}{4}$ P. M. Lightning at 8 P. M. Rain from 1 to 3 A. M. & at 2, $6\frac{3}{4}$ & 8 P. M.
10	125.2	...	S.S.E, E. & E. by S.	...	130.8	Chiefly stratoni. Dizzled at 3 P. M.
11	132.0	0.15	E. by S. & E. S. E.	1.0	179.4	Clouds of different kinds. Thunder at 2 P. M. Lightning at $10\frac{3}{4}$ P. M. Rain at 1 A. M., noon & $2\frac{1}{2}$ P. M.
12	127.4	0.13	S. E. & E. S. E.	...	137.0	Clouds of different kinds. Thunder at $12\frac{1}{2}$ A. M. & 1 P. M. Lightning to S. W. at 11 P. M. Slight rain at $4\frac{1}{4}$ A. M. & 1, $3\frac{1}{2}$ & 6 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 1½ ft. above Ground.	Wind. Prevailing direction.	Wind. Max. Pressure	Wind. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
13	124.4	...	E. S. E. & S by E.	...	138.7	\i to 6 A. M., ⌒i to 11 A. M., stratoni afterwards. Drizzled at noon & 4 P. M.
14	134.0	...	S. by E. & S.	...	53.3	Clear to 3 A. M. \i to 7 A. M. ⌒i to 6 P. M., clear afterwards. Lightning from W. at 1 A. M. Drizzled at 9½ A. M.
15	131.6	...	S. by E. & S.	...	141.0	Clear to 6 A. M., ⌒i to 4 P. M., stratoni afterwards. Lightning to N. at 7 P. M.
16	131.0	...	S. & S. S. W.	...	161.9	Stratoni to 6 A. M., ⌒i to 5 P. M. \i afterwards. Drizzled at 3 A. M.
17	133.0	0.21	S. & S. by W.	0.6	125.3	Clouds of different kinds to 8 A. M., ⌒i to 3 P. M., stratoni afterwards. Thunder at 4½ P. M. Lightning at 6¼, 7 & 8 P. M. Rain at 4, 5½ & 8 P. M.
18	131.2	0.12	S. by W. & S.S.E.	...	104.1	Chiefly ⌒i. Slight rain at noon & 10 P. M.
19	132.5	0.04	S. E. & S. S. E.	...	89.3	Chiefly ⌒i. Slight rain at 2½ P. M.
20	135.4	0.04	S. S. E, S. E. & S.	...	103.5	Clear to 5 A. M. ⌒i to 6 P. M., \i afterwards. Slight rain at 1½ & 2½ P. M.
21	135.4	0.44	S & variable.	...	73.0	Stratoni to 6 A. M., ⌒i to 2 P. M., clouds of different kinds afterwards. Thunder at 1¼, 3, 7 & 8 P. M. Lightning at 6½, 7 & 8 P. M. Rain at 3, 7 & 8 P. M.
22	136.0	...	E. by S. & E.S.E.	...	81.0	\i to 5 A. M., ⌒i afterwards. Lightning to W. at 11 P. M.
23	118.5	0.21	S. E. & S. S. E.	...	127.1	Overcast to 9 A. M., stratoni to 3 P. M., overcast afterwards. Slight rain from 5 to 7 A. M. & 4 to 9 P. M.
24	...	1.20	S. E. & S. S. E.	1.0	188.2	Overcast to 4 P. M., stratoni afterwards. Lightning to W at 7 & 8 P. M. Rain from 3 A. M. to 1 P. M. & at 9½ P. M.
25	121.5	0.38	S. E., S. S. E. & S.	...	201.8	Chiefly stratoni. Slight rain at 1, 3, 7 & 12 A. M. & 2 & 5½ P. M.
26	...	...	S. by E. & S. S. E.	...	163.6	\i to 6 A. M., stratoni afterwards. Drizzled at 8 & 11 A. M. and 6½ P. M.
27	132.0	...	S. S. E. & S.	...	161.4	Clear to 7 A. M, ⌒i to 6 P. M, clear afterwards. Drizzled at noon and 5¾ P. M.

