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## In India.

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THE

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OF

# NATURAL HISTORY.

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EUROPE:—*a popular Physical Sketch. By Professor* SCHOUW. *Translated from the second edition, by Dr.* CANTOR, *Assistant Surgeon, Bengal Medical Service, doing duty with H. M's. 26th Regt. on expedition to China.*[1]

Orbelos, the highest elevation of the Balkan, is computed to be 9600 feet, and is said to be covered with perpetual snow. Towards the north, Balkan sends several rivers joining the Danube, of which Morava is the most extensive; in the south run the rivers Marissa and Vardar. Balkan joins the Alps by an elongated chain, nearly parallel with the Adriatic, extending from S.E. to N.W. nearly 280 miles, and which is usually called the Dinaric Alps.—The highest peak is said to be Monte Dinario, 7466 feet above the level of the sea; Klek is 6933 feet.—The mountains are mostly situated in the vicinity of the sea, towards which they are rather steep. The opposite islands, as Cherso and Osero, are rocky, and of a considerable height.—The Dinaric Alps consist chiefly of limestone, and as they are very dry the inhabitants are obliged to have recourse to tanks. Some of the smaller rivers only have their mouths in the ocean, but on the opposite side some little rivers join the Sau, which united enter the Danube. With regard to wild and cultivated plants, the south-western side corres-

[1] Continued from vol. i. No. 4, page 521.

ponds with Greece and Italy ; whereas the north-eastern side more resembles the Hungarian and east European plain. The *Alps,* the loftiest mountains in Europe, extend as one continued chain from the Hungarian plain to the mouth of the Rhone. The natural boundaries are, in south the great Lombardic plain (the Po valley); in west the lower Rhone valley; in north-west, a basin containing the lake of Neufchatel; in north the Danube valley. In two places the chain blends into others, viz. in SE. into the Dinarian Alps, and in SW. into the Appennines. A small part of the Alps is situated on the sea.

This chain is situated between 43° 30′ and 48° N. L. and extends about 600 miles in length, and from 80 to 160 miles in breadth, and is consequently of an elongated form, narrower on its western extremity. The chief direction is from ENE. to WSW., which however in the western part is changed from NNE. to SSW.

The mean elevation may be fixed thus :—

| | |
|---|---|
| From the SW. extremity to Monte Viso, ... | 6400 feet. |
| —— Viso to Mont Blanc, ... ... ... | 9067 |
| —— Mont Blanc to Monte Rosa, ... ... | 11,733 |
| —— Monte Rosa to Brenner, ... ... | 9600 |
| —— Brenner to Glockner, ... ... ... | 6933 |
| —— Glockner to the NE. extremity, ... | 4800 |

The western extremity is consequently upon the whole somewhat higher than the eastern, and the loftiest part is situated nearer to the SW. than to the NE. extremity. Among the loftiest peaks, are,

| | |
|---|---|
| Monte Viso, ... ... ... ... ... ... | 12,596 feet. |
| Loucyra, ... ... ... ... ... ... ... | 14,400 |
| Mont Blanc, ... ... ... ... ... ... | 15,786 |
| Rosa, ... ... ... ... ... ... ... ... | 15,253 |
| Jungfrau, ... ... ... ... ... ... ... | 13,765 |
| Finster Aarhorn, ... ... ... ... ... | 14,080 |

| | |
|---|---|
| Ortler,... ... ... ... ... ... ... ... | 12,907 feet. |
| Gross Glockner,... ... ... ... ... ... | 13,332 |
| Terglon, ... ... ... ... ... ... ... | 9920 |
| Steiner Alp, ... ... ... ... ... ... | 10,986 |

The most celebrated mountain passes are:—

| | |
|---|---|
| Col de Tende, ... ... ... ... ... ... | 6080 feet. |
| Col de Genêvre ... ... ... ... ... ... | 6504 |
| Cenis, ... ... ... ... ... ... ... | 6826 |
| Grand Bernard,... ... ... ... ... ... | 8213 |
| Simplon, ... ... ... ... ... ... ... | 6613 |
| St. Gothard, ... ... ... ... ... ... | 6826 |
| Splügen, ... ... ... ... ... ... ... | 6933 |
| Stilfser Joch, ... ... ... ... ... ... | 9173 |
| Brenner, ... ... ... ... ... ... ... | 4693 |
| Semmering, ... ... ... ... ... ... | 3306 |

The highest parts of the Alps are nearer the southern extremity, and upon the whole are much steeper than on the northern, from which proceeds a huge terrace, the Bavarian table land, elevated about 1706 feet above the sea.

Considerable longitudinal valleys are found in the Alps, for instance Wallis, the upper part of the Inn-valley, Veltlin; but a greater number still of transverse valleys, as Val d'Ossola, the Levantine valley, the Adige valley, on the south side; the valleys of Hasli, Reuss, Iller, Lech, and Salza, on the north side; from the east proceed the large valleys which are watered by the rivers Mur, Drau, Gail, and Sau; from the south-west the Tinca valley.

The Alps send forth four *capital rivers;* the *Po,* from the maritime Alps,* after receiving nearly all the rivers from the south terminates in the Adriatic; the *Rhine* from the north takes a northerly course through the central European mountains, to the North sea; the *Rhone,* also from the north, follows the western side of the Alps to

* The western Alps.

the Mediterranean; and, lastly, the *Danube,* the sources of which are in Schwarzwald, and Rauhe-Alp, and after receiving a number of branch rivers from the north and east side of the Alps, takes an easterly course towards the Black sea.

At the foot of the Alps appear some extensive *lakes,* viz. in the south Lago Maggiore, Lago di Como, Lago di Garda, with several smaller; in the north, the lakes of Geneva 1173 feet above the level of the sea, of Neufchatel 1386 feet, of Zürich 1386 feet, of Boden 1173 feet, and others; in the east, the Neusiedler and Platten lake. The western side of the Alps presents no extensive lake. The elevated, or Alpine lakes are but small, as the lake on Mont Cenis, at an elevation of 1706 feet. The central formation of the Alps consists of granite, mica slate, granular limestone, and several rocks generally classified under primitive formations, of which also consist the highest peaks; other rocks however appear also on both sides, particularly limestone, occupying a great part of the whole chain. Volcanic rocks are of rare occurrence. The Alps are rich in metallic ores, particularly iron, copper, lead, and quicksilver, and the most important mines occur in Steyria (Steirmark) and Kärnthen, on the east side; the Savoy and Dauphiné on the western. The following will give a summary view of the mean temperatures.

| | | Elevation over the sea. | Annual. | Winter. | Summer. |
|---|---|---|---|---|---|
| Avignon, | 44° N. L. | | 57.8° | 43.2° | 73.6° |
| Marseilles, | 43° 30′ | | 57.8° | 46.62° | 68° |
| Milan, ... | 45° 30′ | 448 ft. | 55.62° | 36.5° | 72.5° |
| Ofen, ... | 47° 30′ | 508 | 51.12° | 31.8° | 70.2° |
| Geneva, ... | 46° | 1299 | 50° | 35.37° | 62.37° |
| Münich, ... | 48° | 1737 | 47.7° | —29.8° | 64.6° |
| Peissenberg, | 48° | 3293 | 42.12° | —28.63° | 51.8° |
| St. Gothard, | 46° 30′ | 6868 | —29.8° | —17.38° | 43.2° |
| St. Bernard, | 46° | 8179 | —31.8° | —18.5° | 43.2° |

The mean temperature at the south-west extremity of the Alps on the coast of the Mediterranean (Avignon, Marseilles) is considerable, and the winter very mild (equal to the spring at Copenhagen). On the Lombardric plain (Milan) the mean temperature is somewhat lower, and the winter proportionally severe, severer even than in Edinburgh; the summer temperature again is proportionally high. During a long series of years, the greatest heat has been 92.75°, the greatest cold 5°. The maritime Alps and the Apennines guard against the influence of the sea, and the climate therefore approaches to continental.

Still more deviating are the seasons in the eastern extremity of the Alps (Ofen), where the difference between summer and winter is 39.37°, in Milan 36°, at Marseilles only 21.37°; the Bavarian table land (Münich) in consequence of its elevation, 1706 feet above the sea, has nearly the same mean temperature as Denmark, and yet the cold is sometimes 19.7° below zero.* At Geneva, in consequence of the elevation, the mean temperature is lower than at Paris, which is situated 3° more northerly, and the winter is proportionally mild, because the Rhone valley affords a passage for the mild south-westerly winds. At an elevation of 3200 feet (Peissenberg) is found a mean temperature like that of Stockholm, but the winter is milder, and the summer less warm than in the Swedish capital.

At an elevation of 6826 to 8213 feet (the monasteries St. Gothard and St. Bernard) the mean temperature is lower than at the North Cape. In the Alps, consequently, a traveller may in less than 24 hours pass through as many different climates as he would on a journey from the foot of the Alps to the North Cape. From a probable calculation, the mean temperature on the top of Mont Blanc must be 27° below the freezing point.

* During some 50 years the greatest cold has been 8.5° below zero, the greatest heat 93.87° in Copenhagen.

The annual *quantity of rain* is considerable at the southern foot of the Alps; a mean number of many different localities gives 54 inches, and in Friaul there are places (Tolmezzo, for instance) where the quantity amounts to 90 inches. The southerly and south-westerly winds carry with them many vapours from the sea and from the warmer districts, where the evaporation is greater, and when these vapour-charged currents of air reach the cold Alps, they condense into rain. At the SW. extremity of the Alps the quantity of rain amounts to 23 inches only, but increases considerably as one gets farther into the mountains, for instance, at Chambery to 58½ inches. On the northern terraces and promontories the quantity is 34 inches; at the northern foot 25 inches; and on the North-German plain 20 inches. Smallest quantity of rain falls at the eastern foot; at Ofen only 16 inches, which one would expect, for as the country is far distant from the sea, and the southern and south-western winds pass from the cold Alps down upon the warmer Hungarian plain, no easy opportunity for the necessary cooling is afforded.

The *snow line* appears on the north side of the Alps at an elevation of 8746 feet; on the south side it does not appear prior to a height of 10,132 feet; but towards east it is as low as 8533 feet. If these facts be compared to the above mean elevations, and the elevation of the highest peaks, the conclusion remains that a great part of the Alps is covered with perpetual snow, which also becomes visible in the north on visiting during the hottest part of the summer the chain of mountains from the Lombardic plain in the south, or the Bavarian table land. These immense stores of snow send down into the valleys 'Gletschen' (i. e. glaciers and avalanches) which moving like those in Scandinavia and Iceland, form a rampart of stones and earth below (Moraines), and communicate a milky colour to the rivers. Most of them, and also the largest, are found in Savoy (particularly in the valley of Chamounix, below Mont Blanc) in Tyrol, in Berner Oberland, and Grau Cünden. They reach down to within 3200 feet of the sea level, and are occasionally on a level with the corn fields.

On the north side the forest trees cease at an elevation of about 5866 feet; on the south side at about 6933 feet. Between the snow line and the forest frontier is situated the zone *of Alpine* vegetation, which in a great measure affords either the identical species found on the Norwegian mountains, or others closely allied to them, consisting of low perennial plants, with proportionally large flowers of beautiful pure colours. In the lower part of this zone the *Rhododendron* (R. ferrugineum and hirsutum) with its beautiful red flowers (Alprose) forms a prominent feature, instead of which the dwarf-birch and certain kinds of low willows are characteristic of the Norwegian mountains. The zone of Alpine plants present neither poisonous nor thorny plants, nor any densely covered with hairs. Here are no fixed habitations, summer-huts only, (Sennhütten, Sätere) occupied for three months, the period during which the sheep and goats graze, (Schaafalpen). From what has been stated already concerning the snow line and the woody region, it will be understood that this zone is situated on the north side, between an elevation of 5866 and 8746 feet, on the south side 6933 and 9173 feet.

The next *zone* is formed by the pines, such as the *larch*, and the '*zirbel*' tree (a kind of pine, with eatable nuts, Zirbelnüsse). The vegetation is almost the same as that which appears in the northern parts of Europe. Some excellent medicinal plants grow here, the pastures are exquisite even for cows, but unavailable for agricultural pursuits. On the south side it is situated at an elevation between 4800 and 6933 feet, on the north side between 4266 and 5866 feet. This zone is employed for cutting of wood, and as pasture for cows (Kuhalpen) and smaller cattle, when they are no longer able to graze in the first zone. Inhabited places, and even some towns occur, as Simplon in the Over-Inn valley 5333 feet, and Sils, 4800 feet, above the level of the sea.

Next follows the zone of the *beech* and *oak*, 4800, 2666 feet on the south side; 4266, 2133 feet on the north side, where the forests consist of the above mentioned pines, and of beech and oak. The plants resemble those of the north European plain. Here we find pastures and corn fields.

The lowest zone is that of the *chestnut*, showing itself completely on the south side of the Alps only (between 2666 and the foot of the mountains) where not only the North-European kinds of grain are cultivated, but also maize, and vine. Of *wild beasts*, are found bears, wolves, foxes, lynxes, which equally appear in Scandinavia; also the chamois, and the ibex—the latter now a days very rare, both of which form the game of the rash hunters; also the marmot, notorious for its long hybernation; and among birds, the bearded vultures (Lämmergeyer) and eagles inhabit the higher regions of the Alps.

*The domesticated animals* are the same as those of the northern and central Europe; grazing is considerable, and exquisite in the highlands. The mule is important as a transport across the mountains. If the Alps be compared to the Scandinavian mountains, the following differences in particular obtrude themselves.

The latter in point of extent exceed the Alps, which however have twice their height, whether the mean height or the loftiest peaks be chosen as standards. (Mont Blanc 15786, Skagestoltind 8112 feet.) The direction of the Scandinavian mountains approaches more N. and S.; that of the Alps more E. and W. The former occupy 13 degrees of latitude, the latter only four and a half, for which reason there exist in Scandinavia a greater difference in climate and plants, i. e. if solely compared to the lowland; as the Alps however are so much higher, they display upon the whole some greater climatic differences. The Scandinavian mountains are exposed much more than the Alps to the influence of the sea, wherefore also the west side possesses a coast climate. The sea makes deep inlets into this chain, which of course is not the case in the Alps. The Scandinavian chain is precipitous towards west, and slopes very gently towards east; the northern and southern declivities of the Alps are more uniform;—the former chain is flat above, and the passes traverse broad table lands, of which the Alps are void, and their passes consist generally speaking of deep depressions in the rocks, where two valleys from opposite sides meet each other. The Alps, on the other hand, form extensive longitudinal valleys, and their transverse valleys differ less than the Scandinavian, where they are very large on the east side, and proportionally small on the west side. A similar difference exists in the rivers; in Scandinavia all the large rivers are found on the east side; in the Alps the rivers of the north side exceed those of the southern, yet the difference between either side is not great. On either side of the foot of the Alps appear extensive lakes; in Scandinavia lakes are found only at the eastern foot; but large mountain lakes are common, compared to which those in the Alps are small. Limestone prevailing in the Alps, is not found in the Scandinavian mountains.

The snow line is situated 6400 feet higher on the north side of the Alps than in the northernmost part of Scandinavia, and 3626 feet higher on the southern side of the former, than on the most southern part of the latter. Nevertheless greater masses of ice and snow are found in the Alps in consequence of their greater height. The woody region is formed by pines in the Alps, by the birch in Scandinavia.

The two lowest alpine zones, viz. those of the beech and the oak and that of the chestnut, are missing in the Scandinavian mountains. Cultivation does not comparatively speaking ascend so high up the Alps as it extends to the north in Scandinavia, for it ceases in the Alps at the elevation of the beech, and the zone of the pines is characterized by pasture, whereas the beech in Scandinavia extends not only to 59°, but cultivation extends to 70°, consequently as much to the northward as the pines. Corn thrives there at a mean temperature below the freezing point, but ceases in the Alps at situations where the range of temperature is higher. This phenomenon is of course to be ascribed to the greater summer heat of Scandinavia. The Alps possess maize and vine, which Scandinavia does not; the pastures on the Alps are richer, and consequently grazing is carried on to a greater extent.

*The Pyrenées*—South of the basin in which the Languedoc canal is cut, and not connected with the Cevennes nor the Alps, this proportionally narrow chain of mountains extends from the Mediterranean to the Atlantic ocean. The southern boundary is formed by the Ebro valley. The chain, situated between 42° 30′ and 43° 30′ N. L. is 220 miles in length, and 48 miles in breadth, and extends in a direction from ESE. to WNW. a different course from that of the Alps, but still it approaches a line from E. to W. The Pyrenées are exposed to the influence of the sea more than the Alps, but less than the Scandinavian mountains.

The mean elevation of the central, which is the highest part, is 7466 feet. The loftiest peaks are

| | |
|---|---|
| Vignemale, ... ... ... ... ... ... | 10,986 ft. |
| Mont Perdu, ... ... ... ... ... ... | 11,200 |
| Pic Posets, ... ... ... ... ... ... | 11,304 |
| Pic Nethou (Maladetta,) ... ... ... | 11,413 |
| Montcalm, ... ... ... ... ... ... | 10,667 |
| Canigon, ... ... ... ... ... ... | 9,174 |

The extent of the Pyrenées is consequently much smaller than that of the Alps, the Scandinavian mountains, or the

Carpathians, but they exceed the two latter chains in height.

The passes are in no respect behind those of the Alps, and consequently appear higher compared to the highest peaks. A number of very regular transverse valleys distinguish the Pyrenées, but no longitudinal vallies of any consequence, nor do they send forth any terraces on their sides.

All the *rivers* from the south side are received by the river Ebro, which follows an easterly course, and whose mouth is in the Mediterranean. The north side sends most of its waters to the rivers Adour and Garonne, terminating in the Atlantic. The most celebrated waterfall is at Gavernie, the height of which is 1280 feet, but the mass of water is not considerable. No great lakes appear like those at the foot of the Alps, or the Scandinavian mountains, and the mountain lakes are few, and very small.

The Pyrenées, like the Alps, are in the middle, granite, mica slate, and granular limestone, on both extremities other rocks occur, particularly limestone and sandstone. No volcanic rocks appear. The metals are the same as those of the Alps, quicksilver excepted.

Our knowledge of the Pyreneian climate is very imperfect.

| | | Annual. | Winter. | Summer. |
|---|---|---|---|---|
| Perpignan, | 42° 30′ N. L. | 60.1° | 45.5° | 74.75° |
| Dax, ... | 43° 30′ | 56.7° | 44.37° | 69.1° |
| Mt. Louis,* | 42° 30′ | 43.25° | 32° | 56.7° |

From this it would appear the climate of the north side of the Pyrenées is milder at the Mediterranean than Atlantic, where there also appears to be less difference between the seasons, which usually is the consequence of the vicinity of the ocean. At Mt. Louis the mean temperature is a little higher than in Stockholm, the winter something warmer, but the summer colder.

* 5226 feet.

The limit of perpetual snow is found on the north side at an elevation of 8320 feet, on the south side at 9174 feet, which is nearly the same as in the Alps, notwithstanding the several degrees more southerly situation of the Pyrenées; another proof that the snow line sinks towards the sea. As the highest peaks only shoot through the snow line, the quantity of snow must be small, and in consequence no glaciers or snow-masses are found, like those of the Alps.

The wild *Flora* corresponds with the Alpine; and the Pyrenées may be divided into alpine zones or those of *alpine plants*—the *pines*, the *oak*, the *beech*, and the *chestnut;* here also the first and second zone is uncultivated, in the third the north European species of corn thrive, and in the fourth the vine and the maize.

The limit of forest trees is on the north side at 6933 feet, on the south side at 7359 feet, of the corn cultivation at 5226 and 5546 feet; as the pastures are neither so rich nor extensive as on the Alps, *grazing* is less flourishing. The *wild beasts* are the same as those of the Alps, with the exception of the ibex.

*The southern Europe* consists of three extensive peninsulas: viz. the Spanish, the Italian, and the Greek, together with several islands.

*The Spanish peninsula* is bounded by the Mediterranean, the Atlantic, and the Pyrenées; and forms a tolerably regular square, interrupted by no deep indents on the coasts, or gulfs. Opposite the eastern coast are situated the Balearic islands. The latitude is between 36° and 43° 30′. The greatest extent from N. to S. is 480 miles; from W. to E. 540 miles. The greatest part of the peninsula rises to a considerable connected mass, the mean elevation of which is 2133 feet, and on this Madrid is situated; Granada is still higher, 2550 feet. A traveller setting out from the north or east coast for Madrid, will have to ascend to a considerable height, but once having reached the table land, his path will be easy, for in the west the table land slopes gently towards the sea. This extensive table land presents several mountain chains, viz. one in the north, another in the south, and three intervening chains; the first mentioned two take a somewhat regular direction east and west, the intervening ones run more N. E. and S. W.; each of these five, and particularly the three intervening chains, consist properly speaking of several smaller ones, to all of which are attributed particular names, but as their course is pretty much the same, they will here be comprised under common names.

The chain forming the northern margin of the table land between the bay of Biscay and the river Douro, might be denominated the *Asturic Gallician mountains,* and considered as a continuation of the Pyrenées. They attain a considerable height, particularly in the western part; the statements, however, of their elevation are too contradictory to be relied upon. The highest peak is called Pennas d'Europa.

The second chain, between the Douro and Tagus, is the *Guadarama,* the western extremity of which is called Serra d'Estrella. The highest peak is Penalura, 8230 feet. St. Ildefonso, the highest castle in Europe, is elevated 4053 feet above the sea, and the pass leading near it 5120 feet. The third chain is *Serra Guadeloupe,* between the Tagus and Guadiana; the fourth, *Serra Morena,* between the Guadiana and Guadalquivir, are much lower than the two first mentioned chains.

Serra Nevada, forming the southern margin of the table land, has a considerable elevation. Cerro de Mulhacen is 11,594 feet, surpassing the highest peaks of the Pyrenées. The Albujarras, reaching 9280 feet, may be considered as promontories to Serra Nevada.

In the east the table land is bounded by several small interrupted mountain chains, which hardly admit of being classified under one general denomination.

Altogether separated from the principal chain are *Serra Monchique*, a small elongated chain along the south coast of Portugal, the highest peak of which, Serra de Foja, is 4053 feet, and Montserrat, south of the Pyrenées, attaining a similar elevation.

The plains of the Spanish peninsula are but insignificant; the largest are those in Catalonia and Arragon, the coast plains in Valencia, and those in central Portugal.

The islands of Majorca and Minorca are mountainous; the Silla Torellos on the former is 5121 feet, on the latter the Silla Toro is 4800 feet above the sea.

In consequence of the south and north margins of the table land being situated so near the sea, the rivers here must be small, and as it slopes towards west, most of the large rivers have their mouths in the Atlantic, as for instance the *Minho, Douro, Tagus, Guadiana,* and *Guadalquivir.* The greatest rivers on the opposite side, proceeding to the Mediterranean, are Ebro, Guadalaviar, Xucar, and Segura. The Spanish peninsula possesses no lake of considerable extent. Most of the Spanish mountains present primary rocks; the table land is chiefly composed of a red sandstone, which tends to give the country an arid appearance. The principal metals are lead, (particularly in the province of Jaen,) tin, (in Gallicia,) iron, copper, silver, and quicksilver. The most important mines are those worked in Gallicia and Serra Morena. Also *meerschaum* is found; *rock salt* is very common in Catalonia. At Gibraltar a kind of limestone appears, containing many fossil remains of mammalia; no active volcanoes exist on the peninsula, but basalt in several places.

Our knowledge of the *climate* is rather imperfect; that of Lisbon and Madrid however is known, and shows a remarkable difference between the west coast and the tableland.

| | | Annual. | Winter. | Summer. |
|---|---|---|---|---|
| Lisbon, ... | 38° 30′ N. L. | 61.2° | 52.9° | 71° |
| Madrid, ... | 40° 30′ | 58.3° | 43° | 76.7° |

Considering Madrid is situated nearly two degrees more northerly, and 2133 feet above Lisbon, the mean temperature is proportionally higher in Madrid, which is to be ascribed to the heating of the extensive table land; the winter, however, is 10.1° colder, and the summer 4.6° warmer, by which a continental climate is produced on the table land. In Madrid the thermometer has been observed to rise as high as 10.40°, and to fall as low as 16.3°, or perhaps lower. In Lisbon, on the contrary, the highest point of the mercury has been 69°, and the lowest 27.5°. Snow and frost are phenomena of rare occurrence in Lisbon, but not at all uncommon in Madrid. Sufficient observations to determine the temperature of the south coast of Spain do not exist; in all probability the mean temperature will be found amounting to 65.7°, perhaps a little more; the winter is very mild. At Faro (Algravia) the lowest point at which the thermometer was observed is said to be 45.5°.

The annual *quantity of rain* amounts to twenty-six inches, in Madrid to nine and a half inches, the table land consequently suffers much from drought, and in this respect also presents a contrast with the coast. On the table land, as well as on the coasts, the summer rain is very scanty, but the autumn and winter are the regular rainy seasons; thus, in Lisbon one twenty-fifth part only of the annual quantity of rain falls during summer; but during winter more than one-third. In Estremadura it is said, that seven to nine months sometimes pass without any rain. On the table land the atmosphere is almost uninterruptedly clear during the summer.

*Perpetual snow* occurs on Serra Nevada only (from which its name) but the table lands of Serra Guadaramo and Estrella are covered with snow for four or five winter months, they are however used as pasture during summer. The vegetation of the coasts of the Spanish Peninsula presents the general features characteristic of the Mediterranean coasts in central Europe, among which we may particularly mention the *evergreen trees* and *shrubs,* requiring a mild winter, and which therefore cannot thrive to the northward of the mountains separating southern from the northern Europe. To the evergreen trees belong the *cork tree,* several species of oak, which unlike ours retain their foliage in winter, the *laurel,* the *myrtle,* the *lentiscus,* the so-called "*strawberry-tree,*" *the pine,* and the *cypress.* Here also appear a greater number of finely scented plants and shrubs than in the north, particularly among Labiatæ (rosemary,) thyme, sage, &c.); numerous *bulbs* with beautiful flowers, and many of our garden plants, as the wallflower, tazette, anemone, adonis. Several tropical forms appear, such as the *dwarf-palm.* The luxuriant grasses of the northern countries are missing, particularly during summer, when the soil suffers from drought and heat.

[To be continued.]

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## *Economic Geology.* *By* Lieut. R. Baird Smith, *Bengal Engineers.*

The doubts with which the claims of geology to economical importance were so long received, may perhaps be traced to the unphilosophical spirit and perverted views with which its study was originally pursued. Founded entirely on extensive, minute, and careful observation, it required a degree of patient application uncongenial to the speculative tendencies which pervaded the scientific world at the time it first began to attract public attention, and as all science was then commingled with polemical controversy, the leading doctrines of geology, intimately associated as they were with certain points of theological belief, furnished a ground on which the opposing parties could meet and struggle. The consequence naturally was, that amid the bitterness of controversial discussion, observers viewing the limited range of facts they possessed through a distorted medium, drew only such conclusions as were agreeable to their own opinions, while a spirit of wide and unwarranted generalisation took the place of close and rigid induction from carefully observed phenomena. Under such circumstances geology was little more than a mass of fanciful and fantastic cosmological doctrines, and practical men seeing theory succeed theory in endless succession, and remarking the useless, and often mischievous tendency most of these speculations exhibited, naturally became prejudiced against the science in which they originated. In time, however, as generally happens in such cases, these controversies wrought their own cure, and men began to see that in order to form any correct notions of the original state of our earth, it was first essential to obtain accurate ideas of its present and actual condition. Devoting themselves therefore to observation and careful induction from that alone, geologists succeeded in rapidly rearing a fabric second in solidity, beauty, and importance to but one in the whole range of physical science, establishing the claims of geology to high economical value by exhibiting numberless instances of its successful application to the purposes of man, and at the same time deriving from their discoveries such additional and convincing proofs of the benevolence, wisdom, and power of God, as in themselves to be sufficient to render "doubt absurd, and atheism ridiculous."

Economic geology has now an existence as real as economic astronomy, chemistry, or botany, and an acquaintance with its principles is calculated to afford most valuable assistance in, and is sometimes absolutely essential to, the successful prosecution of all those varied schemes of utility, ornament, or profit, in which the engineer, architect, coal worker and miner are respectively engaged.

The importance of disseminating information on this subject is therefore unquestionable, and were a proper system to be pursued, the mineral wealth and resources of this country might be investigated and developed to an extent hitherto unknown. Three or four years ago the Government in England having had its attention directed to economic geology by the distinguished geologist Mr. De la Beche, and appreciating its many important applications, sanctioned the establishment of a Museum for the special purpose of promoting its cultivation, and facilitating its study. The object contemplated in forming this "National Museum of Economic Geology," as it has been called, "is to exhibit at one view the known mineral wealth and resources of Great Britain, so arranged as to furnish every information to those required to direct, or anxious to promote, any public or private undertaking, as to the extent to which such wealth and resources might be available for their purposes." The localities of all mineral substances used for roads, public works, and buildings, for ornamental purposes, from which useful metals are extracted, or which illustrate the application of geology to agriculture, are carefully marked on good maps, and all information concerning them centralised and made accessible with every possible facility.

Indications have recently been given of an intention on the part of the Court of Directors to encourage the formation of a similar institution in this country, and should the system which has received the sanction of the British Government be fully adopted here, its influence on the progress of our acquaintance with the economic geology of India will, it can scarcely be doubted, prove most decisive. Much consideration will however be requisite in arranging the details of the plan, so as to make it productive of the greatest possible amount of general benefit, and many difficulties arising out of the peculiar circumstances in which those who might be inclined to avail themselves of its establishment are placed, will require to be overcome before all that it is capable of effecting be actually realised.

It has been stated to us that the Government of India have given a favourable reception to a suggestion for the formation at Delhi of an establishment similar in principle to the senior department of the Royal Military College at Sandhurst, where commissioned officers have every opportunity of prosecuting those branches of professional study for which such establishments alone furnish the requisite facilities. The beneficial operation of the Sandhurst senior department in furnishing officers well qualified for the scientific duties of the army, or for detached employments requiring scientific attainments, is undisputed, and there can be but little doubt that a similar institution, offering to officers of all branches of the Indian army like facilities for the acquisition of professional and general knowledge would be attended with results equally beneficial, and probably, under existing circumstances, even much more so. Supposing then that such an establishment should ultimately be formed, the Museum of Economic Geology for which the Directors have sent out a collecti on of properly arranged geological and mineralogical specimens, might most advantageously be attached to it, and economic geology made one of the studies prosecuted there. By such an arrangement, the officers who in rotation joined the institution would have the opportunity of becoming acquainted with the principles of the science, would have their attention directed to the various points connected with the economic geology of British India which yet require investigation, and grateful for the facilities afforded them by Government, would go forth again prepared to render the information they had acquired in every way subservient to its interests, by endeavouring to develop the mineral resources of the country, and contribute to the welfare of the people over which its power extends.

Unless however some such means as the preceding are taken to give effect to the design contemplated by the Court of Directors in sending to this country what may be considered the nucleus of a Geological Museum, it cannot be expected that much benefit will result from the step, since the pecuniary loss to which individuals would be subject were they to quit their duties for the purpose of attending the Museum, will always operate as an effectual bar to their doing so. It is to be hoped however that the spirit of the Home Government will be sympathised with here, and that effectual measures will be adopted to open up to the Service generally the means of acquiring information of so useful and practical a character.

In the following papers it is proposed to describe some of the most common applications of geology to the useful purposes of life, and although, from the extent of the subject, a portion only of it can be presented to view, it is yet hoped that the effort will not be unaccompanied with advantage.

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## No. 1.

### *On the Geological Relations of Artesian Wells.*

The dependence of the welfare and prosperity of the inhabitants of tropical countries generally on their possessing abundant supplies of good water, gives a natural prominence to the means usually resorted to for obtaining these, and as the method of boring, when employed in subservience to certain general principles included within the province of economic geology, offers peculiar facilities and advantages, the development of these principles may prove at once interesting and useful. It too frequently happens that they are unknown, or if known are neglected, since had the case been otherwise it is certain that the records of our Indian boring operations, varied and extensive as they have been, would have exhibited results of a more satisfactory character than they have hitherto done. It is undoubtedly true that sources of failure lurk unseen in localities to all outward appearance most favourable for boring experiments, and no amount of geological knowledge can enable one to predict, with absolute certainty, the success of individual operations, any more than the most thorough acquaintance with the laws of mortality can enable one to foretel the duration of individual lives; but still the geologist is in possession of information which gives him the power of duly estimating the probabilities for and against success in each particular case, and can confidently point to the course warranted by reason and experience. The proof of the correctness of this remark will appear as we advance into the subject of this paper.

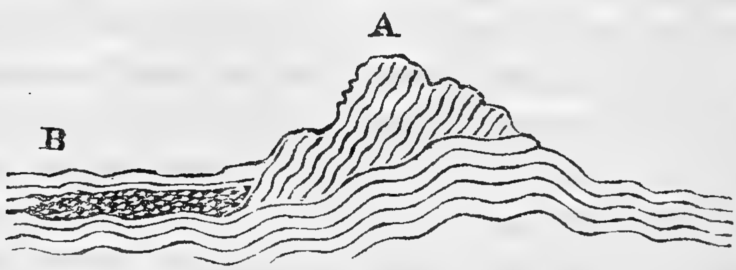
The clouds of heaven and the waters of the ocean are the two great natural reservoirs by which the earth is supplied with water, and a system of circulation is maintained between these through the medium of the atmosphere. We examine the beautiful, but hitherto inexplicable machinery by which this process is carried on, in vain, to discover indications of the first step towards its establishment, and it is from an entirely different source we learn that the earth was the primary source of the system, since before rain fell " A mist went up from the earth and watered all the ground."—The cycle thus commenced has flowed on uninterruptedly; from that early day is this world's history, up to the present time, the source of unnumbered blessings to the varied subjects of the kingdoms of nature.

The waters of the ocean, in obedience to the law of evaporation, ascend through the lower portions of the atmosphere in minute and invisible particles, which under the influence of their as yet mysterious attractive affinities become aggregated in its higher regions in the form of clouds. These are distributed through the instrumentality of the winds over the surface of the earth, and according to circumstances descend either as refreshing showers, or attracted by mountain ranges serve to feed the numerous streams which flow from these, or absorbed by the earth itself as they pass through its porous strata, and form those internal reservoirs whence natural and artificial fountains derive their supplies. It is with the latter case alone we have at present to do, and the geological relations by which it is accompanied will now be examined.

Since the diameter of an Artesian well is seldom more than six or eight inches, it is evident that to make it economically valuable, the water must not only rise in it, but must also overflow with some force at the surface. Such overflowing is indeed the characteristic of an Artesian in contradistinction to a common well, the supply in the latter maintaining a stationary level, and its diameter being necessarily considerable. In order that the water in an Artesian well may thus rise above the surface, it is essential that hydrostatic pressure should be exerted upon it, and to this end a certain disposition of strata is necessary. The important connection between the geological structure of any particular locality and its adaptation for boring operations is thus apparent, and in passing we may notice the incorrectness of the opinions not unfrequently advanced, that all localities are alike, and that since Artesian wells have succeeded in a great many places, they are therefore applicable in all. A very limited acquaintance with the peculiarities of the earth's structure, and of the arrangements of the beds composing its crust, would suffice to shew how untenable such views are.

Districts in which the class of rocks usually denominated primary, prevail, to the exclusion of those of later formations, are not favourable for the employment of the method of boring. It does indeed sometimes happen that when such districts have been subjected to violent disturbing forces, when the strata have been fractured and upheaved, and faults formed, that large bodies of water collect beneath the surface; but these disturbances being local, and most frequently furnishing themselves natural drains for the collected waters, their occurrence does not remove the many obstacles primary districts present to the success of boring experiments. The individual rocks of which these are composed being of a close, hard, crystalline structure, and exhibiting no alternations of porous with impervious strata, the only chance of success would be in meeting with some interior sheet of water, but this is far too vague to warrant the expenditure of time and money which would necessarily be incurred, and it may therefore safely be concluded as a general principle, that boring operations ought not to be undertaken in primary formations, since the natural machinery on which their success depends is not to be found in these. The geology of India, like its history, carries us back to the earliest epochs, and primary rocks constitute a large portion of its framework. This is especially the case in southern India, where granitic rocks are almost universal. These are generally covered at low levels with nothing more than a bed of derivative sand by which water is readily absorbed, and may again as readily be recovered by common wells. Every attempt however which has hitherto been made (and there have been several) to increase the supply of water in these localities by boring through the hard and massive rocks has naturally failed, and the failures are easily explicable from the circumstances above stated.

The alternations of porous with impervious strata in later sedementary deposits, and the continuity of these over extensive areas, with their occurrence at high as well as low levels, furnish us with those dispositions which most favour the adoption of the Artesian system. The extensive development of secondary and tertiary formations over the surface of the earth affords a wide field for boring operations, and already in England, France, Germany, Italy, America, and it is said in China, they have been extensively and successfully employed. To illustrate the geological principles on which the action of Artesian springs depends, let us suppose that the upper part of a hill, A, consists of a soft porous sandstone, and that by noting its dip, it is observed to pass at a low angle, beneath the plain B; continuing the exa-




mination of the locality it is found that the sandstone is completely covered by a bed of close adhesive clay, over which again a certain depth of surface soil reposes. Now with this arrangement, which is not an uncommon one, it will readily be observed, that the water falling on the sandstone being easily absorbed by it will naturally seek the lower level of the plain, passing underneath clay, and as the process of absorption will have been in progress for ages, it is probable that the water-bearing stratum will be highly charged. Should it have become thoroughly saturated, a series of natural Artesian springs will be found along the line of junction of the impervious clay with the sandstone, and should this line be but little elevated above the level of the plain, it would be unadvisable to attempt boring, since the water would be carried off by these natural drains. But if no springs are found, or if they are only found at a considerable height above the plain, then the sandstone under the clay would certainly be charged with water, and a bore carried through the latter would have every probability of success. The water would rise with a force proportional to the perpendicular height of the source of supply above the point of issue, and it may be remarked, that if there are good grounds for believing the porous stratum to be continuous for a considerable distance, or to communicate directly with other porous strata, it is not necessary to sink the well in the immediate vicinity of the hill, and it would be advantageous, especially in countries subject to periodical droughts, to have as great an interval as might be compatible with the success of the project between the well and its source of supply, since there would then be the less risk of exhaustion.