Abstract of the Result of the Hourly Meterological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
28	130.0	0.04	S. & S. by W.	...	147.9	Clear to 5 A. M. \i & ⌒i to 6 P. M., clear afterwards. Lightning to W. at 6 & $8\frac{1}{2}$ P. M. Slight rain at noon.
29	130.0	...	SbyW,S.S.W.&S.	...	188.0	⌒i & \i to 6 P. M., clear afterwards. Lightning W at midnight and from 9 to 11 P. M. Drizzled at 2 A. M.
30	133.2	0.41	S, S. E. & S. by E.	1.0	149.6	Stratoni to 8 A. M., ⌒i to 5 P. M., clouds of different kinds afterwards. Lightning to W at midnight and 8 P. M. Rain at 6 & $7\frac{1}{2}$ P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒_i Cumulo strati, \⌒i Nimbi \\⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.691
Max. height of the Barometer occurred at 10 A. M. on the 30th. ...	29.841
Min. height of the Barometer occurred at 5 P. M. on the 2nd. ...	29.541
Extreme range of the Barometer during the month	0.300
Mean of the daily Max. Pressures	29.751
Ditto ditto Min. ditto	29.624
Mean daily range of the Barometer during the month	0.127

	o
Mean Dry Bulb Thermometer for the month	83.1
Max. Temperature occurred at 2 P. M. on the 21st.	92.0
Min. Temperature occurred at 5, 6, & 7 A. M, on the 23rd & 24th....	78.0
Extreme range of the Temperature during the month	14.0
Mean of the daily Max. Temperature	88.0
Ditto ditto Min. ditto, ...	80.0
Mean daily range of the Temperature during the month... ...	8.0

Mean Wet Bulb Thermometer for the month	80.4
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	2.7
Computed Mean Dew-point for the month	78.5
Mean Dry Bulb Thermometer above computed mean Dew-point ...	4.6
	Inches.
Mean Elastic force of Vapour for the month	0.955

	Troy grain.
Mean Weight of Vapour for the month	10.25
Additional Weight of Vapour required for complete saturation ...	1.61
Mean degree of humidity for the month, complete saturation being unity	0.86
	o
Mean Max. Solar radiation Thermometer for the month ...	128.6

	Inches.
Rained 26 days,—Max. fall of rain during 24 hours	1.88
Total amount of rain during the month	7.91
Total amount of rain indicated by the Gauge attached to the anemometer during the month	7.20
Prevailing direction of the Wind... ... S, S. S E. & S. E.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Sept. 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.
Mid night												
1												
2							1	1				
3											1	1
4											1	
5											1	
6												
7												
8												
9												
10												
11												
Noon.							1					
1											3	
2									1		1	
3												
4											1	
5												
6												
7												
8												
9												
10												
11												

Hour.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.
									No. of days					
Mid night			2		1		5		5		6		6	
1	1	1	1		2		5	2	5		5		6	
2			2		2		5		4		5		6	
3			2		3		4	2	6		3		5	
4			3	1	2		4		7	1	2		8	1
5	1		2		2		3		7	2	3	1	7	1
6	2		2		4		3		5	1	4	1	6	
7	1		2		5		5	2	3	1	2	1	8	
8			1		6		5	1	6		1		4	
9			2		3		7	1	6		3		1	1
10	1		1		5		7	1	4		1		4	1
11	2				3		6		4	1	2	1	2	
Noon.	3		1		3	1	2		6	2	3	2	3	
1	3		1		1		4	2	4	1	3		4	
2	2	1	1		4	1	4	2	3		1		8	
3	4	2	1		1	1	2	1	4	2	6		8	1
4	2				1		4	1	7	2	4	1	5	1
5	1		1		4		2		7	2	2	1	4	
6	1		2		1		3	1	6	1	3	1	10	1
7	2		2		1		2	1	5	2	6		7	1
8			1		2		2		6	3	8	2	7	
9			2		1		3		5		8	1	7	
10			2		1		4	1	4		9		7	
11			2		2		3		4		9		7	

Hour.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	3		2																			
1	3		2																			
2	3	1	2																			
3	3		2	1	1	1																
4	2		1																			
5	3		1																			
6	3	1	1																			
7	3	1																				
8	3	1	3	1																		
9	1		6																			
10	1		4		1																	
11	4	1	5		1																	
Noon.	5	3	2		1																	
1	5		2																			
2	3		2																			
3	2		2																			
4	1		5																			
5	4		5																			
6	3	1	1	1																		
7	4		1																			
8	4	1																				
9	4																					
10	3	1																				
11	3																					