It is quite possible that when the auger brings up sand the water may not immediately rise, since it may have percolated only to the lower portion of the porous bed, but the disposition is favourable, and perseverance will ultimately ensure success by driving the bore through the sandstone till it reaches the water line. There is a farther possibility that the sandstone instead of reposing on an impervious bed, may be underlaid by a pervious one, and to this the water may have penetrated. Still however the probabilities are in favour of success, since in alternating beds an impervious one may reasonably be expected to occur after two or more pervious strata have been met with. Throughout nearly the entire series of secondary rocks, especially in the oolitic and cretaceous groups, such alternations occur, and boring has been successfully employed in many localities where these formations alone prevail. A similar succession of loose arenaceous or calcareous with compact impervious argillaceous deposits characterises tertiary formations, and these being disposed chiefly in basin-shaped hollows, have been found peculiarly adapted for Artesian wells. It is only indeed in secondary and tertiary formations that boring has realised its full economical value, since, as far as my information extends, I am not aware of any instance of perfectly successful boring operations carried on either in transition or primary districts. As before stated, accidental causes may give rise to temporary supplies on such localities, but the hydraulic arrangements essential to the action of an overflowing fountain not being there available, the Artesian system cannot be introduced. Hence then it may be borne in mind as a general principle, that all countries in which secondary or tertiary formations are extensively developed, will furnish those localities in which boring may be employed with the greatest probability of an adequate return for the expenditure incurred.

The locality which perhaps more than any other in the world has tended to give celebrity to Artesian wells, is the tertiary basin of the Thames, the strata of which consisting of a series of siliceous, calcareous, and argillaceous deposits, both of mechanical and chemical origin, rest in a basin-shaped hollow of secondary chalk. As this chalk, and also the sandy beds of the basin itself, outcrop at various points, the water falling upon them immediately percolates through them and accumulates in the lower portions of the basin. It here remains under great pressure, since the London clay, a bed of compact adhesive clay several hundred feet in thickness, overlays the whole. The moment therefore this clay is pierced by the auger the water rushes through the aperture with great violence, and the point of supply being considerably elevated above that of issue, an overflowing well is established. No disposition could be more favourable for boring operations than this, and hence the very general success which has attended them in this and similarly constituted localities has perhaps led to their economical value being over estimated, and over sanguine hopes entertained of their universal applicability. It is to be regretted that the cases of failure have not been recorded as well as those of success, since if we are to accept the authority of a writer in the second vol. of the Transactions of the institution of Civil Engineers, these would have led to some modification of our present views on the subject, and would certainly have tended to lessen our confidence in the system generally. The tertiary basin of Paris has also, as might be anticipated from its constitution, been found admirably adapted for boring operations, and in it they have been carried to the enormous depth of 1800 feet (English). If we are to judge by the unfortunate issue of the many attempts which have been made to obtain Artesian springs in the delta of the Ganges, we would conclude that such formations are not adapted for boring, and it may be useful to consider briefly in how far this conclusion is supported by the geological information furnished by the most recent and most successful of the series.

Had the delta of the Ganges been formed slowly and gradually by sedimentary deposits from the river, without the interference of disturbing forces, the inclination of the strata composing it would have been so slight that the water percolating them would have no tendency to rise above the surface, and the establishment of overflowing wells would consequently have been hopeless. The deepest section of the delta we have as yet obtained shews however very clearly that this uniformity has by no means prevailed uninterruptedly during its formation, but that disturbing forces of considerable, occasionally of great, intensity have at different periods been in active operation, altering the relative level of the country over which the river has flowed, and producing changes in the bed of the receiving basin itself. The nature of the fossil remains, and the dimensions of the gravel found at 480 feet from the surface of the ground, the greatest depth hitherto attained, were such as to lead Dr. M'Clelland to the conclusion, that when these were originally deposited bold rocky mountains existed in close proximity to the present site of Calcutta; and taking his data from the results of personal observation on the transporting power of rapid currents, he estimates the distance of these mountains as not greater than 20 or 30 miles.*—Resting on this bed of coarse conglomerate, the entire depth of which is unknown, although it cannot be less than 80 feet, the bore having pierced it to that extent, there are beds of carbonaceous matter and lacrustine clay bearing the clearest evidence of having been quietly deposited on a marshy surface richly clothed with vegetation. Ere this could have taken place, the powerful currents indicated by the gravel must have been arrested, and as this could only be effected by a great lowering of the inclination of the bed of the river, we may infer the check arose from the entire subsidence of the range of hills above alluded to. The extent to which this took place it is impossible for us to estimate, but the deposits which the river continued to make would repose upon the depressed masses, and were boring operations to be carried on successfully in such localities, they would ultimately expose these again to our observation. Supposing then, as without impropriety we may do, that the rocks of which these hills were composed stretched away beneath the conglomerate bed formed by the large gravel borne along by the torrent issuing from them, we are led to believe that had the Fort William boring operations been successfully carried through the entire depth of the conglomerate, the auger would then have impinged on the solid rock; and if so, the question naturally occurs—Would the experiment have terminated favourably? When we remember that the conglomerate was almost entirely composed of debris from

* The reader who may wish to see this subject treated in greater detail, is referred to a paper "On the Structure of the Delta of the Ganges," by the writer, in the 3rd vol. of the Calcutta Journal of Natural History, and more especially to Dr. M'Celland's editorial remark on that paper in the same work.

primary rocks, admitting of the inference that the chain of hills itself was formed of members of this series, there can be but little hesitation in replying in the negative. We cannot of course say with absolute certainty that the conglomerate is underlaid by the solid rock, but from the considerations adverted to, the probabilities are in favour of its being so. But although in the instance of the boring operations in Fort William it appears probable that success never would have been attained, it by no means follows that deltas generally are ill calculated for similar experiments. On the contrary, these operations, by exhibiting undoubted proofs of changes in the relative levels of the part of deltas due to the action of disturbing forces, continued at intervals during the deposition of their constituent beds, furnish good grounds for the belief that the hydraulic arrangements required for the success of the Artesian system exist in such formations, and that attempts to establish overflowing wells by boring through them, may be made without involving any violation of the general principles already developed on which the action of these depends.

Sufficient has now it is hoped been said to convey a general impression of the geological relations on which the Artesian method is essentially dependant, but it remains still to notice the principal sources of failure to which it is subject, an acquaintance with these being absolutely necessary to the formation of a correct estimate of the propriety of boring in any given locality.

The effect of those disturbing forces to which geologists have by almost common consent assigned an igneous origin, and which have prevailed during every epoch, has been the production of innumerable dislocations in the strata of which the earth's crust is composed, and we accordingly find them fractured, altered, and upheaved in every possible way. Secondary and tertiary equally with transition and primary rocks have felt the influence of these disruptive agents, and the continuity which is so essential to the hydraulic efficiency of the former has in many cases been materially interfered with, in others entirely destroyed. There is, accordingly, no cause of failure in boring operations more faithful than the occurrence of these dislocations, or "faults." Their effects are various; they either wholly interrupt the percolation of the water through the porous beds, or open up a passage for it interiorly, so that it descends deeper into the earth, or they throw it to the surface in the form of springs, in localities where it may be of comparatively little importance. Much care is therefore necessary in ascertaining the existence, nature, and direction of these dislocations in the vicinity of any locality intended for an Artesian well, and although they are frequently concealed, yet the character of the adjoining country, the disposition of the strata, and above all the existence or non-existence of surface springs, will afford materials for the formation of an estimate of the probabilities of success. With reference to the last mentioned circumstance it has been remarked, that powerful springs are almost invariably indications of extensive faults, and in the examination of large tracts of country no single instance has been found in which the one occurred unaccompanied by the other. Faults, it is true, constitute a most important part of the general hydraulic machinery of the globe, but their influence on the particular system under remark may be most injurious, and to estimate duly their effects in deranging the conditions required for the effective action of an Artesian well, is a most important preliminary step to commencing the actual work.

Observations on the dip or direction of inclination of the strata should also be carefully made, and should be extended over a considerable portion of the adjoining country. The inclination of the beds will necessarily determine the course of the percolating water, and if these are exposed either by natural or artificial sections, in the neighbourhood of the locality under examination, then the water will discharge itself there, and a well sunk without reference to a circumstance of this nature would inevitably prove unsuccessful. When the deposits rest in basins these observations are of much importance, since by neglecting them the bore might be commenced on the verge of the porous strata, instead of at some distance within the basin; and in such a case as no pressure would be exerted on the water the establishment of an overflowing well would be impracticable. A clear apprehension of the general principles on which the Artesian method depends will suggest several minuter sources of failure, but it is unnecessary to specify these in detail, since on careful examination of the locality they would not escape notice. Improvements in the mechanical department of boring, will, it may be expected, gradually diminish the risk of failure from the depth to which the porous or impervious beds may extend, and also from the tenacity or hardness which the latter may possess. The first mentioned sources of failure can only be discovered and guarded against by the aid of the geologist, and we repeat again, that no boring operations ought ever to be undertaken irrespective of the information he is able to afford, otherwise there is no reasonable warrant for the expense their prosecution involves.

We have hitherto spoken of boring exclusively as a principle, but in conclusion it may be remarked, that it is not unfrequently useful as an auxiliary in meeting demands for increased supplies of water. When a water-bearing stratum is pierced by the auger, and the water is found to rise only partially in the bore, a common well may then be sunk down to this level, and the bore will act as its feeding pipe. The comparatively slight expence of boring admits of its extensive employment in this way, and it is peculiarly applicable in doubtful localities, where the great outlay required for a common well of considerable diameter, combined with the possibility of its being ultimately unsuccessful after all, would effectually prevent its being resorted to.

## *On the Red Marl* Formation of Mysore.* By CAPTAIN J. CAMPBELL, *Assistant Surveyor General, Madras Establishment.*

In the Madras Journal of Science I have already hazarded publicly my opinion that writers on primary geology have been too hasty in framing their theories of the operations of nature. It is fortunate that in this I stand not alone, but have the able support of Dr. Boase of Cornwall, and apparently of most of his associates in the Royal Geological Society of that country, (vide Boase's Treatise on Primary Geology, 1834).

In Europe there are many tracts in which primary formations prevail, but none have yet been described in which granite is the prevailing, and most apparent rock. Whenever therefore granite and its associations are described, we find the wildest and most contradictory opinions promulgated.

Werner in first drawing attention to primary geology, from the examination of a tract where tabular rocks prevail, was naturally led to the Deposition and Aqueous theory. Hutton and Playfair from the examination of the north of Scotland, where granite in its associations appears to form veins in the adjacent rocks, of course hit upon the Igneous theory, which, on the strong ground afforded by the tract selected, was successfully maintained; and Macculloch in confining himself to the same tract has collected also strong evidences of the igneous action, but for want of a sufficiently extended experience and acquaintance with like formations in other countries, has committed himself in sneering at Saussure,

* As this term is applied in England to certain beds of new red sandstone containing calcareous conglomerate and nodules of limestone, it is necessary to remark that the author uses it in a peculiar sense, as explained in the sequel.—ED. CAL. JOURN. NAT. HIST.

because that distinguished philosopher, from being better acquainted with the extensive alpine and rocky districts of Europe, has tacitly acknowledged himself incapable of describing the active causes employed by the Creator in forming those portions of the globe which he had carefully, but only superficially examined; such at least we must consider to be the spirit of Macculloch's remark, "that after twelve years more experience Saussure died and made no sign."

Dr. Boase in describing Cornwall has pointed out many phenomena quite incompatible with prevailing theories, and also by references to the works of other writers has shewn that the same phenomena may be observed in other parts.

The circumstances pointed out by Dr. Boase have obliged Professor Philips to acknowledge, that "we may freely admit that they in some cases point to agencies not yet familiar to our philosophy; that a full examination of the whole series of granites, porphyries, serpentines, and killas, and of the disseminated and venigenous minerals in them, will kindle a brilliant light in the most secret laboratory of nature; but one thing is wanting, an exact description of all the characteristic facts observable in each particular case, *without the adornment of theory* or the disarray of new nomenclature, (Encyclopædia Metropolitana—Geology). This candid acknowledgment from one of the first professors of the science is, I consider, as great a concession as could be expected from a professed theorist, and would seem to confess that geologists in describing primary formations have thought too much about theories, and too little of giving exact descriptions.

In South India, the primary and granitic formations are developed in such vast extent, that the most casual observer cannot fail to collect the most useful information; and did geologists in that part of the country display a little more energy in appreciating the advantages they have at command, there can be little doubt that in a few years they might claim a first rate place in the acquisition of the knowledge required for a proper elucidation of the subject.

The geology of South India has been stigmatised as monotonous, and as in great measure devoid of interest. In this opinion I cannot concur; for I have found in the examination of the Salam district, which is a particularly marked granitic formation, the most majestic piles of rocks, the most wonderful associations, the most extraordinary and attractive development of particular phenomena, and the most exciting variety and interest. It is true the formations are continuous and extensive, perhaps therefore monotonous to some; but the utmost facility is thus afforded to multiply the observation of facts, and to ensure the correctness of consequent deductions. It is true that the examination of such a formation cannot afford amusement to an idle hour, and the best memory would fail in attempting to compare observations in detached points, unless aided by minute and laborious examinations, and the careful use of ink and paper.

What may be called the red clay formation of Mysore is one of these, so-called, "monotonous" formations; but being one of the most extensive and continuous in South India, is also one of the most interesting. I have not had the opportunity of traversing its whole extent, and can by no means pretend to describe it perfectly, but hoping to be able to correct some errors, as well as to draw more attention to the subject, and perhaps to elicit information which may be now in abeyance, I shall do my endeavour to state the results of my own observations as well as I am able.

A similar formation to that of Mysore is unknown in South India, and the district in which it occurs is the most elevated in that part of the country, being about 3,000 feet above the level of the sea. The extent of this formation I am unable to determine, and I have been unable to find the necessary information in the works to which I have access. Bangalore, Oossoor, Pedda Ballapoor, and Nundydroog, are all situated on this tract, and from the summit of Nundydroog all the surrounding country for 30 miles at least appears to be the same. Venkettgherry, Baitmungalum, and Colar are also, if I remember correctly, situated upon it. This tract is separated from the lower plains which surround it by a sudden rocky break, or abrupt difference in the levels, in which granite is the prevailing rock, mixed with crystalline schists, porphyries, and traps. This break occurs at Naiknairy; at a few miles east of Oossoor; at a few miles south of Bangalore, on the road to Seringapatam; at a few miles west of Bangalore.

The general surface of this formation is an arid, gently undulating level, in sweeps of a mile or two in width, and about 100 feet high at the most, and it is peculiar also in appearance, from being generally almost bare of trees and wild shrubs, although a few topes of mangoes and some banian trees may sometimes be seen in the hollows, or near tanks. The composition is sometimes a sort of red sandy clay like a half-burned brick, but more generally it is of a friable structure, exactly like some of the softer kinds of the new red sandstone of England; and as I consider it best in describing rocks, that the names applied should give the most correct idea of their structure and composition, without any reference to geological position, I therefore propose to call this formation, "Red marl," a term which I think is not likely to mislead any one, or to cause any person to suppose that the formation has any thing to do with the new red sandstone of England in geological position or associations.

Although in general the structure is friable between the fingers, yet it is sufficiently firm and solid to resist the action of rain and running water, unless when collected into nullahs, and in consequence the channels of these are in general deep mural ravines, often 20 feet in depth. In some parts I have seen a structure arranged in thin layers, containing embedded rounded pebbles, but I believe this to be generally almost superficial, and to be probably a recent aggregation of the debris washed from the surface.

The surface yields easily to the native plough, and produces crops of *Raggy*, *Iwaree*, and *Cholum* without irrigation, but generally the upper part which has been disintegrated by cultivation is so superficial, that an extensive surface may sometimes be seen where the soil has been entirely washed off by the heavy rains, leaving the bare naked original rock, bearing on it the crossed scratches or small channels produced by the point of the plough.

It is remarkable that in this formation both kunkur and carbonate of soda are almost unknown, while from the soil in the hollows, muriate of soda, mixed with muriate of lime, are commonly found, and the separation of the muriate of soda is a manufacture of considerable extent.

The depth of the red marl is very various, sometimes being more than thirty feet, while at others it is not more than two or three, and in other parts the red marl is altogether wanting, the coarse white kaolin* which universally underlies it appearing at the surface.

By sections in the nullahs it appears that this formation is universally underlaid by a continuous bed of granite, which appears also to have an undulating surface, for at various points it protrudes in the shape of smooth, rounded masses, sometimes of great magnitude, as at Nundydroog.

* The author here uses the term *kaolin*, and from his accurate knowledge of the constituents of rocks he is doubtless perfectly right. We have however availed ourselves of the discretion he has kindly intrusted to us, of suggesting the term "porcelain clay," which is the same thing, while the term is much better understood by the generality of readers in almost every sense. As the improvement of Pottery in India is now becoming an object of public interest, Captain Campbell, in the course of his valuable researches may be able to point out the best variety of the clay in question, for this important purpose.---Ed. Cal. Journ. Nat. Hist.

This granite is the hornblendic kind which is so universal in South India, and the surface of the larger masses appears generally to have a cleavage into layers, which yields to the heat of a wood fire upon it, and it is in consequence generally used as building material. From this tabular cleavage, and its being generally striped with veins darker than the rest containing more hornblende, it has been called gneiss by some writers. But both gneiss and other schists are almost unknown in this formation, and the only part in which I have seen any gneiss is near Nundydroog. Gneiss and striped granite are often confounded by Indian petrologists, but I think there could be no mistake if attention was given to the way in which they cleave with regard to their structure.

Hornblendic granite is often seen in mammillar masses, crossed by a regular striped structure, exactly resembling the lamination of gneiss; but it has no cleavage at all in the direction of the apparent lamination, and on the contrary Dr. Benza has pointed out that the tabular cleavage is almost universally horizontal, while the apparent lamination is vertical; while in both hornblendic and micacious gneiss the cleavage corresponds with the apparent lamination, both of which are generally vertical when in situ.

The red marl in some very few instances may be seen lying immediately upon the granite, but almost always a stratum of coarse kaolin is interposed between the granite and the red marl. This kaolin is generally of a pure white colour, and of a soft friable structure, and it is in consequence often mined for the purpose of being fraudulently mixed with chunam, which I have above remarked is very scarce in this tract.

Near the granite the kaolin has a coarse granular and cellular structure containing grains of quartz, and it shews a very apparent graduation within the space of about three or four feet into a fine white pulverulent earth meagre to the touch;

from this point it appears again often to graduate in colour and composition, becoming more red and ferruginous as it approaches the red marl, and sometimes the graduation between the red marl and kaolin is perfect, not apparently by any mixture of the two, but by a gradual change in composition, and also by the kaolin becoming more arenaceous. But in general the division between the two is quite distinct, the kaolin running in white, tortuous, gradually decreasing veins into the red marl for several feet; at the south side of Davenhully this is very beautifully and distinctly shewn in a nullah where the veins of the kaolin are also reticulated, insulating portions of the red marl between them.