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.780	29.865	29.720	0.145	84.2	90.0	79.8	10.2
2	.794	.850	.719	.131	83.9	90.5	80.5	10.0
3	.806	.879	.744	.135	83.8	90.6	80.0	10.6
4	.753	.824	.661	.163	84.6	90.4	79.8	10.6
5	.712	.781	.648	.133	85.1	90.0	80.5	9.5
6	.721	.789	.680	.109	84.5	89.5	81.0	8.5
7	.673	.750	.596	.154	83.2	89.6	77.7	11.9
8	.666	.756	.515	.241	80.4	82.6	77.5	5.1
9	.769	.833	.722	.111	82.3	86.3	79.4	6.9
10	.787	.855	.714	.141	83.4	89.0	79.3	9.7
11	.765	.826	.718	.108	83.6	89.0	80.0	9.0
12	.792	.867	.750	.117	83.5	89.3	80.0	9.3
13	.771	.835	.694	.141	83.6	89.0	78.6	10.4
14	.755	.806	.713	.093	83.2	88.6	79.0	9.6
15	.782	.839	.737	.102	82.6	87.6	78.5	9.1
16	.788	.853	.741	.112	82.3	87.5	77.0	10.5
17	.785	.844	.731	.113	80.8	84.5	79.2	5.3
18	.792	.858	.733	.125	79.2	83.5	77.0	6.5
19	.826	.886	.783	.103	79.1	84.5	77.4	7.1
20	.832	.887	.774	.113	80.9	87.5	77.0	10.5
21	.820	.871	.764	.107	81.0	85.5	76.8	8.7
22	.863	.912	.803	.109	80.5	87.2	78.2	9.0
23	.916	.978	.860	.118	80.9	87.0	76.4	10.6
24	.945	30.009	.883	.126	80.5	86.7	74.7	12.0
25	.900	29.962	.844	.118	79.5	84.4	74.5	9.9
26	.912	.974	.878	.096	79.7	84.7	75.8	8.9
27	.957	30.018	.917	.101	78.7	84.2	75.0	9.2
28	.957	.026	.915	.111	76.9	82.9	71.5	11.4
29	.937	.015	.893	.122	76.7	83.5	71.0	12.5
30	.909	29.973	.857	.116	77.1	84.5	71.2	13.3
31	.947	30.010	.889	.121	78.0	85.7	72.0	13.7

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.0	4.2	77.1	7.1	0.913	9.78	2.46	0.80
2	79.7	4.2	76.8	7.1	.905	.69	.44	.80
3	80.2	3.6	77.7	6.1	.931	.98	.12	.83
4	80.2	4.4	77.1	7.5	.913	.76	.63	.79
5	80.2	4.9	76.8	8.3	.905	.67	.90	.77
6	80.4	4.1	77.5	7.0	.925	.90	.45	.80
7	79.1	4.1	76.2	7.0	.887	.52	.37	.80
8	78.5	1.9	77.2	3.2	.916	.89	1.05	.90
9	80.0	2.3	78.4	3.9	.952	10.23	.35	.88
10	80.4	3.0	78.3	5.1	.949	.18	.78	.85
11	80.2	3.4	77.8	5.8	.934	.01	2.02	.83
12	80.2	3.3	77.9	5.6	.937	.04	1.96	.84
13	80.2	3.4	77.8	5.8	.934	.01	2.02	.83
14	78.7	4.5	75.5	7.7	.868	9.31	.58	.78
15	77.3	5.3	73.6	9.0	.817	8.77	.91	.75
16	76.7	5.6	72.8	9.5	.795	.54	3.04	.74
17	78.2	2.6	76.4	4.4	.893	9.61	1.43	.87
18	77.5	1.7	76.3	2.9	.890	.63	0.93	.91
19	77.2	1.9	75.9	3.2	.879	.51	1.02	.90
20	77.5	3.4	75.1	5.8	.857	.23	.87	.83
21	77.5	3.5	75.0	6.0	.854	.20	.94	.83
22	77.4	3.1	75.2	5.3	.860	.28	.70	.85
23	75.5	5.4	71.7	9.2	.768	8.28	2.82	.75
24	73.7	6.8	68.9	11.6	.701	7.55	3.43	.69
25	73.2	6.3	68.8	10.7	.699	.54	.12	.71
26	73.6	6.1	69.3	10.4	.711	.67	.05	.72
27	72.5	6.2	68.2	10.5	.686	.41	.00	.71
28	70.9	6.0	66.7	10.2	.653	.09	2.77	.72
29	70.4	6.3	66.0	10.7	.638	6.92	.88	.71
30	70.0	7.1	65.0	12.1	.617	.71	3.21	.68
31	70.1	7.9	64.6	13.4	.609	.60	.59	.65

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.823	29.956	29.569	0.387	79.2	82.5	73.2	9.3
1	.813	.949	.541	.408	79.0	82.0	73.0	9 0
2	.804	.945	.522	.423	78.6	81.8	72.5	9.3
3	.796	.947	.515	.432	78.3	81.6	72.0	9.6
4	.790	.942	.516	.426	77.9	81.5	71.8	9.7
5	.805	.955	.604	.351	77.7	81.0	71.5	9.5
6	.823	.978	.631	.347	77.5	81.0	71.0	10.0
7	.845	.995	.660	.335	78.4	82.5	71.4	11.1
8	.866	30.010	.700	.310	80.5	85.6	74.2	11.4
9	.883	.022	.750	.272	82.1	86.8	76.7	10.1
10	.882	.026	.741	.285	83.5	88.0	77.6	10.4
11	.867	.003	.720	.283	84.8	89.3	79.5	9.8
Noon.	.840	29.983	.693	.290	85.9	90.6	81.2	9.4
1	.811	.952	.661	.291	86.2	90.5	82.4	8.1
2	.787	.932	.624	.308	86.2	90.5	81.0	9.5
3	.775	.923	.602	.321	85.6	90.3	78.2	12.1
4	.771	.923	.596	.327	84.6	89.5	78.2	11.3
5	.776	.935	.597	.338	83.9	89.2	78·8	10.4
6	.787	.941	.607	.334	82.3	86.8	78.5	8.3
7	.803	.954	.629	.325	81.3	86.0	77.5	8.5
8	.823	.971	.619	.352	80.7	85.5	76.0	9.5
9	.837	.983	.620	.363	80.2	84.4	75.0	9.4
10	.841	.981	.611	.370	79.7	83.4	74.5	8.9
11	.837	.975	.583	.392	79.3	82.6	73.8	8.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	76.9	2.3	75.3	3.9	0.862	9.32	1.24	0.88
1	76.8	2.2	75.3	3.7	.862	.32	.18	.89
2	76.6	2.0	75.2	3.4	.860	.31	.07	.90
3	76.4	1.9	75.1	3.2	.857	.28	.00	.90
4	76.2	1.7	75.0	2.9	.854	.25	0.91	.91
5	76.0	1.7	74.8	2.9	.849	.20	.90	.91
6	75.8	1.7	74.6	2.9	.843	.14	.90	.91
7	76.4	2.0	75.0	3.4	.854	.25	1.06	.90
8	76.9	3.6	74.4	6.1	.838	.04	.94	.82
9	77.2	4.9	73.8	8.3	.822	8.84	2.67	.77
10	77.5	6.0	73.3	10.2	.809	.66	3.34	.72
11	77.7	7.1	72.7	12.1	.792	.47	.99	.68
Noon.	77.8	8.1	72.1	13.8	.778	.29	4.58	.64
1	77.7	8.5	71.7	14.5	.768	.18	.81	.63
2	77.7	8.5	71.7	14.5	.768	.18	.81	.63
3	77.5	8.1	71.8	13.8	.771	.21	.55	.64
4	77.1	7.5	71.8	12.8	.771	.23	.16	.66
5	77.4	6.5	72.8	11.1	.795	.52	3.61	.70
6	77.3	5.0	73.8	8.5	.822	.82	2.76	.76
7	77.2	4.1	74.3	7.0	.835	.99	.25	.80
8	77.2	3.5	74.7	6.0	.846	9.12	1.92	.83
9	77.1	3.1	74.9	5.3	.851	.19	.69	.85
10	76.9	2.8	74.9	4.8	.851	.19	.53	.86
11	76.8	2.5	75.0	4.3	.854	.24	.35	.87