Sometimes the granite may be seen in round insulated boulders of considerable magnitude embedded in the kaolin, but there is never seen the slightest graduation between the granite and the kaolin, the distinction being always perfect, without the slightest alteration in the composition or structure of the granite, except a very slight scaliness on the outside of the masses, which may be sometimes seen.

Both in the red marl and kaolin, tortuous, vertical, and irregular veins of quartz are seen, sometimes several feet in length, composed of cracked pieces arranged with the *angles perfectly coinciding*, but always separated from each other about the 1-10th of an inch, as if they had shrunk after having been expanded by a state of high ignition. In the large nullah near what is called the Belfry, I observed a large plate of quartz nearly four feet square and only about two inches thick, inclined slightly so as to lie on its bed, while the whole surface was exposed, by which it was apparent that the whole was cracked into pieces about two inches square, as in the veins.

I have remarked the almost general absence of schists in this formation, but some situations afford peculiarities, for instance, two or three miles west of Bangalore, where some very well characterised hornblende slate &c. may be seen, but the locality is very confined.

Another peculiarity is the almost entire absence of white quartz, which is so common among the schistous formations of other parts.

This formation has generally been characterized by writers as having resulted from the decomposition of granite. This term "decompound" appears to have been but too commonly used by Indian geologists as a convenient mode of accounting for phenomena which were difficult to explain. In the case in question not only is there no evidence of decomposition, but it is also necessary to suppose that the decomposition has created the veins of the white kaolin, and also the quartz veins, and besides that this all-creating power—decomposition, must have made various accidental minerals which occur in many places between the kaolin and the red marl, as in the Belfry nullah at Bangalore, where massive scaly mica, a beautiful pink kind of fuller's earth, and also a blueish grey variety of the same, are found in great abundance. It is certainly possible that the formation may be a disintegrated more solid rock, which is still in situ, but even this it is difficult to suppose to be likely, (certainly not difficult for certain geologists to imagine, for it is only necessary to examine their writings to perceive at once that there is no difficulty too vast for their imagination, whenever a favourite theory is concerned). But in the present case it is necessary to remember, that if the rock was once more solid, it must therefore at one time have occupied a smaller space, and to have expanded during the process of disintegration, and as no evidence appears of the movement and disruption which must have taken place *laterally* during this process, it would seem not to be very probable, unless indeed a soluble portion of the original rock is supposed to have been removed by the percolation of water. As one not much inclined to far-fetched theories, I prefer considering the formation to be in the state in which nature formed it.

Veins of hornblendic rock, arranged in globular masses, sometimes traverse the red marl, as pointed out by Dr. Clarke for what he calls basalt in the above rock. In a few cases basalt dykes are seen in the granite, as in one instance at Bangalore, and at Deonhully, but they never traverse the red marl.

Pisiform cellular laterite is common all over this formation, it is composed apparently of small nodules of clay ironstone of a red brown colour, cemented together by yellow ferruginous paste. But I cannot agree with Lieutenant Baird Smith in supposing it always to be a recent production, for although I have found in many situations small portions which contained apparently water-worn angular fragments of rock, yet I have also more frequently found it where recent aggregation was impossible, as for instance on the west side of Yellavunkah, where the nodules are seen disseminated through the red earth for many yards round a nucleus of laterite, which is also embedded evidently in situ, and I have also frequently taken from the outside of a block of hornblende rock (black granite) portions differing in no essential from this laterite.

In no work to which I have access do I find any description of a similar formation. Dr. Thomson in his Outlines of Geology mentions that sandstone of the old red formation occurs in the Ord of Caithness, probably covering granite; and Macculloch mentions the superposition of old red sandstone upon granite in Caithness and Aberdeenshire. In the want of more perfect descriptions it is surprising how closely the description of the new red sandstone formation of England applies to the tract in question. Brande (Outlines of Geology) remarks, "that the appearance of the whole may be described by the figure of a sea surrounding elevated islands, consisting of rocks of the subjacent series;" instead of these rocks if we imagine these to be granite, the description closely applies, for such is exactly the appearance of the gently waving plain north of Bangalore.

Brande further remarks, "The texture of the new red sandstone, I had almost said its colours, are very various; sometimes it is soft and clayey, but in parts it is much more lapideous and indurated, and is associated with beds of a peculiar conglomerate consisting of nodules of different substances cemented by marl or sand;" this applies equally to the red marl of Mysore; and Macculloch and other writers mention the occurrence of mottled or variegated portions both in the old and the superior sandstones, composed of intercomingled red and white. Portions answering this description may be seen also near Bangalore at the Belfry, where a low mound or rise of some extent is composed of red lithomargic earth mottled with white kaolin.

These coincidences are too vague to draw any conclusion from, but they are certainly very curious, and naturally lead to the inquiry, whether any sufficient evidence can be found to imagine any similarity between this formation and the older beds of England.* The principal points I have described will I think forbid this, and my own inference is, that the formation is cotemporaneous with the subjacent granite.

I have remarked that the depth is in many situations very great, but there are, I think, evidences that it has been at one time much greater, for Nundydroog, and the principal hills will be found capped with the same red marl, answer-

* To establish an identity between this formation and the red marl of English geologists, every thing is required. The red marl rests on the coal formation, and supports the oolitic and cretaceous groups. In order to make out the identity, it would be necessary to suppose the whole of these formations to be absent, with the exception of this isolated bed alone, which would require to present very unequivocal proofs indeed of identity with the red marl, before we could regard that fact to be established, or even probable.—Ed. Cal. Journ. Nat. Hist.

ing exactly to that in the plain below. On Nundydroog this cap is in many places several feet in thickness, on which is built the old Hindoo fort still remaining. It is common to find arenaceous soil of this kind on the summits of the highest hills, not originating from vegetable decay, or decompositions of the rock, but evidently in its original situation. This would lead to the belief that these hills had at one time been covered to the summit, and had gradually been denuded by the detrital action of water and other causes.

That the soil of this formation is being gradually washed down to the lower plains, no one can doubt, when they observe the sections which the nullahs are rapidly cutting through it, and the constant removal of the disintegrated surface. And as on a general average the red marl is not more than three or four feet in thickness, a period must arrive when this will be all removed, laying bare the granite and the kaolin, which latter totally incapable of supporting vegetation, Mysore will then become a "howling wilderness," and as unfitted for the existence of man or beast as the deserts of Africa.

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*Some remarks on Meteorological Observations. By* Captain J. Campbell, *Assistant Surveyor General, Madras Establishment.*

After perusing your meteorological observations in the 1st number of the "Calcutta Journal Natural History," I have put together roughly the following remarks as my contribution to assist in the investigation of this subject.

Being one of those whom you justly censure, who having had considerable opportunities of observing endemic disease, particularly fever, yet from considering the subject to be the province of the physician, thought it best to leave it to him, I therefore add such remarks on the subject as my experience enables me to make, to which I hope you will append your observations on those points which I am unable to explain.

The study of meteorological phenomena is a subject which has been too much neglected in India, where there are so many with infinite leisure to procure the most valuable results.

The power of solar radiation, the structure and changes of clouds, their electrical state, the number of strata they form in the air, the elevation of these beds, the changes in the air which produce the sensation of cold, and that closeness vulgarly called "muggy,"* and the causes of haziness in the air, are all subjects on which very little is still known, and in which the philosopher will find ample interest. Having had frequent opportunities, for long periods, of observing the clearness of the atmosphere from an elevated station, I must beg to differ with you on the sufficiency of the cause which you have suggested to account for the haziness of the air at times. In the plains of Bengal it is certainly probable that dust may assist in obscuring the air, but in parts of South India where rocks and jungle prevail, and little or no dust could be raised by the highest wind, this haziness of the atmosphere at certain periods is still found to prevail.† The cause of this has escaped my pene-

* The sensation of cold not only depends upon habit, but also on the degree of evaporation from the body, and also perhaps on the electrical state of the air, which probably produces that "creeping of the skin" produced by a change of weather, so well known to those who have suffered much from "hill fever."

† We must have all Captain Campbell's observations before us, before we can ascribe the haze in southern India to causes, different from those on which it has been found to depend not only in India, but in other quarters. We should know the force and direction of the winds, and changes they are liable to in these respects, and how far these are connected with corresponding changes in the atmosphere. It is impossible to fix a limit to the distance to which light earthy particles may be

tration, nor am I able even to suggest a reason for it. It appears to depend neither on the dampness nor dryness of the air, the clearness or cloudiness of the sky, the temperature, the prevailing winds, nor the height of the barometer.

Generally speaking, when the air is saturated with moisture it is then clearest, but I have seen the air also beautifully clear, when the dew point was ten or twelve degrees of Farhenheit below the temperature, and also perfectly hazy during damp weather.

Dr. Prout in his Bridgwater treatise has given it as his opinion that the slight excess of oxygen which the air contains above the proportions of oxygen and nitrogen required to form a chemical compound, may at times enter into chemical composition with the vapour of water contained in the air, and thus produce a change in its hygromatic state. I do not find that Dr. Prout has stated his reasons for considering this hypothesis as probable, but as coming from such an authority it must be considered at least as *possible,* and then may not perhaps this chemical change produce the haziness in question?

Your remarks on mists and fogs are corroborated by my observations, the detailed results of which will be published at some future time.

carried in the atmosphere by land winds, so as to affect its transparency. In the south of Italy the wind described by Schouw in our present number must carry the earthy particles with which it darkens the air at certain seasons across the Mediterranean from Africa, a distance of from 400 to 600 miles. The earthy particles with which the westerly winds are loaded in Kemaon in April and May, must be carried a distance of from two to three hundred miles, and in the latter portion of their course for 150 miles over damp wooded tracts and mountain ridges of from 6,000 to 8,000 feet in height, before they are deposited at night during the subsidence of the wind from local causes.—Ed. Cal. Journ. Nat. Hist.

Mists over tanks have been ascribed by some writers to the condensation of the moisture in the air, by the colder water in the tank, the superior radiating power of water being supposed to account for its being colder than the surrounding soil; but I have always found that the water of the tank was warmer than the adjacent air, and the mist was produced by the condensation of the vapour arising from the former.

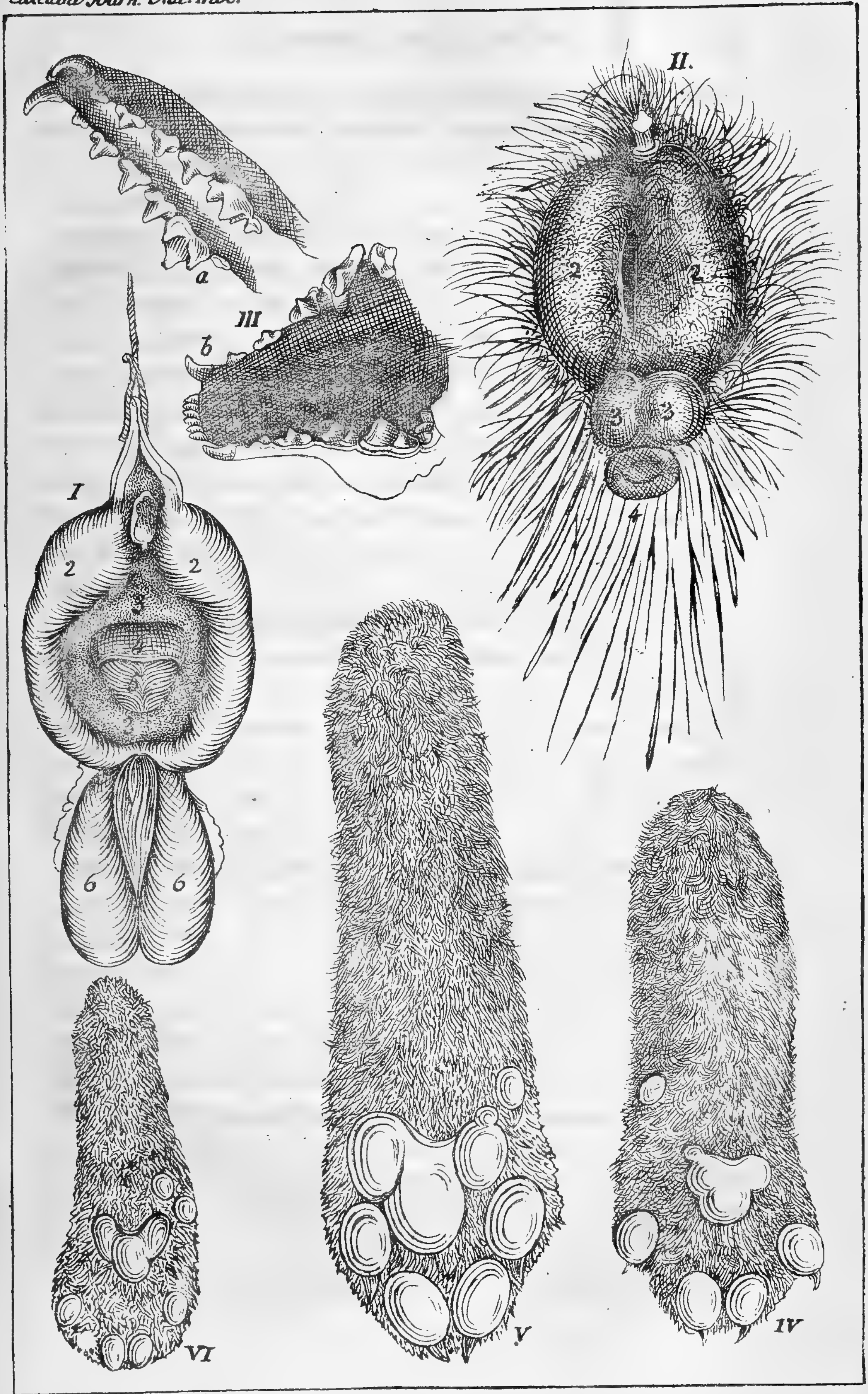
On high elevated pinnacles of granite I have had opportunities of trying the temperature of isolated masses of mist, which were carried past me floating with the wind, and have invariably found their temperature to be below the dew-point at the time, and generally two degrees at least cooler than the surrounding air. Daniel, at page 101 of his Meteorological Essays makes an assertion opposed to the above, but there can be but little doubt he must have been led into error by reasoning on false principles. The mechanical condensation of the volume of a vapour will of course produce the evolution of heat, but it is also as plain that the condensation of vapour into *mist* must always have been produced by the temperature of the vapour having been lowered.

Caps of mist settled on the summits of mountains have been ascribed by Daniel (Essays, page 123) to the condensation of moisture produced by the contact of the cold mountain, and this opinion has been very generally assumed. As these settled caps of mist appear to be stationary even where the wind blows strong, this hypothesis would seem not very probable, more particularly as had the mountain been colder than the surrounding air, the vapour would have been deposited on it in the form of dew; and mist would not have been formed. Having had opportunities of being on conical hills of granite while thus capped with mist, I have always found that the rock was much warmer than the air, and that it was the vapour arising from the warm and damp rock which was condensed by the colder wind, while the general air not being saturated with moisture, absorbed the mist soon after it had been blown away a little from the rock.

I have had the opportunity of seeing a great deal of fever, and have observed that in the plains this disease generally appears during the cold weather after the rains. It is at this time generally that natives are attacked, those suffering most in whom the circulation is languid, and who are temperate in their habits; while those who are accustomed to the free use of spirituous liquor, generally suffer but little more than Europeans. I have supposed that the want of warm clothing was sometimes the cause of fever appearing, and have tried, by obliging sepoys always to wear their woollen dress, to prevent it; but I have never observed that it had the slightest good effect, on the contrary, the half-naked coolies did not suffer more than any others.*

While employed in the Kimedy district, a wild jungly tract close under the Ghauts, about 40 miles N. W. of Chiccacole, I have observed that while fever prevailed, tanned leather, as boats and shoes, would one day be covered with mould, and a day or two after that all the books were often curling open, the sudden dryness of the air contracting the backs, while the mass of the papers of the book remained still expanded by moisture. From this I drew the inference that the sudden alterations in the hygrometic state of the air might have something to do with the cause of fever. At the time I had no meteorological instruments by which I could measure the extent of the change, but that great changes did

* We were informed once by an officer of high rank, distinguished no less by his general information, that the natives of certain hills near the Malabar Coast were invariably attacked with fever on approaching the Coast, which to its own inhabitants as well as to Europeans was a remarkably fine climate.—Ed. Cal. Journ. Nat. Hist.




B H Hodgson Engr. del.

suddenly take place, I consider as plainly proved by the circumstances noted above. While on the hills of Goomsoor in 1836, in the Kond country, I had provided instruments, but the climate was not unhealthy, and the changes were not great.

In the hill tracts of the Salem district the healthiest time is directly after the rain has ceased, and before all the moisture which has accumulated has had time to evaporate; the most unhealthy time is just before the rains commence, when the alternations of dampness and dryness of the atmosphere are considerable.

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*On the Civet of the continent of India, Viverra Orientalis.* Hodie melanurus. *By* B. H. HODGSON, ESQ. *Resident at the Court of Catamandu.*

In the first No. of the "Calcutta Journal of Natural History" there is a notice of a Civet from the Cossia Hills, which Mr. McClelland supposes to be distinct from Civetta and Zibetha of authors. The subject is involved in double perplexity from the variations to which these animals are liable, and from the inadequacy of all recorded descriptions of the Civet and Zibet. The greater and the lesser species of these animals are common in the Tarai and Hills of Nepal, and they are recorded by me in my Catalogue of Mammals as *Viverra orientalis,* new forsan *Civetta* vel *Zibetha,* and as *Viverricula* (nobis) *Indica* and *V. Rasse.*

The first of these three is probably identical with Mr. McClelland's animal, but from my experience during the past 12 years, I own myself as much inclined to doubt the specific distinctness of the *Viverra et Zibetha* of authors as to allege positively the independence of this third species on both the former. The specific character which I gave to my *V. orientalis* in May 1838, when I forwarded drawings and skins to England, is as follows :—Iron grey Civet, with body marked or unmarked, with lateral and anteal surfaces of the neck conspicuously quadricinctate, with black and white, the black prevailing, and black tail furnished with 6 narrow perfect white rings. Snout to rump *32-3* inches; tail 19 ; mean height 14 to 15. It seems to me however that the specific characters of Civetta and of Zibetha must be amended before one set can be assigned to *V. orientalis* (Potius *melanurus*) at once precise and accurate.

Without further preface I will proceed now to a full description of a fine male specimen of our animal which I obtained in our valley in March, 1836, thereafter noticing contradistinctively a specimen from Dorjiling, in which the Civet-like markings of the body, so faint in the former, are most striking.

The general colour of our animal, which is an old male, is iron grey, more or less fulvescent and sordid. Below the belly and inside of the limbs close to it are hoary white. Limbs nearly to the body brown, black, or deep sooty; whole inferior surface of the head and throat with the margins of the gape and bridge of the nose, the same : mystaceal region and tip of chin hoary like the belly; ears outside black for the most part, but becoming dusky and even grey towards tips; lining of the ears hoary grey: head above and laterally void of marks, and coloured like the body, but paler : no mark under the eye : sides and front of the neck occupied by four conspicuous alternating black and white bands, which proceeding from behind the ears first run longitudinally towards the shoulders, and then suddenly turn down to gird the front of the neck, which they entirely embrace, and which from the superior breadth of the inner dark zone is rather black than white. Within (that is nearer to the head) this large dark zone is a semblance of a third dark one, which however rather resembles horns put off towards the ears from the dark inferior surface of the head than a separate pectoral zone. Outside the external dark zone there are traces of a pale edging or band; and if we include this faint line (clear enough on the abdominal aspect) as well as reckon separately the last named, also counting the dark line of the head below, we have a succession of eight pale and dark spaces. But the more prominent are only four, whereof the outer dark one is somewhat broken on the shoulder, it descends nearly at right angles, whilst the inner one is quite entire, more accurately curved, and so broad below or on the abdominal aspect of the neck that, that aspect must be called black rather than white. Above, or dorsally, the neck has no mark, at least none distinct, though the vague tracing of the dorsal mane which only becomes distinct at the withers, may here be seen. This mane is by no means strong or conspicuous, and it ceases wholly at the base of the tail after somewhat breaking the first pale caudal ring. It is accompanied by a white edging on either side, and these colours thus pass into that member, or the tail, which somewhat exceeds half the length of the animal, and is gradually attenuated from a thick base.

Whatever other changes our larger *Viverra* are liable to, the caudal rings hold an unvarying character, and in this species they are uniformly six in number, pale upon a black ground, with a gradually increasing interval towards the tip, and, though wider below than above, yet upon the whole far smaller than their dark interstices. One and half to two inches of the dark ground colour occupy the tip of the tail before the nearest pale ring is reached. It has already been noticed that the dorsal mane breaks the first ring towards the base of the tail. The body of the animal is almost wholly immaculate, and even on the shoulders and tibiæ the wavy bands we expect to meet can hardly be traced. In other mature specimens these lines may be seen here and there, only, not on the flanks or body of the animal where the iron grey has a bluish cast, sometimes overlaid with dull fawn, especially on the buttocks. In our present subject little or none of the latter hue can be traced.

In all our specimens the fur consists of wool and hair, constituting a thick warm covering, but liable to vary with the seasons and health of the animals. The wool is copious and wavily curled: the hair straight, and a third longer, moderately adpressed, and neither harsh nor soft. In the present animal the hair is ½ to ¾ inch long: the wool one inch. On the tail the wool and hair are both present, nor is either longer than on the body: the face and limbs are dressed in fine close glossy hair only: the colour of the wool (in all specimens) purpurescent, dusky: two-thirds of hair and more, towards the base, the same: the terminal third ¼ white, or fulvescent-white, and ½ (the outer) black. Some hairs wholly dark, and hence results the iron grey hue of the animal, the generally sordid tinge of the white even on the belly, being caused by the interior dusky colour of the wool and hair throughout. The Dorjiling specimen is of the same size as the above, and also a male.

The general resemblance of the two in the essential marks, proportions, &c. is perfect, including the scantiness of the mane; nor will the nicest scrutiny serve to detect any differences, save that the fur is rather shorter and more adpressed in this one, and that the third dark pectoral zone is distinct from the dusky throat, instead of merely forming horns to it, whence, reckoning the pale edging between the last two; and that without or beyond all the dark marks, we have here the complete series of eight pectoral zones, though a fastidious objector might reject some of them as vague. They may be counted however, and therefore are noted, lest their omission should hereafter mislead. The line of these zones is in general black and white respectively; but the latter colour is more or less sordid; and the dark inferior surface of the head (here included) is decidedly not black but dusky, or sooty brown, like the limbs. All these things are however so in the first specimen also, from which this therefore is only differenced by the clear and striking Civet-like marks occupying the body of the present subject. These marks are oblique on the shoulders and hams, and have there usually a straight lined character, whereas on the body they are vertical and wavy, presenting the exact appearance of a succession of waves advancing from the rear to the front, and often passing, as real waves will do, nearly into open circles or eyes, especially towards the dorsal ridge and mane. This may possibly be a distinct species or variety. I have noted it as the latter, with the trivial name of *Undulatus*. In this marking it is nearly allied to *Civetta*.

My other specimens are mostly of the unmarked kind, and juniors: the rusty hue is clear on the hams, and sometimes passes on to the tail near them. The tibiæ are barred, and the shoulders or brachia likewise, but the flanks and body are immaculate: six narrow perfect white rings on a black tail, and four principal, or six to eight principal and inferior, alternate black and white pectoral zones, of which the former constitutes the ground hue, distinguish all alike.

In May (27th) 1836, I procured four young ones of one of these species or varieties, but of which I know not, for the mother escaped. The young were about a span or six inches long, and could not have been born a week, yet their eyes were open, and all their organization (save the teeth) perfect; they had the pectoral and caudal marks, especially the latter palpably developed, but the dorsal dark line could hardly be distinguished owing to the generally darker hue of the little creatures, none of which lived beyond September. They were found on the bare ground, under thick copse wood, and their mother with them. On the 26th July they were two spans, or twelve inches, long, or double the size when first taken, and then they had four molars above and as many below. A survivor to 15th September was then 14½ inches long, and had cut all the molars. On 20th June the incisors appeared. But I must hasten to return to my first subject, and subjoin such a detail of its dimensions as *with* the colours, may serve to fix the species in the judgment of the skilful. Dimensions of *Viverra Orientalis*, potius *Melanurus*, mature male.

| | ft. | in. |
|---|---|---|
| Snout to base of tail, ... ... ... ... ... ... | 2 | 8 |
| Tail only,... ... ... ... ... ... ... ... | 1 | 5½ |
| Tail and terminal hair, ... ... ... ... ... | 1 | 6¼ |
| Head, length of a long curve, ... ... ... | 0 | 6¾ |
| Ditto ditto straight, ... ... ... ... ... ... | 0 | 6¼ |
| Greatest breadth, ... ... ... ... ... ... | 0 | 3 |
| Ditto depth, ... ... ... ... ... ... ... | 0 | 2⅞ |
| Width between the ears across parietals, straight, ... ... ... ... ... ... ... | 0 | 2½ |
| Ditto between inner canthi of the eyes, ... ... | 0 | 1¼ |
| Length of ears from crown of head, ... ... | 0 | 2 |
| Ditto ditto from the lobe,... ... ... ... ... | 0 | 2 |
| Elbow to top of corpus,... ... ... ... ... | 0 | 5⅛ |
| Corpus (inclusive) to tip long finger,... ... ... | 0 | 3½ |
| Knee (true) to os calcis,... ... ... ... ... | 0 | 7 |
| Os calcis to end of longest toe,... ... ... ... | 0 | 5¼ |
| Mean height of the animal, ... ... ... ... | 1 | 3 |
| Girth behind the shoulder,... ... ... ... ... | 1 | 5 |
| Weight (fat,) ... ... ... ... ... ... ... | 18 lbs. | |

I shall close this description, in order to render it complete, with a notice of the structure of the animal: head conico-depressed, with ears and eyes remote; its vertical line very slightly curved from snout to occiput, and the bridge of the nose straight: muzzle or nude extremity of the nose clearly defined, rounded, slightly grooved in front, not so above nor mobile, nor much exceeding the teeth; the nares canine, being opened chiefly to the front with a narrower curved fissure to the sides; eyes midway between the snout and anteal base of the ears, somewhat oblique: rather prominent, largish, dark, with variable pupil; the third lid capable of being brought entirely over the eye; lips adpressed, and furnished with long firm mustachios: lesser tufts above each eye, two behind the gape on the cheeks on either side, and one under the chin, nine in all: ears moderate, ovoid, longer than wide, placed rather high up, and yet remotely from each other; the helix anteally having but a moderate attachment to the sides of the head,* fissure on posteal edge of helix small and simple; tragus small, but palpable; antitragus less so, one small salient process on the superior margin of the couch, helix freely exserted from the scull, and capable consequently of free lateral motion; softly furred behind and on the margin before or within; the couch and auditory passage hid by longer soft hairs springing from the anteal and attached portion of the helix: neck and body moderately elongated and full, especially towards the buttocks; tail rather more than half the length of the animal, furred like the body, thick, and gradually tapering from the base; limbs short, fine, strictly digitigrade, five-toed before and behind, the two centrals longest and equal; the two laterals shorter and equal; the fifth or thumb very small, but not elevated, being placed close to the edge of the main rest or pad of the foot, and touching the ground with its own little pad; toes short, and connected by a furred membrane to posteal edge of terminal pads, which are soft and nude: main pad trigonocordate, full soft, nude, and extending forwards to ends of first phalanges of the digits: a small metacarpal tuberosity behind the limb; but no metatarsal one: nails or talons

* In *Viverrula* the helix is carried forward toward the eye so that the ears are brought near to each other.

subfeline and partially retractile, but except in youth blunt and worn by constant attrition with the earth to which these animals are exclusively confined, and are thus distinguished by habits, as well as structure, from the small vermiformed and scansorial species (*Indica et Rasse* of authors) equally common throughout India, which I have separated under the subgeneric term of *Viverrula.*

The greater species are as frequent in the mountains as in the plains: the lesser vermiformed species are found only in the latter, and in every part of them. In both the peculiar odoriferous apparatus is fully and equally developed, and each has besides a fœtid anal apparatus analagous to that of *Mydaus ursitaxus,* &c. consisting of two solid glandular bodies placed centrally on either side the anus, just within its external margin, and opening on either side by a palpable pore whence pressure sends forth a marrowlike offensive secretion; essentially similar glands and pores are found in the *Maries flavigula* and others of the fœtid genera of this family: but it has not been noticed that they exist in the true Civets, in addition to their peculiar organs, which last as to position are pubic or preputial, as in the *Paradoxuri,* and also in *Moschus,* or *the Musk Deer,* a very noticeable circumstance!

The peculiar glands of the Civets when dissected from the skin, are found to be not rounded bodies but flat ones, each (in *Orientalis vel melanurus*) 2½ inches long by 1½ broad, a congeries of glands like a cauliflower exactly. Cuvier asserts that the Genets, to which our lesser Indian Civets are so much allied in size and form, have this peculiar odorous apparatus only in any evanescent or rather incipient state; and as I cannot doubt his assertion (the type of *Genetta* being common in France) it follows that our lesser species are not, as alleged, Genets, for they have this apparatus as complete as the larger or true Civets. I have therefore separated the smaller

Civets, and constituted them a new group, which is equally distant from *Viverra* on one side and *Genetta* on the other.

The *Viverrula* are not one-third of the size of the *Viverra;* they have the true vermiform structure; the thumbs are more remote than in *Viverra;* and the animals are enabled, and wont with their more acute and more feline talons, to climb with facility, a faculty wholly denied to the *Viverra.* Lastly, whereas the latter are more common in the mountains than in the plains, the former are exclusively confined to the plains, where they appear to be spread universally from Cape Comorin to the base of the Himalaya. How many distinct species India possesses of the small, as well as of the large Civets may perhaps be disputed, but *Bengalensis, Indica, et Rasse,* certainly appear to be distinct, whilst, if *Civetta et Zibetha* be justly sundered, our present subject, or *Melanurus,* may prove to be independent of either. The young I procured are believed, with some reason, to have belonged to this species, which therefore would appear to produce four perfect young ones at a birth, at the beginning of summer (the teats are six and ventral); and as these helpless little creatures were found on the bare ground, the species would seem seldom or never voluntarily to seek the shelter of holes or burrows, though I have known it do so for safety when pursued.

These animals, in the mountains, dwell in forests or detached wood and copses, whence they wander freely into the more open country by day (occasionally at least) as well as by night; for I have seen one killed at noon three miles from cover, in the midst of the fields of this valley. They are solitary and single wanderers, even the pair being seldom together, and they feed promiscuously upon small mammals, birds, eggs, snakes, frogs, insects, besides some fruits and roots. In the Tarai the larger Viverræ are found in uncultivated copses, and they are said further to protect themselves by borrowing ; at least they are frequently taken in holes, whether made by themselves or obtained by ejection of other animals. The Mushars, a low caste of woodmen, eat their flesh. The Tarai name of the animals is Bhraun, the hill name Nit Biraloo. The lesser species are called in the Tarai Sáyer and Bugmyúl, indiscriminately, but not Katás, that name being given to a distinct animal. The Tarai specimens of the Bhraun agree sufficiently with those obtained in the mountains, but I have only procured skins from the former tract: nor is there any essential difference of habits or manners in the high-land and low-land animals, though subterranean dwellings are seldomer used, if at all, by the mountaineers.

P. S. *On the internal visera of Viverra melanurus.* Liver 11. oz. three prime divisions, all of which are bilobate: gall bladder partially imbedded in anteal division, two inches long by one of greatest diameter. Stomach, as spread on a table, 13 inches along greater arch, by five along the lesser ; bagpipe shaped; outer coat decidedly muscular and gradually more so from fundus towards pylorus: mucous coat uniformly smooth: small intestine eleven feet, very strong coated, uniform calibre of one inch: greater gut $1\frac{1}{2}$ feet with diameter of two inches; no sacs: cecum two inches long—cylindrico, conic, diameter one inch, and like great gut, simple in structure, and smooth inside. Spleen five inches by one; pancreas five inches by $1\frac{1}{2}$; omentum and kidneys void of fat ; kidneys $1\frac{1}{4}$ inch long, simple ; bladder three inches by $1\frac{1}{2}$ ; on either side of anus towards caudal margin two solid glands of size and shape of sparrow's egg, void of ducts or necks, and opening into rectum just within the anal aperture; secretion thick and fœtid, passing slowly out on pressure.

*On a new Species of Prionodon.* P. Pardicotor nobis. *By* B. H. Hodgson, Esq. *Resident at the Court of Catamandu.*

In my catalogue of Nepalese mammals, drawn up for the Linnæan Society, and in my descriptions of new species in the Journal of the Asiatic Society, I have omitted all mention of a very beautiful little animal that is sufficiently common in the mountains of Nepal, though not until the last three years known to me as a denizen of them.

Two of the four specimens I now possess were procured for me by Dr. Campbell in Sikim, I having in vain endeavoured to obtain a *perfect* specimen in Nepal.

The last from Sikim exhibits the dentition in a very complete manner, as also the feet, leaving therefore only the anal and pubic follicles subject to doubt; and as I see no immediate prospect of obtaining a fresh or living specimen, I will no longer defer giving a short but distinct account of this new species of Prionodon, for such I believe the animal in question to be, beyond all doubt.

The teeth, Plate 1, *fig.* 3 a, b, answer exactly to Dr. Horsfield's formula of Prionodon, whilst the feet are most completely feline, with the requisite exception of the fifth posterior digit which is here present, though wanting in Felis. These are the essential marks of the genus Prionodon; and are found in our animal, as in the generic type, united with a vermiform structure and inferior size, such as are seen in the lesser civets of India, or that form between which and the true cats the Prionodons take their place.

Our little animal further approaches the cats and the type of Prionodon by its soft glossy fur, which is closer and finer than in any species of civet. Head elongate-conic, compressed, viverrine, with the eyes placed at equal distance between the nose and the anteal base of the ear; muzzle or nude extremity of the nose small, rounded, distinct, slightly grooved above and in front, and having the nares opened anteally and laterally: lips adpressed, and furnished with very long but rather soft mustachios: smaller tufts above the eye and on the cheek; none on the chin: ears fully developed, placed high up, ovoid, rounded at the tips; the helix considerably attached to the scull anteriorly, and furnished posteriorly with a simple fissure; softly furred behind and on the margin interiorly; the rest of the interior nude and hid by the longer hair springing from the fore part of the helix: neck and body both considerably elongated and slender: limbs short, fine, feline, but the thumbs rather nearer to the other digits than in Felis, and a corresponding digit to the hinder extremities. Talons very acute, and entirely sheathed and concealed. Tail equal to the body and neck, perfectly cylindric, and furred like the rest of the animal's skin.

"Anal pouch" very apparently present, but the exact character of it not determinable; tongue aculeated backwards. The colours of the animal are very rich and beautiful, resembling closely, and no way yielding in beauty to those of the leopard, the ground being an uniform rich pardine fulvous, and the marks jet black. The marks too are almost wholly rounded as in the leopard; but they are full or entire, that is, have not open centres; and upon the neck (superior) they take that linear character which is nowhere seen in the leopard: lips, chin, inferior surface of head, neck, and body, together with the toes, immaculate: bridge of nose and superior surface of head mixed with dusky, but no distinct, marks: a vague spot or two on the cheeks: ears outside black; inside pale: immediately behind them arise two unbroken lines proceeding to a little beyond the shoulders, and two more below these proceeding brokenly to them only; rest of the upper and lateral surfaces of the body covered with large round entire black marks, of which six or seven may be counted longitudinally from the shoulders to the base of the tail, and eight transversely, those nearest the dorsal ridge being the largest, and the others gradually lessening as you descend the flanks and the limbs, the latter of which outside, are spotted to the base of the digits : tail banded with sixteen to seventeen nearly equal, and perfect rings of alternate black and fulvous, the last ring being vague with mixed hues, and dusky tip to the tail, and the dark caudal rings upon the whole the larger: mustachios dark, nude skin of nose and pads of the feet of a fine fleshy pink hue. So far as can be judged by the skins, the dimensions agree most closely with those of Horsfield's type, or *P. gracilis,* being about sixteen inches long and thirteen to fourteen more for the tail, with a mean height of about six inches. The animals are said to have the manners of cats, to spring and climb with great power, to prey on small mammals and birds, and to frequent trees much in search of the former, as well as for shelter. The following specific character may serve to mark our animal;—*Prionodon,* with rich pardine hues, or orange buff spotted with black; the neck above with irregular lines; the body above and laterally with large entire round marks, eight in transverse and seven in longitudinal series, diminishing in size from the dorsal ridge and extending outside the limbs to the digits ; below entirely immaculate ; tail with eight to nine nearly equal and perfect rings of each of the hues of the body, or black or ruddy yellow. Habitat, the Sub-Hemalayan mountains : not known in the Plains.

PLATE I. Illustrations of *Viverra, Viverricula,* and *Prionodon.*

Fig. I. Odoriferous pouch stripped of its integuments ; 2,2 the glands ; 3,3 dilated rima lying between them ; 4,5 upper and lower secreting surfaces at bottom of the rima ; 6,6 testes.

Fig. II. The same parts covered with integuments; 2,2, the glands as they appear with rima between them undilated; 3,3, testes; 4 anus with its lateral pores.

Fig. III. a, b, Dentition of *Prionodon.*

Fig. IV. Hind foot of *Virricula* with toes dilated.

Fig. V. Hind foot of *Civetta* with toes dilated.

Fig. VI. Hind foot of *Prionodon* with toes dilated.