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1½ ft. above Ground.	WIND. Prevailing direction.	Max. Pressure	Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
1	133.5	...	S. by E. & S.S.E,	...	87.9	╲i to 8 A. M., ⌒i to 6 P. M., clear afterwards. Drizzled at 5½ P. M
2	133.4	...	E, S.E. & S. byE.	...	92.2	Chiefly ⌒i. Drizzled at 4. P. M.
3	134.0	...	S.byE,E.byS.&S.	...	132.0	Clear to 7 A. M., ⌒i to 6 P.M., clear afterwards. Thunder at 12½ A. M., & 2 P. M. Drizzled at 2½ P. M.
4	134.5	...	S. S. E., S. E.& S.	...	108.9	Clear to 8 A. M., ⌒i to 7 P.M., clear afterwards. Lightning to S. at 6¼ P. M.
5	131.8	...	S., S. E& S. S. E.	...	61.4	Clear to 7 A. M., ⌒i to 5 P.M., clear afterwards.
6	133.2	...	S. S. E. & S. E.	...	143.6	Clear to 6 A. M., ⌒i to 6 P. M., clear afterwards. Lightning to W. at 8 & 9 P. M.
7	133.0	0.20	E. & variable.	4.0	160.1	Clear to 5 A. M., ╲i & ⌒i to 6 P. M., overcast afterwards. Brisk wind from 9 to 11 P. M., Rain at 7 & 11 P. M.
8	...	1.49	S. S. E. & S. E.	9.0	475.9	Overcast to 6 P. M., stratoni afterwards. Strong wind & rain from midnight to 5¼ A. M. Drizzled at 6 & 8 A. M., & at 3 P. M.
9	125.0	...	S. E. & S. S. E.	...	155.2	Stratoni to 5 A. M., ⌒i to 12 A. M., stratoni to 6 P. M., clear afterwards. Thunder at 11 and 12½ A. M. Lightning at 3 A. M. & 11 P. M. Drizzled at 3½ P. M.
10	134.0	0.04	S.S. E, & S. by E.	...	64.4	Clear to 6 A. M.,⌒i to 6 P.M., clear afterwards. Lightning at midnight & 1 A. M. & at 10 P.M., Slight rain at 2 P. M.
11	134.0	...	S. by E. & S.S. E.	...	54.8	Clear to 7 A. M.,⌒i to 4 P. M., clear afterwards. Drizzled at 2½ P. M.
12	131.0	...	S. S. E. & S.byW	...	56.2	⌒i &╲i to 6 P. M., clear afterwards. Lightning to E at 7 P. M.
13	132.4	0.16	S.byW.& variable	...	63.0	╲i to 7 A. M., ⌒i to 6 P. M., overcast afterwards. Thunder at 8, 9 & 10 P. M. Lightning at 6, 7, 8, 9 & 10 P. M. Slight rain at 10½ A.M. & 4 P. M. & from 9 to 11 P. M.
14	131.5	...	S. W. & N. N. W.	...	77.0	Clouds of different kinds to 2 P. M., clear afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage $1\frac{1}{2}$ ft. above Ground.	WIND. Prevailing direction.	WIND. Max. Pressure	WIND. Daily Velocity.	General aspect of the Sky.
	o	Inches		lb	Miles	
15	131.5	...	E. N.E.&N.N.W.	...	70.8	Clear to 6 A. M., ⌒i to 4 P. M., clear afterwards.
16	127.0	...	N by W. &N.W.	...	157.5	Clear to 9 A. M., \⌒i afterwards.
17	130.4	0.46	N. E. & E. S. E.	...	164.9	Chiefly stratoni. Thunder at 2 & 3 P. M. Lightning to S. E. at $6\frac{1}{2}$ P. M. Rain at $2\frac{3}{4}$ A. M., & 3 P. M.
18	...	0.21	N.N.E. &variable	...	92.9	⌒i to 4 A. M., overcast to 2 P. M., stratoni afterwards. Thunder at 10 A. M., & 5 P. M. Slight rain from 6 to 11 A. M.
19	124.0	...	N. N. E. &E.byS.	...	83.4	Stratoni to 1 P. M., overcast to 5 P. M., \⌒i & \i afterwards. Drizzled at $2\frac{1}{2}$ & 4 P. M.
20	133.2	...	E. S. E. & S.	...	59.8	\i & ⌒i
21	124.5	...	W by S & E.N.E.	...	53.0	\i to 7 A. M., ⌒i to 2 P. M., stratoni afterwards.
22	130.4	0.47	E. N.E,NE.&SSE	...	94.3	⌒i to 1 P. M., overcast to 6 P. M., clear afterwards. Thunder at 3 P. M. Rain at $5\frac{1}{2}$ A. M. & 3 P. M.
23	124.6	...	E.N.E.&N. by W.	...	106.2	Clear to 11 A. M., _i to 4 P. M., clear afterwards.
24	127.0	...	N.N.E.&N.by W.	...	127.8	Chiefly clear.
25	122.0	...	N.by E,&W.N.W.	...	92.7	Chiefly clear.
26	...	...	W.N.W.&W.by N	...	73.9	Clear to 2 A. M., ⌒i to 10 A. M., _i to 5 P. M., clear afterwards.
27	...	...	W.by N&W.N.W.	...	50.8	Clear to 1 A. M., \⌒i to 5 A. M., clear to 10 A. M., ⌒i to 4 P. M., clear afterwards.
28	120.3	...	W.NW&W.by N	...	54.0	Clear. Slightly foggy from 8 to 10 P. M.
29	121.5	...	W. by N. & W.	...	47.9	Clear to 10 A. M., _i to 4 P. M. clear afterwards.
30	120.0	...	W.	1.0	73.2	Clear. Slightly foggy at 7 & 8 P. M.
31	124.0	...	W. by S. & N.	0.8	80.7	Clear. Slightly foggy from 9 to 11 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒i Cumulo strati, \∼i Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1869.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.820
Max. height of the Barometer occurred at 10 A. M. on the 28th. ...	30.026
Min. height of the Barometer occurred at 3 A. M. on the 8th. ...	29.515
Extreme range of the Barometer during the month	0.511
Mean of the daily Max. Pressures	29.885
Ditto ditto Min. ditto	29.761
Mean daily range of the Barometer during the month	0.124