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## *New species of Rhizomys discovered in Nepal. By* B. H. Hodgson, Esq. *Rhizomys badius, nob., Bay Bamboo Rat of Nepal.*

A recent discovery enables me to add the genus Rhizomys to the Fauna of Nepal, a fine male specimen of what appears to be a new species having just come into my possession, which was obtained in the mountains some miles north of the great valley. The recorded species of this genus are, I believe, but two at present, one of which is from China and the other from Sumatra. We now add to these a continental Indian species, characterised thus—

Rhiz. badius. *Unicolor: pilis internē nigri cantibus schistaceis: longitudo Corporis* 8 *uncia, caudæ* $2\frac{5}{8}$, *capitis* $2\frac{1}{4}$: *Pedis antici (cum ungue)* $1\frac{1}{16}$: *pedis postici* $1\frac{3}{8}$, *auriculæ* $\frac{1}{4}$.

The piles are exceedingly soft, straight, moderately adpressed, and rather woolly than hairy, though there are a very few somewhat longer ones, which may be termed hair. The average length of the fur is $\frac{3}{4}$ of an inch, and is quite uniformly distributed over the body wherever it exists; for the end of the muzzle anteally, the ears, the hands and feet, and lastly the genital region, are nude. The colour of these nude parts is fleshy white; that of the fur throughout, clear bright bay externally, and internally dusky slate-colour. The small divergent mustachios are dark. The short truncated and entirely nude ears are hid by the fur of the head and cheeks. Except in this last particular the drawing in Hardwicke's Illustrations representing *R. sinensis* gives a perfectly just idea of the present species, which however has a very distinct interdigital membrane enveloping the proximal phalanges of all the digits, anterior and posterior.

These animals are found in Nepal, as I am informed, only in the Northern region to which the marmots also are confined, both frequenting the same tracts, though the latter affect a still nearer neighbourhood to the snows. The Bay Rhizomys neither burrows nor climbs, but is confined to the surface of the earth. The species is said to be rare, and solitary for the most part, but without manifesting any particular affection for the bamboo. The plant indeed can hardly be said to exist in its habitat. Houses it wholly avoids, according to the vague information I at present possess on the subject.

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P.S. Relative to the paper on the Indian Civets by Mr. Gray, the investigator of the family of the Viverridæ, it is remarked that the true Civets are six; 1. *V. Civetta;* 2. Buffon's *Zibetha,* which is the *Undulata* of Gray; 3. Cuvier's and Horsfield's *Zibetha,* or the *Tangalunga* of Gray, in which the caudal rings are broken above; 4. *Gauda,* of Hamilton, or *Rasse* of Horsfield; 5. Pallida of Gray which is one of (the *Viverriculæ, nob.*) 6. *Gracilis* of Horsfield, or the *Delundung* of Java.

Upon this enumeration I may remark, that the *Pallida* and *Undulata* of Hardwicke's Illustrations are unknown in the Taraï, or Hills of Nepal; that Indica is omitted, though satisfactorily separated by Horsfield in 1832 (see Proc. Zool. Soc. Jan. 10), and that though the teeth of Gracilis, as far as they go, resemble those of Viverræ, yet the absence of the last molar, added to the perfectly feline and sheathed claws of this species, with other lesser diversities all fully participated by a second species, or our *Pardicolor*, justify the separation of the two sub-generically. So I think *Rasse, et Indica,* are reasonably removed from the Civets proper by myself, as the form connecting the Civets proper with the Genets, just as *Prionodon* connects them with the Cats, and *Cynictis* with the *Mongooses.* By the way, the above remarks show that my proposed name of *Undulatus* for a species or variety of true Civet of Nepal, which can no more be confounded with Gray's *Undulatus* than with the Civet or Zibeth of the English Règne Animal, is preoccupied. I beg to propose Civettoïdes instead. I have elsewhere shown that Gray's observations on the odoriferous apparatus and on the feet of these animals are liable to question.

B. H. Hodgson.

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*Flora of central France; or a Description of the Plants which are the spontaneous inhabitants of the central region of France, and of those which are generally cultivated there, &c. By* A. Boreau, *Professor of Botany, Director of the Botanical Garden of Angers.** (*2 vol. in 8vo. Paris,* 1840.)

We have been aware for sometime that the territorial division of France into provinces or departments has little relation with its botanical geography. Indeed the considerable number of partial Flora which have appeared in the course of the last century, and since the commencement of the present, although furnishing materials for a general French Flora, in a scientific point of view they are not so interesting, considering the arbitrary and restricted limits of

* From the *Annales des Sciences Naturells, April* 1840, communicated to the Calcutta Journal of Natural History, by Joseph M'Clelland, M. D.

the localities which formed the domain of the Flora. For this reason we have applauded as much as possible the efforts of botanists who have given more general tables of the vegetable statistics of France; tables circumscribed alone by the natural limits of the different climates of this great empire. The central region participating at the same time with the climate of the east, west, north, and south, it was very difficult to determine its limits; it sends branches as it were into the contiguous regions, and these in the same way confound themselves more or less with this central region, as we may imagine from the principles of physical geography; notwithstanding we have botanists as indefatigable as they are learned, who have undertaken this work.

M. A. Boreau, aided and encouraged in every possible way by M. le Comte Jaubert, has occupied himself during many years in the exploration of the departments which constitute the central region, and in the work which we announce to the learned world, he gives the result of his laborious investigations.

In a concise and elegantly written introduction, he exposes the hydrography and geology of the central region, which extends in a great part on the departments of Cher la Nieve, la Saône-et-Loire, l'Allier, la Creuse, l'Indre, Loir-et-Cher, Loiret, l'Yonne, and also the most western portion of the Cote-d'Or. It is now well ascertained that these two points of physical geography are of much importance to botany, and that according to the abundance of running water, and the different nature of the formations, the vegetation assumes a different general aspect, or exhibits remarkable peculiarity.

We shall notice here, according to the author, the principal peculiarities of the vegetation of these great geological divisions. The rye and some oats are the grain more especially cultivated in the primitive districts, which do not admit of the culture of wheat or vine. The surface of these districts is generally uneven and mountainous. Water abounds there limpid and pure, and runs with velocity in each valley. Vegetables offer also here a peculiar aspect. The beech-tree, the chestnut, horn-beam, and sometimes the birch tree form the scenery of the forests; and among the plants, the most remarkable which grow commonly in those lands, we may mention, Ranunculus aconitifolius, Cardamine amara, et sylvatica, Viola paulustris, Lychnis diurna, Stellaria nemorum, Chrysosplenium alternifolium, Cotyledon umbilicus, Sedum vellosum, Sorbus aucuparia, Comarum paulustre, Geum rivale, Alchimulla vulgaris, Sambucus racemosa, Senecio adonidifolius, Doronicum austriacum, Vaccinium myrtillus et oxycoccos, Polygonium bistorta, Salix pentandra, Potamogeton rufescens, Carex teretiuscula et Canescens, Equisetum sylvaticum, polypodium phogopteris et dryopteris, Asplenium septentrionale, Lycopodium clavatum. The secondary formations compose a series of peculiar beds which extend from the old red sandstone to the chalk formation inclusively. The coal formation is favourable to the development of the Leguminosæ, and these plants constitute the base of herbaceous vegetation: the Ononis repens var elatior, the Trifolium medium, elegans, ochroleucum, &c. form in the month of July, carpets of magnificent aspect.

Under the name of Jura division, we understand the lias, the oolitic, and cretaceous formation. Often the lias presents itself under the form of very thick argillaceous beds, separated here and there by certain thin beds of calcareous loam. These lands are very fertile, the happy proportion of alumina, lime, and silex which constitute good vegetable mould, favour in a high degree the culture of grain, and more especially of wheat. But in a botanical point of view these formations are not so distinct. With the exception of certain peculiar species, the greater part of which are found in districts composed of the oolitic limestone, there is a great unformity in their vegetation. The Trifolium elegans is very abundant in the lias; but we find it generally where clay is found combined in greater or less proportion with silex.

The vegetation of Jurasic calcareous earth, divided into inferior, middle, and superior oolite, is characterised by the abundance of certain plants which are never found in primitive lands, and that we find very rarely in more modern formations: such are the Adonis æstivalis et flammea, Erysimum odoratum et orientale, Thlaspsi montanum, Hypericum montanum, Linum montanum, Corronilla minima et varia, Hippocrepis comosa, Buplevrum protractum et falcatum, Ptychotis heterophylla, Sison amomum et segetum, Peucedanum cervaria, Libanotis montana, Cornus mas, Senecio erucœfolius, Inula salicina, Chrysanthemum corymbosum, Phyteuma orbiculare, Campanula repunculoides, Gentiana germanica et cruciata, Anchusa italica, Orobanche cruenta Teucrium montanum, Globaria vulgaris, Asarum euaropœum, Orchis odoratissima, Galeata pyramidalis, Ophrys apifera, arachnitis, antropophora, myodes; Epipactis rubra, Phalangium ramosum, Convallaria polygonatum, Carex gynobasis, Melica ciliata, Sesleria cœrulea.

The cretaceous lands consisting of the inferior, middle, and superior chalk formation, sends forth a vegetation which varies according to the nature of their upper surface. When carbonate of lime or clays predominate, we observe many plants of lias and calcareous grounds, some Cruciferæ, especially Diplotaxis and Sisymbrium, which seem to delight in chalky grounds.

When sand or silicious gravel is found at the surface of the soil, then the vegetation approximates that of the old red sandstone, or even granite. The origin and constitution of the soil of tertiary lands being very different according as those lands have been produced from isolated deposits formed in circumscribed localities, or thrown on sea shores, or formed at the bottom of vast fresh-water lakes, there will result a great variation in their vegetation. Indeed the fertile plains of Beauce have little relation with the sand deserts of Sologne, and the sterile heaths of *l'Indre* resemble little those lands of rolled sand which, on the hills of Nierre produce such beautiful forests. In general fresh water calcareous lands afford many species which are common to them and the oolitic lands, while the gravelly portions, on the contrary, exhibit the vegetation of siliceous grounds. In attrition grounds *(attérissemens)* more or less ancient, which are known by the name of alluvion, and which form often considerable extents of fine sand, the vegetation is equally interesting to the botanist, and circumscribed from that of ancient formations. The Silene otites, Crucinella angustifolia, Vicia monantha, Astrocarpus sesamoides, delight in those localities.

M. Boreau concludes from his observations that others are really only two kinds of soil, which are distinct with respect to vegetable productions:—the siliceous, under whatever form it presents itself; and the calcareous, to whatever formation it belongs. He afterwards pays particular attention to three divisions of central France, which draw from the nature of their soil a characteristic aspect, and limits which are truly natural; these are Morvan, Sologne, and Brenne. We regret not being able to follow him in all the inquiries relative to those countries so little known, and so worthy the attention of the botanist.

The geological constitution of the soil exercises a great influence on the temperature, and consequently on the development of beings which inhabit it. This remark serves to explain the variation of climate, which we observe in the different points of the central region. M. Boreau gives a long list of species, which one would think belonged only to warmer climates, and although these species cannot all receive the qualification of meridional, at least their enumeration may afford an idea of the points of contrast which the Flora of the centre presents, compared with those of meridional departments of France. It is necessary also to remark the affinities of the central region with the north, the east, and the west of France. It is particularly from the west that the Flora of the centre draws its most characteristic feature.

The author thinks that the plants of the west are propagated even to the centre of France by passing up the vallies of the Loire, and more especially those of the Cher and l'Indre.

Perhaps also the marine atmosphere exercises its influence as far as the occidental part of the central region; at least it is to this influence, more than the elevation of temperature, that we must attribute the complete development of certain vegetables which in the central part support the winter's cold with great difficulty; for example, it is only in the west of the departments of l'Indre, and of Loire-et-Cher that the Cerasus (Lauro Cerasus) and the Laurus nobilis bear fruit, and are reproduced spontaneously from seed; it is there only that the Punica granatum ripens its fruit, and braves the most rigorous winters.

M. Boreau has determined the limits which certain plants of the west respect with regard to those of the central region. The Erica ciliaris does not appear to advance farther than de Blois; the Erica scoparia, which is found at the north of the forest of Orleans and at Fontainbleau, does not pass to the east of the Loire; it encroaches little on the limits of Sologne and of the department of l'Indre, and is not found in the department of Nievre: it is the same for the Pinguicula lusitanica, Helianthemum alyssoides, Quercus toza, and of many others which pass as far as Bourges, but few of which pass the department of Cher.

A Flora which draws all its characteristic traits from contiguous regions can not exhibit plants so very peculiar that they cannot be met with in many other localities. However the Euphrasia jaubertiana has only been found in the central region. Saint Amond is in France the only certain locality of Farcetia clypeata,* the Spiræa hypericifolia grows no where in such great abundance as in the vicinity of Bourges, and the Trifolium elegans perhaps does not present itself in any place in such considerable masses as in the department of Nièvre.

The history of the botany of central France which follows the introduction from which we have extracted the most remarkable passages, offers great interest to persons who devote themselves particularly to the study of the progress of French botany. The author makes known the works of many learned, but modest botanists, whose entire life was consecrated to the exploration of the locality they inhabit. After having enumerated the services rendered anciently to the science by Caperon, Reneaulme, Gaston of Orleans, and Robert his celebrated flower painter, by Morison and Marchant, who directed the magnificent botanical garden which this prince had founded at Blois, M. Boreau does not omit any of the botanists of the last century who have contributed to enrich, or better elucidate, the Flora of central France. In fine, he comes down to our contemporaries, and he delights to cite those who communicated useful documents to him: it is thus that he pays a just tribute of acknowledgment to M. le Comte Jaubert, to whom we owe the exploration of a part of the department of Cher; to M. Saul who traversed in all directions the central region; and to all the botanists of the central departments who have studied with zeal and perseverance, each their peculiar locality.

We cannot dwell long on the chapters which compose the first volume; it will suffice to cite the title, to give publicity

* The ruins of the castle of Montrond, where this plant abounds, dates from the wars of la Frond, in 1652. It appears to have existed there for a great length of time. M. Jaubert found it in 1820. It is difficult to say how this plant of the East was propagated in this locality, from whence perhaps it will soon disappear, those ruins having been transformed into a public promenade.

to the kind of utility which the author wished to give to his work.

First he indicates the principal elevations of central France above the level of the sea. We must follow this indication by an elementary summary of botany, and of the analytic key of the Flora of central France; a work which appears to us in a high degree deserving the merit of exactitude. In fine, the precautions we should take in the formation of a Herbarium, on the properties, usages, and etymology of plants, terminate the first volume.

It remains for us to mention the second volume, which treats of the Flora of the centre of France, properly so called; but although this part of M. Boreau's work is most important, we cannot give even the most succinct analysis of it. The discussion of species, in effect, is ill suited to a work like ours, for to do so properly, and in proportion to the merit of the author, it would be necessary to dedicate a space, the extent of which the nature of our Annals will not permit. It is necessary therefore to expose the general plan of the Flora, and indicate the manner by which the author has executed its details.

M. Boreau has followed the order of natural families and the classification of the Prodromus of M. de Candolle, except certain modifications which had been pointed out to him by M. Auguste de Saint Hilaire.

The synonymy of species is not very complicated, the author using as often as he could the Linnæan nomenclature, but still in relation with the progress of science, for when he thought it necessary to adopt generic or specific mutations in use in the present day, he has also given the Linnæan synonymy. The common names are indicated as often as they are applicable to well determined species. The descriptions of plants are not very long, but they suffice to distinguish the plant. However M. Boreau has often added observations which complete descriptions, or furnish useful information on their organization and critical synonymy. He indicated profusely localities of species which are not common in all places.

The number of species described is 1631, divided into 575 genera. They belong to Phanerogamous plants, to which the author has added some families of Monocotyledones, Cryptogames, Ferns, Lycopadiaceæ, and Equisetaceæ; as to the Cryptogamæ properly so called, and Agamæ, the author has given the simple catalogue of Mosses, Hepaticæ, and Lichens.

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*Observations on Spermatophoræ of molluscous Cephalopods, on the structure of Carinariæ, of Dendrophyli, &c.; extracted from a letter of* M. Milne Edwards, *dated Nice, April 28th* 1840, *and communicated to the Academy of Science by* M. Audouin.*

By this letter it appears that these bodies, the Spermatophoræ, were discovered by Swammerdam and Needham in the male genital organs of Cephalopods; some anatomists supposed them spermatic animalculæ of extraordinary size, others parasitical worms, however the author of the above letter was not sufficiently acquainted with the structure or function of these bodies, and this lead him to make a more minute inquiry than had hitherto been made. He mentions Dr. Peters, a young naturalist from Berlin on a mission to Nice, who joined him in the same investigation, and it is I presume to their joint efforts that we owe the discoveries mentioned in the letter to the Academy.

The Cephalopods which they procured for examination were the males of the *Poulpe commun, Poulpe à-longs bras,*

* From the *Annales des Sciences Naturelles,* April 1840, communicated to the Calcutta Journal of Natural History, by Joseph M'Clelland, M.D.

*Elédon musque, Seiche officinale, Calmar commun;* in these creatures these spermatic filaments were found abundantly. Their conformation differs according to the species to which they belong, but we always distinguish a sheath in the form of a siliqua, composed of two tunics, and containing in its interior a long tube turned on itself like an intestine, filled with a white opaque matter, and in connection with a membranous apparatus more or less translucid. This intestine-like tube is a spermatic reservoir containing millions of Zoosperm, and the apparatus to which it is attached by its anterior extremity, serves to burst the sheath, and to determine the exit of the spermatic reservoir itself. The structure of this ejaculating organ varies according to the species, and the mechanism by the aid of which the projection of the spermatic reservoir is effected differs equally in all the Cephalopods submitted to our examination; drawings were exhibited to the Academy to elucidate this description.

Thus these bodies, which Cuvier called the *filamentary machines of Needham,* are neither spermatic animalculæ, nor parasitical worms, but organs of fecundation, such as I am unacquainted with an example of, in the animal kingdom. We propose to denominate them *Spermatophoræ,* and can compare them to nothing better than to grains of pollen contained in the fecundating corpuscles, and which burst in the same way to discharge themselves when they have arrived from the male to the female organ of a flower.

It is probable that those Spermatophoræ are also in Cephalopods a means of transport for the seminal fluid, by the aid of which it arrives in the female apparatus, notwithstanding all absence of an organ of copulation; as for the spermatic animalculæ contained in the interior of these singular bodies, they differ in nothing from those of other animals: only you will remark that they offer a difference either in volume or in form, in each of the Cephalopods I have mentioned above.

*Anatomy of Carinariæ.* On the termination of great winds which prevailed in the commencement of the month of May, the bay of Nice was visited by a great number of Carinariæ, and M. Peters and I commenced certain inquiries on their structure.

You know that we consider all the molluscæ of the order Heteropoda as being generally hermaphrodite; G. Cuvier in a note to the second edition of his Regnè Animal says—M. Laurillard thinks them of separate sex, but he does not appear convinced of the truth of this opinion; and M. Delle Chiaje thought he discovered in the Carinariæ a testicle situated near the ovary. It was easy to assure ourselves that the sex was perfectly distinct in these molluscæ; the male and female differ by the most evident external characters; indeed in the male we see in the right side (the creature being supposed in pronation, which is the inverse of its ordinary position) under the visceral nucleus, an apparatus of copulation well developed, an apparatus which is completely wanting in the female; the female possesses a genital orifice near the anus, of which the male is deprived, the testicle occupies the same place as the ovary, and resembles it much, but instead of ovules characterized by the existence of a vitalline sack and a vesicle of Purkinge, it contains membranous capsules filled with zoosperm. These animalculæ have a long tail, and perform their motions with velocity; we were assured of the same fact in the Firolæ. The circulating apparatus of Carinariæ differ much from the description which has been given of it, and the nervous system of these animals is more complicated than in other molluscous gasteropods known at the present time, for besides the labial ganglious cerebral and subœsophagean, there is a pair of optic ganglions, a pair of ophtalmic ganglions, a pair of hepatic and one subanal ganglion, lastly, you will also find stomato-gastric nerves analogous to those we have discovered, together fifteen years ago in the Crustaceæ, and which M. Brant has since found in a great number of invertebral animals.