	°
Mean Dry Bulb Thermometer for the month	81.4
Max. Temperature occurred at noon on the 3rd.	90.6
Min. Temperature occurred at 6 A. M, on the 29th.	71.0
Extreme range of the Temperature during the month	19.6
Mean of the daily Max. Temperature	87.0
Ditto ditto Min. ditto, ...	77.3
Mean daily range of the Temperature during the month... ...	9.7

Mean Wet Bulb Thermometer for the month	77.0
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	4.4
Computed Mean Dew-point for the month	73.9
Mean Dry Bulb Thermometer above computed mean Dew-point ...	7.5

	Inches.
Mean Elastic force of Vapour for the month	0.824

	Troy grain.
Mean Weight of Vapour for the month	8.87
Additional Weight of Vapour required for complete saturation ...	2.40
Mean degree of humidity for the month, complete saturation being unity	0.79

	°
Mean Max. Solar radiation Thermometer for the month ...	128.9

	Inches.
Rained 13 days,—Max. fall of rain during 24 hours	1.49
Total amount of rain during the month	3.03
Total amount of rain indicated by the Gauge attached to the anemometer during the month	2.67
Prevailing direction of the Wind... ... S. S. E. & variable.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Oct. 1869.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
																					No. of days																											
Mid night			1		1		1		1								3	1	1		6		4		1		2				1				1		1		2		2				2		1	
1	1		1		1		1		1						1		1		2	1	7		3		1		2				1				1		1		2		2				2			
2			1		2		1		2						1		1		2	1	7		3		1		2				1				1		1		2		2						1	
3			1		2		1	1	3						1		1		1		8	1	2		1		2				1				1		1		2		2						1	
4			1		2		1		3				1		2		2		1		5	1	2		1		1				1				2		1		2		2						1	
5			2		2		1		2		2				2		1		2		4	1	2		1		1				1				2		1		2		2						1	
6	1	1	1		2				3		2	1			1		2		2		4	1	2		1		1				1				2		1		2		2						1	
7			1		4		1		3		2	1			2		1				6		2				1				1				2		1		2		2							
8					3		3		2				2				2		4		4	2	2				1						1		2		1		2		1		1					
9	1						6		3				2		1		2		1		5	1	2				1								2		1		2		1		1					
10			1		1		3		2		1		2		2		2		4		4	1	1				1								2		1		2		1						1	
11			1		1		3		3		1		2				3		4		4	1	2												3	1			2		2							
Noon.			2		1		2		1		2		1		1		4		3		4		1				1		1		1				2				1		1		1				1	
1	1		2				3		1				2		1		2		5		3				1		1		2		1						2		1		1				1		1	
2	1		2		1		1		2				1		2		2		3		2		2		2	1	1						1				3		1		3				1			
3			1		1						3	1							2		5	2	4	2	1		1				2	1					3		1		3				3		1	
4	2				1				1				1		2				2	1	6	2	3		1		1				1	1					3		2		1		2				2	
5	1								1				1		1		1		1		6		2		2		2						1	1			2		4		1		1		3		1	
6	2										1				2				2	1	4		3		2		1		1								2		4		2		1		3		1	
7	1				1										1		1		2	1	6		2		2		1		2								2		2		3		1		3		1	
8	1				1				1				1		1		1		1		6		2		3		1		1								2		2		2		1		2		2	
9	1				1		1		1						1		2		1		6		3		2		1										2		2		3	1			2		2	
10	1				1		1		1				1				2		1		6		3		2		1										2		2		2		1	1	2		2	
11	1				1		1		1						1		2		1		6		3		1		2								2	1	1		2		2				2		2	