*Observation on the sex of Echini.* The separation of sex in the gasteropodous Mollusca is not astonishing, but what will surprise you I presume is, that in the Echini there exists male and female perfectly distinct. This curious fact has latterly been stated by M. Peters, and I have since often had occasion to verify the assertion; externally the testicles of Echinodermata differ in no respect from the ovaria, but the liquid which they contain is of a milky whiteness, instead of being orange as in the females; it furnishes zoosperm, the tail of which it is difficult to perceive, and the movements of which are characteristic.

*Structure and sexual organs of Dendrophylli.* I have sent you also a drawing which demonstrates the external conformation and the internal structure of calcareous polypiferous polypi, of which M. de Blainville has formed the genus Dendrophyllus. If we judge of these animals by the figure which has been given by Donati, and which the greater part of modern authors have reproduced, we shall believe them possessed of the most confused organization; but the tentacles in the form of pincers which we supposed surrounded their mouth does not exist, and their structure both internal and external differs little from that of the Actiniæ, and principally from the Caryophilli, properly so called, analogy proves it so; but I have moreover demonstrated that these coralligenous polypi, the same as the superior animals, possess distinct sexual organs; some have ovaria, while others contain in the place occupied commonly by the female organs, testicles of the same form as the ovaria, and containing instead of eggs, spermatic animalculæ. You may see one of these zoosperm figured in the above mentioned drawing.

*Observations on the structure of Acalephæ Hydrostaticæ.* I have also had occasion to study some of these singular creatures, *Acalephæ hydrostaticæ*, which have been known by the name of Physophoræ, which resemble long garlands of flowers intermixed with little berries, and spirally contorted stipules; not yet having finished the drawings, it will be difficult for me to communicate what I have been able to collect from their complicated structure. I may intimate that I have now the conviction that these are not simple animals, but aggregations of a great number of individuals produced (par bourgeons) and living reunited the same as compound polypi.

It seems equally probable to me that these compound Acalephaæ have their distinct sex; for in some, where the traces of an ovary could not be perceived, I found organs filled with spermatic animalculæ.

*Apparatus of circulation; Holothuriæ.*—Lastly I send you also a drawing of the apparatus of circulation of the Holothuriæ.

The descriptions which have been given of them by MM. Tiedeman and Delle Chiage are so discordant, that it was necessary for me to examine this point again; and I have assured myself that the disposition of the vessels is almost the same as that indicated by M. Delle Chiage.

It is a matter of regret we have not the drawings mentioned in the above letter of M. Milne Edwards; they refer to facts of the greatest importance in Zoology.—Jos. M.

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## *Notice of a fossil Termes. By* M. Ouchakoff.*

The greater part of fossil insects which are described and which have been observed in amber, belong to those genera existing in hot countries, and almost all of them have an analogy more or less great with our living species. According to my information on this subject we have not yet discovered in amber insects the types of which seem not now to exist, and which have no actual representations in existing genera;

* From the *Annales des Sciences.*

and it appears also well established that the insects disseminated in fragments of amber, that we find in great quantity on the coasts of the Baltic sea, approach generally to species peculiar to distant regions.

However this remark, according to my opinion, is not applicable to the class Arachnida, or at least to the spiders properly so called. I have been led to think so, and the examination of many portions of amber, and the silence of all authors on the discovery of new genera of spiders, have rendered my opinion more certain. M. Walkenaer, a celebrated arachneologist, has given the description of a new species of the genus *Altus*, found in a fragment of amber from the collection of M. Faujas de Saint-Fond, having a great analogy with certain European species. M. Marcel de Serres cites also a species of Tegenaria, determined by the same arachneologist, and found in the insectiferous formation of Aix: I possess also certain fragments of amber containing two spiders, one of which appears to me to belong to the genus Tegenaria.

As to insects properly speaking, we find them often in a fossil state, analogous to exotic species. MM. Defrance, Brongniart, and Germar, have indicated many individuals of the genus Curculio unknown in Europe. M. Desmarets has discovered Termites in amber, which seem peculiar to India and Africa. According to the testimony of M. Latreille there only exists two species of this genus in Europe.

Among the fragments of amber which I received from Koenigsberg there was one which contained two insects of the same species, belonging to the family of Planipens and to the genus Termes, they are joined together, and surrounded with air bubbles, not so as to prevent me from seeing by the aid of the microscope the whole of the inferior part of the body of one of the individuals.

I shall now give the distinguishing character of my fossil insect.

Its head is large, rounded, and narrow behind, presenting a longitudinal depression and spot on the middle of the forehead. The mandibula do not exceed the length of the upper-lip, the four palpes are distinct, the shortest labials have four joints, of which the two first joints are very small, the third sècuriform, and the last conical and elongated. The maxillary palpes have five joints, the last of which appears bifid. The antennæ longer than the head augment towards the extremity; they are moniliform, and composed of fifteen distinct joints, the first cylindrical, and larger than all the others; the last is somewhat oval. The proto-thorax is very small; the meso-thorax and meta-thorax narrower than the abdomen, form two hemispheric parts. The anterior extremities are much separated from the others, the posterior are much longer, with a membranous elevation slightly folded between the haunches. The tarsi are composed of four or five joints, the last of which is very long, curved, and terminated by two distinct hooks. The abdomen is (effilé) having certain traces of transverse folds, and its extremity furnished with two appendices as in the Blattæ. The eyes are hid by air-bubbles, and are impossible to be seen; it is the same with the wings, if (which is doubtful) these insects have wings. The body is yellowish, and almost transparent.

We remark that the insect adheres by one of its feet to a round body which is silky and slightly indented, which we may consider as an egg or shell. According to the character which I have given, this insect differs from adult Termites, which have their antennæ more filiform, and composed of seventeen joints.

M. Latreille in his Natural History of Crustaceæ and Insects gives us the following details on the Termes lucifugum of the vicinity of Bordeaux.

At a certain period, he says, the society of these Termes is composed of four sorts of individuals, we find two which remain always without wings, which are elongated, active, soft, and of a yellowish white, provided with six feet, having the head, the corselet, and the abdomen distinct. Their head is large, furnished with mandibula and jaws, but deprived of eyes, or having them very small. We distinguish these two sorts of individuals by the form of their head; in those which compose the greater number of the society, the head is much larger; this part is rounded, and the mandibula are not advanced; while in the others, which scarcely form the twenty-fifth part of the group, the head is much longer, elongated, and of a cylindrical figure, terminated by prominent crossed mandibula. We find at the end of winter and in the spring, individuals resembling the former, which have four white appendices in the form of wings, two on the second ring, two on the third; if at the end of a month we open the Termitière, we find only a few of these individuals which have lost their wings. We find also in cavities in wood the eggs of these insects in the form of impalpable powder; we may conclude from these observations that the individuals without wings, with a round head and short mandibula, are larvæ, that the individuals resembling these, but having appendices of wings are Nymphæ; that those which have wings are perfect insects. It is to be presumed that the entire development of these insects is only completed at the end of two years, because when one part of them appear with wings, we find others in the nidus in the form of larvæ, which could not undergo this last metamorphosis sooner than the following year.

The character which M. Latreille gives to the larvæ of Termites agrees perfectly with our fossil insect, and I am inclined to look upon it as a *Termes lucifugum*, in the form of a larva without the presence of the abdominal appendices which I have mentioned above, and which are only seen in insects of a perfect state. The number of joints in the antennæ prevents us from considering this insect as a female which had lost the wings.

In the last place, I am led to believe that this insect is in a perfect state, and that it should form a new genus among the Neuropteræ Planipennæ, particularly as the natural history of these insects is yet little advanced, and is not sufficiently elucidated by observations on them in their native localities.

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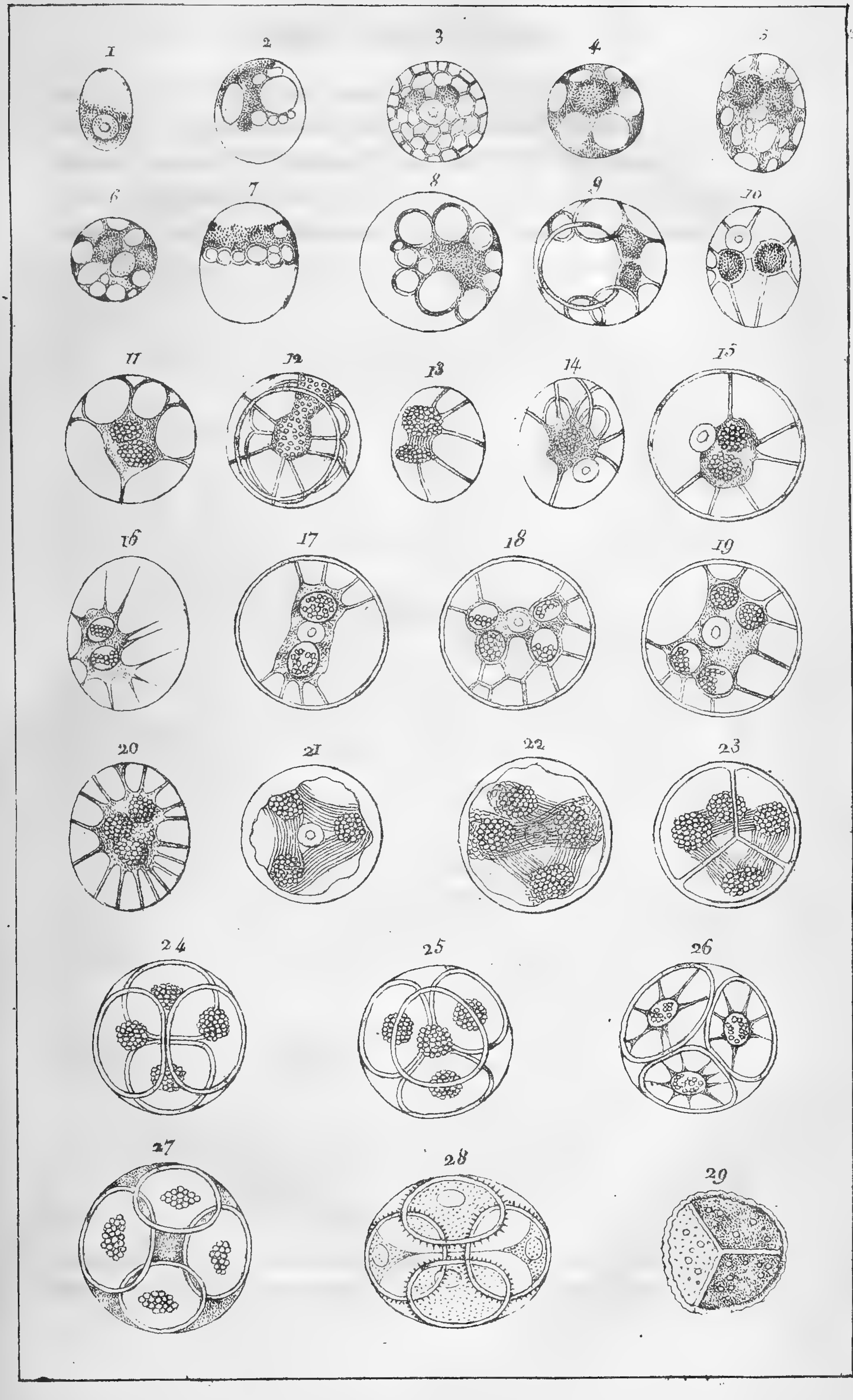
## *On the development of the Sporæ of Anthoceros lævis. By* Hugo Mohl*.

It is now some years since M. de Mirbel and I published almost simultaneously some inquiries on the development of Sporæ. If as to the most important points our results were the same, we differed notwithstanding on many others. The circumstance of differing in opinion with an observer of such eminence as M. de Mirbel, incited me strongly to resume the same subject. For this purpose I made choice of the *Anthoceros lævis,* which seemed to me best suited for these investigations, because the mother-cellules contain a much less number of granules than those of all the other Crytogamæ which I have examined; and in which I hope to follow more easily the formation of the membranes of the Sporæ. So much the more do I conceive it my duty to publish the result of my inquiries, as in many instances they will confirm the theory of M. de Mirbel, and may also contribute to dispel the difference of opinion which exists between this most learned man and me.

I shall commence by indicating in a few words the points on which I entertained the same opinion as M. de Mirbel, and those on which we differed.

In his Mèmoire on the *Marchantia,* M. de Mirbel considered the Sporæ of this plant, as well as those of *Targionia* as simple cellules or utricules, and assures us that they

* From the *Annales des Sciences Naturelles,* April 1840, communicated to the Calcutta Journal Natural History, by Jos. M'Clelland, M. D.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are produced three or four in number from the interior of other cellules.

He gives no detail of the manner by which this is performed, but he exposes, in the most detailed manner, the analogous fact, the development of the pollenic grains, especially those of the *Citrouille.*

In this case the membrane of the cellules in which the pollenic grains are found, and which is full of a granular mucilaginous substance, becomes gorged with juice, and swollen to such a degree that it assumes a considerable thickness; on its internal surfaces there are four septa produced, which direct themselves toward the centre of the cellule, and divide its contents into four parts, and uniting in the centre of the cellule in such a manner that the cellular cavity is divided into four compartments entirely separated. Then there is formed in each of those compartments, and around the granular substance which it contains, a membrane which in the *Citrouille* is at first smooth and colourless, afterward becomes yellowish, and covered with papillæ (mamelons). Examination of ripe grain exhibits that internally to this membrane there is formed another, which at certain points is found joined to the external membrane. The cellules in which the pollenic grains are formed become dried and tear, so as to liberate those pollenic grains.

In a later Memoire (Ann. Sc. Nat. 2d ser. iv.) M. de Mirbel enters into details concerning the formation of these two membranes, the one external, and the other internal, and indicates that they draw their origin from the cambium contained in the mother-cellules of the pollenic grains, that is to say, from the mucilaginous mass which before the formation of the membrane of the pollen envelopes the pollenic grains, and which fills the space between these grains and the wall of the mother-cellule, and which first becomes changed into the external membrane of the pollen, and afterwards into the internal membrane.

As to the analogy which I have indicated exists between the formation of the Sporæ and that of the pollenic grains, M. de Mirbel announces that there exists a constant difference in the manner by which these two organisms become developed, so that in the Sporæ the mother-cellule, after that the four Sporæ are formed, becomes divided into four cellules, which in consequence of the increasing volume of the Sporæ, become shrivelled and lacerate, whilst the four compartments into which the mother-cellules of the pollenic grains are divided by septa, do not become separated from each other.

The inquiries which I have published on the development of Sporæ (Flora, 1833; Archives de Bot. ii. 341) agree with the results obtained by M. de Mirbel in this, that in descending to the Lichens (with the exception of the Equisetaceæ) there was developed four Sporæ in one mother-cellule; that in these latter, and before the development of the Sporæ, we found a liquid granular substance; and this became divided afterwards into four parts, which then became covered with a peculiar membrane. But as to the manner by which the membrane of the Sporæ became formed, my results differ from those obtained by the French physiologist. Thus, I think in consequence, particularly of the examination of *Riccia glauca* and of the *Anthoceros lævis,* I have a right to admit that the granular mass which fills the mother-cellule becomes divided of itself into four parts, and is not as it were divided by the partitions which direct themselves from the circumference of the cellules to the centre; that each of these parts become covered first by a thin and homogenous membrane, around which after a time a second external membrane is formed, which very often becomes cellular; that those four Sporæ become surrounded again on every part by the close mother-cellule, and that this latter becomes absorbed without previously being divided. The points on which I differ in opinion from M. de Mirbel, reduce themselves therefore to the manner in which the contained granular liquid becomes divided into four parts, to the manner in which the membrane of the sporæ is produced, and to the presence or absence of division in the mother-cellule.

If the inquiries I have just made concerning the development of the sporæ of the *Anthoceros lævis* do not furnish satisfactory results on all these questions, it will at least furnish some materials, which will exhibit the nature of these changes in a better light.

The sporangia of the Anthoceros exhibit this peculiarity, that the development of their sporæ is not complete at the same time in the whole length of the fruit, but that the sporæ placed nearest to the summit of the sporangium develope themselves much sooner than those sporæ of the inferior part of the fruit. This peculiarity of the successive development of sporæ in the same sporangium facilitates much the investigation of these bodies. As in the other Hepaticæ, the sporæ are developed by the number four in the mother-cellules, and manifest almost without exception that disposition which I have designated by the name tetrahedric reunion.

The youngest mother-cellules which I have found appear diaphanous, generally ovoid, sometimes globular, in which, at one of the extremities, or very near it, we perceive a thin granular mucilaginous disk, of yellowish green, not manifesting any determined or regular form, and applied to the wall of the cellule. This granular disk is not perfectly circumscribed: it is without colour, very diaphanous, and confounds itself with the rest of the perfectly transparent cellule, without exhibiting any manifest limit. It is in this disk, or rather below it, that, by an attentive examination, we find a nucleus manifesting in appearance a colourless globule, or round nucleus, (Pl. ii. fig. 1.) By the action of iodine, the granular disk, as well as the nucleus manifest a deep brown colour, and a yellowish tint is disseminated also at the same time on the rest of the cellule, which previously was perfectly diaphanous; we then see that the disk passes insensibly by its circumference into a mucilaginous substance, which covers internally the whole mother-cellule, which seems to coagulate by the action of iodine, and which presents, as it were, the appearance of a membrane detaching itself in part from the mother-cellule, the membrane of which remains perfectly unchanged in colour. The mutations observed in the course of development affect first chiefly the mucilaginous disk. This disk indeed becomes successively dilated on its borders, so as to cover very soon the half or more than the half of the nucleus (fig. 2 and 6); at another time it manifests the form of a transversal band (fig. 7); with this augmentation of volume it undergoes another remarkable change—the green granular mass augments, the granules become more apparent, and commence at the same time to separate in a manner, more or less evident, into two parts placed one beside the other, which at this time are rarely completely separated, but which generally are in contact by their borders, or are in connection by the interposition of a kind of bridge (figs. 2, 3, 5, 6). This green mass is not exactly circumscribed at its circumference, it disappears in a colourless mucilaginous mass, very finely granular, and it is the transparence of this which precludes us from examining it more in detail.

This substance does not manifest itself under the form of a homogenous contiguous membrane, but it forms meshes of greater or less magnitude, circular, or angular (fig. 2, 9). On seeing this organization we could with difficulty refrain from the opinion that we had before our eyes a cellular membrane, the cells of which were formed of a tender, mucilaginous, granular mass, and that the cavity of these cellules was a simple vacuum in this mass, like the vesicles of froth; but as on turning the mother-cellule we see on its walls the whole of the mucilaginous mass forming only a thin layer, and as, if these were true cellules, not only the contour of these circles and polygones, but also their faces should be formed of the same granular substance, while those appear absolutely diaphanous; it is perhaps more probable that this mucilaginous substance only forms a layer on the internal wall of the mother-cellule. This layer in some points is very thin, or absolutely interrupted; in others it is thicker, and by this property manifests a retiform cellular organization.

It is not possible even by the use of iodine, which tinges this mucilage yellow, to demonstrate the presence of cellular formation.

The nucleus does not take part in this formation; frequently it is so concealed under the green granular mass, that it is imperceptible, or almost so; at other times however (fig. 3,) we find it placed by the side of or between the two divisions of the green mass, and is there seen with more facility; we remark at the same time, in this case, that the nucleus has remained the same, and that it was quite separate from the above mentioned mucilaginous formation; this latter does not appear to have any relation with the nucleus, except that it has always its point of concentration directed to the point where the nucleus is situated, and between this latter and the mother-cellule. By ulterior development not only the quantity of the greenish granular mass augments, but its separation into two adjacent masses, which has already commenced sometime, becomes manifest, the two masses being at first reunited (fig. 9, 12), but afterward they become completely separated (fig. 13); at the same time we see that the colourless, mucilaginous, granular mass in which the green substance is found deposed becomes augmented. In the commencement this colourless substance, as also the green granular substance, was spread against the wall of the mother-cellule; but now those two substances commence to advance more and more towards the interior of the cellule: then the green substance, interspersed with granules of greater or less magnitude, conglomerates into one mass, and afterwards into two, surrounded by an atmosphere formed of a colourless substance.

This atmosphere extends itself outwardly into the meshes already described, and resembling cellules (figs. 8, 9, 12) which successively extend themselves into all the space of the mother-cellule, and which at a certain period change so much the form of the vesicles which are either round (figs. 8, 9) or angular, in consequence of mutual pressure (figs. 12), that at this period at least the transformation of a part of the mucilaginous into a cellular organism cannot be doubted.

This cellular aspect of the colourless substance only however exists a short time; because, in proportion as the green granular vesicles draw themselves with the nucleus into the interior of the mother-cellule, a part of the colourless substance accumulates around it in an amorphous mass, and the circular meshes become insensibly changed into filiform elongations, which, commencing at this central mass assume a radiated direction towards the wall of the mother-cellule, and which gives in that manner a solid position to the central formation, which until this time was suspended in the juice of the cellule. (Figs. 10, 11, 13, 14, 15.)

At this period the granules of the green substance augment considerably in volume, and by the use of iodine show that the large granules are formed of *amidon.*

The mucilaginous atmosphere, as well as the filaments which emanate from it and pass towards the mother-cellule, assume by the use of iodine as before a yellowish brown tint. It happens also, often in consequence of being placed a long time in water, or by other causes, that the granules of this green mass become contracted, and occupy a small space (figs. 16), or that in general they are less numerous; in this case we see very clearly that the mucilaginous atmosphere is condensed at the circumference of these granular masses, forming an almost circumscribed cavity, exhibiting in this manner as it were almost globular cells filled with green granules. Towards the exterior the walls of these cellules are however not completely evident, but they pass immediately into finely granular mucilage.

Now each of these granular masses, which I shall designate by the name of granular cellule, is divided into two distinct parts, in such a manner that in all there are four. First these four cellules are placed by the side of each other (figs. 18, 19, 20,); but they separate, approximate the wall of the mother-cellule, and assume the position of the four angles of a regular equilateral tetrahedron (fig. 21, 22).

The mucilaginous mass in which the granules are placed becomes equally divided, and each of these parts become enveloped by a particular atmosphere which is thin and mucilaginous. The principal part of the colourless mucilage becomes changed, on the other hand, into fibrous threads, which direct themselves from one granular cellule to another. The nucleus (figs. 21, 22), which at this period appears always to diminish in volume, is found placed at the centre of the mother-cellule and of the mass formed by the fibrous filaments, is absolutely distinct from the four granular cellules.

During the time that the contents of the mother-cellule exhibit those mutations, the wall changes equally; originally this part was formed of a thin membrane, which was very tenacious, however since the period when the green granular mass became divided in two, the wall of the cellule became more and more thick, (figs. 15, 17, 18, 19, 21, 22).

When the granular cellules are placed close to the wall of the mother-cellule it frequently happens that the wall does not present an equal thickness, but in certain places becomes swollen more than in others (fig. 21.) At this period the mother-cellule is not only become larger, but its form, at first ovoid, becomes almost always globular; however in this respect there are a great number of exceptions.

The thickening of the walls appears to emanate in part from a true increase of these parts, and this is an entirely normal mutation, because it is manifested regularly at this period. Afterward however the thickening of the wall is only apparent, and manifests itself before the eyes of the observer when the cellules have been a long time in water, for the cellular wall is then very hygroscopic, and is formed of a gelatinous substance, rather tenacious, it tears with difficulty, and is not tinged brown by iodine.

It happens often that in consequence of the prolonged action of water the cellular walls become considerably swollen in the interior towards the cavity of the cellule, and often to such a degree that this latter disappears almost entirely, and that the mass contained within is often pressed to the centre, assuming an amorphous appearance.

Soon after that the mother-cellules have assumed this state, there is a division manifested in their cavity. Thus there is formed at the inner surface of the cellular wall, and always between two granular masses, a narrow line, three of the lines in passing from the circumference unite in the centre by obtuse angles (fig. 23.) Those lines, as results from the number and from the position indicated by the granular cellules, are six in number, they unite in four points, and divide in that manner the surface of the cellule into four triangular surfaces. Those lines are the first rudiments of septa which afterward will replace them. The manner by which those septa are formed is a matter of much difficulty to observe, and I should intimate, that in spite of reiterated inquiries I have not been able to dispel the doubt which still remains in my mind on this subject.

The fine lines of which I have spoken, appear to be narrow raised lines, emanating from the interior of the cellular wall (or the rudiments of septa) which afterwards join towards the middle of the cellule, where they reunite. That which weighs at least some thing in favour of this theory is, that at the period when these lines appear for the first time (fig. 23), the filaments of fibroso-mucilaginous substance which pass from one granular cellule to another, exist yet in all their integrity, which proves that in the interior there cannot yet be any septa formed.

But a point which merits also to be mentioned, is, that in consequence of the action of water on the mother-cellules those lines can be made to disappear again; thus it appears to indicate that they were only formed by a very small elevation towards the interior, and it is this elevation which appears to be changed in consequence of the hygroscopic enlargement which the membrane of the mother-cellule has undergone.

This state which consists in lines found on the wall of the simple cellule, soon passes, because in the greater number of cases in which the division of the cellular wall on such like surfaces is visible, we find that the septa also are already completely developed. Those septa, as it results already from their relative position, have a triangular form.

Two of their faces are plain, and the third, that which is turned towards the exterior, is convex; these are very thin, and are formed, like the mother-cellules, of a semigelatinous substance, which is not affected by iodine.

The nucleus of the mother-cellule, difficult to discover before the division, exhibits now no trace after the division is produced; it would appear to have been entirely absorbed at this period.

Each of the four divisions of the mother-cellule formed by the septa, contains one of the four granular cellules (figs. 24, 26). These latter do not change at first, because they contain yet a great number of amylaceous grains (fig. 24, 25), and become slightly tinged of a green colour from the influence of iodine; but soon in the greater number of cases the number of amylaceous grains diminish (fig. 26), and it is then that we can exactly distinguish the wall of the cellules completely developed and limited also externally. They are found attached by gelatinous filaments (fig. 26), the same as generally happens in the undivided mother-cellule.

A little after the division of the mother-cellule, the formation of the membrane of the sporæ is perfected.

Before this division takes place, the use of iodine exhibits that there emanates from the mucilaginous fibrous substance which fixes the granular cellules to the wall of the mother cellule a thin gelatinous mass, which directs itself along the internal surface of the mother-cellule, and covers this surface in the form of a thin layer. This mucilaginous layer becomes brown by the use of iodine; but it is so thin and so very incoherent, that evidently we should only consider it as a thin mucilaginous layer, and not as a distinct membrane. After the division of the mother-cellule, we find in each of its parts an analogous mucilaginous layer, which thickens rapidly, and becomes entirely distinct when put in contact with iodine by its yellowish brown tint, the mother-cellule remaining colourless, it acquires a greater coherence, represents a true membrane, and afterwards may be seen even without the use of iodine, and which from this time forms the membrane of the sporæ, (fig. 24, 26).

The form of the *spora** is that which we find generally in the most perfect cryptogamæ, that is to say that towards the centre of the cellule it exhibits a pyramidal apex with three surfaces, and externally a convex surface. But as according to that which has been said above, the internal surface of the mother-cellule frequently exhibits at the approach of the period in which the division is to be accomplished very

* Spore Fren (Spora Hedw., Sporula, Richard, Gondylus, Goert. Besimen Neck.) Authors have substituted this term for that of grain to designate the reproductive corpuscles in cryptogamous botany.—Jos. M.

irregular depressions, it happens commonly that the young sporæ manifest on their external surfaces undulated eminences and depressions, which only disappear in consequence of ulterior development.

From the time that the membrane of the sporæ becomes developed, the sporæ may be separated from each other by pressure (fig. 27); when this compression is augmented, the mother-cellule lacerates, and the sporæ pass out by the opening formed in this manner. When chance favours us, we can sometimes see the mother-cellule forming thin septa between the sporæ.

The membrane of the sporæ is first colourless and smooth; afterwards it becomes finely granular (fig. 28) on the convex surface, which is in contiguity with the external wall of the mother cellule; at the same time it assumes a yellowish tint; at a still later period, the three surfaces of the pyramidal summit become granular (fig. 29), and the angles become thickened.

By compressing the sporæ of the *Anthoceros* between two pieces of glass we cannot prove the duplicity of their membrane; but the presence of an internal membrane is very probable, because of the analogy between these sporæ and those of other more perfect cryptogamous plants and mosses.

The ulterior mutations between this period and the maturity of the sporæ, are in relation either with the mother cellule, or with the sporæ themselves.

The mother-cellule as soon as the membrane of the sporæ become perfectly developed loses its anterior state of hygroscopicity; in proportion as the sporæ augment in volume, and become more and more thickened, the mother cellule becomes thinner and thinner; in fine, when it approaches the period of maturity it becomes entirely absorbed.

In the sporæ themselves the number of the amylaceous grains diminishes, and terminates by completely disappearing, and the mother-cellules in which they were contained, and which now have assumed a yellowish tint, evacuated, and enveloped by a little mucilage become placed against the wall of the sporæ (fig. 28). These mutations of the granular cellules are produced sometimes sooner and sometimes later, or it may happen while the membrane of the spora is still of a clear yellow and very transparent, there yet exists a considerable accumulation of granules when even this membrane is of a yellowish brown and little transparent. In the end the little cellule seems always to become resolved, for in the ripe sporæ we find only a grumous, mucilaginous liquid, mingled with particles of oil.

I may be permitted to add a few observations on the above exposition of the results obtained by my inquiries on the *Anthoceros.*

As to the mother-cellules, those inquiries perfectly confirm the opinion of M. de Mirbel, that they become divided; my former opinion, that in the more elevated cryptogamous plants the four sporæ become developed by the side of each other in the cavity of the mother-cellule, is therefore decidedly ill founded.*

On the other hand, I presume that my observations on the contents of the mother-cellules should modify some little the theory proposed by M. de Mirbel, indeed according to this high authority the formation of the sporæ should depend more particularly on the mother-cellule, the contents of which are described as a homogenous, mucilaginous, grumous liquid, that the raised septa divide mechanically into four parts. This theory is therefore in direct opposition to mine, according to which, the development of the four sporæ

* The open acknowledgment of error, as in the present case, is commonly the characteristic of distinguished talent. And perhaps more particularly so in natural history than in any other scientific or literary pursuit—Jos. M.

take place in one cellule from the organic transformation of its contents, without the cellular wall exercising any influence whatever on their evolution.

The observations on the *Anthoceros* appear to prove that the truth holds the middle between these two theories. The facts which have been exposed above, indicate that the exterior of the mother-cellule is, long before its separation, the theatre of an organic activity, manifesting itself on the organisms, which change in a most varied manner.

Besides the nucleus, which has no connexion with the ulterior formation of the sporæ, we find in this cellule a mucilaginous, grumous organism, which assumes different forms, giving birth to four amylaceous grains, and before there is manifested the slightest trace of division of the mother-cellule, has already determined the quaternary number of sporæ, their relative position, and consequently also their form. But it is extremely surprising that the position and number of septa emanating from the wall of the mother-cellule, should depend on the position which the granular cellules assume in the mother-cellule, as we have seen in the *Anthoceros;* the form the most frequent which the four granular cellules assume is tetrahedric, the same as in a great number of Cryptogamæ, which I have already proved as far as the sporæ are concerned; and in this case six septa always become manifest. But in the Anthoceros we again find the exceptional case (which forms the rule in many other Cryptogamæ), that the four sporae are found placed one beside the other on a peculiar plane, and in this case there are only four septa formed. The relation of the number of septa of the mother-cellule with the relative position of the sporae is not astonishing, if the sporae were only the result of the mechanical division of the contents of the mother-cellule, or if in free space, the membranes of the sporæ first become manifest, and that between them membranes were formed which had applied themselves to the wall of the mother-cellule thus to form septa, it would have been different.

But matters now become enigmatical, because that the septa emanate from the wall of the mother-cellule, and become regulated according to the position of the granular cellules which manifest no organic relation with the mother-cellule. It is difficult to say that I have not succeeded in observing something here of mechanical influence, or it may be a question whether this relation of the position of septa opposite that of the granular cellules depends on certain dynamic influence; but I presume to be able to infer that it is not the manifestation of four or six septa which determines the formation of four sporæ, and that the entire formation of the sporæ is produced from the membrane of the mother-cellule, but on the contrary the septa are only the consequence of development of the substance contained in the mother-cellule.

If I have formerly announced that the internal membrane of the sporæ is formed before the external, and that in many cases this latter is cellular, I am bound to acknowledge this observation as erroneous, which was suggested to me by the circumstance of the membrane of the sporæ being at first uniform, colourless, and smooth, in a word, it resembled the internal membrane; and that it is only sometime after this that it changes its nature; this is the circumstance I had not previously remarked.

The membrane of the sporæ forms at first, as it appears, a coagulated, and solidified mucilage, smooth on the exterior; afterwards there are inequalities formed on the external surface (as in the *Anthoceros*), or rather a plexus of patelliform eminences, without (as I previously presumed) we had a right to consider this plexus as the formation of a proper membrane, and more especially of a cellular membrane. The membrane of the sporæ becomes so intimately applied to the mother-cellule, that all the eminences correspond; to the depressions in the tender substance of the mother-cellule when the membrane of the sporæ is covered with granules or little pointed eminences *(de granules ou de piquans,)* we shall find simple cavities corresponding to these in the mother-cellule; when the former is covered with a fibrous network we see corresponding to this pentahexagonous prolongations of the mother-cellule, passing into depressions in the form of alveoli of the membrane of the sporæ, and imparting to the membrane of the mother-cellule, when we separate it, a tessellated aspect. This is well seen in the *Riccia glauca.*

According to what I have mentioned above, it is very probable that the membrane of the sporæ is the production of the mother-cellule, and, as it were, a hardened secretion of this latter, it appears rather to draw its origin from the condensation of the mucilaginous and granular substance above described, and that the mother-cellule only appears to determine the form of the membrane of the sporæ.

This seems to me to be proved not only from the development of the *Anthoceros* just as I have described it, but I am solicitous to intimate in this place the analogy in the sporæ of the inferior Cryptogamæ, for example, that of certain Confervæ, as the *Zygnema,* in which the membrane of the sporæ is formed around an accumulation of granules, which is less than the volume of the cellule, and in which consequently the membrane of the sporæ is in no way applied to the wall of the cellule.

When in fine, as to the separation of the mother-cellule into four distinct cellules, each of which contains a spora, which according to M. de Mirbel will form the distinctive character between the mother-cellules of the spora and those of the pollenic grains, I am of opinion that it is not observed in all the mother-cellules of the sporæ, but that, in plants nearly allied, sometimes it takes place and sometimes it does not. I have not succeeded in observing it in the *An-*

*thoceros punctatus* (a plant on which however I have only made a small number of observations); but it manifests itself in a positive manner in the *Jungermannia epiphylla,* while I have not seen it in the Riccia glauca. It seems to me consequently that we should not value too highly the question, viz. whether the four divisions of the mother-cellule remain reunited or not, and that, notwithstanding, we cannot consider the solution of this question, as furnishing a characteristic distinction between the mother-cellules of the sporæ and those of the pollenic grains.

I should intimate, that the figures of the plate were drawn from an augmentation of 380.

Translated from the Annales des Sciences Naturelles, for the Calcutta Journal of Natural History.—Jos. M.

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*Report made to the Academy of Science, in the sitting of the 9th March* 1840, *by* M. DE BLAINVILLE, *on a memoir of* M. DUFO, *entitled, Observations on Marine, Terrestrial, and Flaviatile Molluscs from the Sechelles and Amirantes Islands.**

Zoology is not only composed of a knowledge of the external and internal organization of creatures, of their specific distinctions, of their position in the natural series which they form, departments which are as it were reserved for professional Zoologists, to have arrived this length previous studies would have been necessary, collections at our disposition, books of description and plates; but it demands equally an acquaintance with the manners and habits of animals, which although evident deductions often of the peculiarities of organization, are not so however always without exception. So that the study of living creatures, their relations with the earth, with the medium in which they live, with the other organized bodies by which they nourish

* Translated from the An. Sc. Nat. for the Calcutta Jour. Nat. Hist. by Joseph M'Clelland, M. D.

themselves, or to which they serve as nourishment, with those of their own species for reproduction, is of such great importance that, in the common opinion, this single part seems to constitute the science entirely.

It is to this essential point of the science of molluscous animals, or to their natural history, that the works of M. Dufo will convey a very great number of new facts, which will essentially double their value, when we observe that to acquire these, it was necessary to remain many years in localities suitably chosen, where he might have great abundance of molluscous animals ; and, as one of the circumstances most favourable to the reproduction of these creatures in certain localities, is indubitably the distance of human establishments, and more especially of civilized man, we see how much enthusiasm it required, and even expence, to maintain one's self a sufficient length of time in such places.

To this end M. Dufo, stimulated by his tase for conchology rather than any other motive, without any other mission than the desire of being useful, went and stationed himself in the *Archipel des Iles Sechelles et Amirantes,* which offer a great number of creeks and rocks, of sand beds and shoals, and is seldom visited by navigators ; then having taken with him a few negroes and suitable provision, he was able to devote himself without fear of being interrupted to long and repeated observations on many points of the natural history of conchiferous molluscous creatures, also on the opercules, and the differential shades through which the shells pass during development.

The first point, so long neglected, and to such a degree that we may intimate its study almost to have commenced in our own day, and by the exertion of one of our friends, has acquired a true value, since it has been demonstrated that we might take advantage of it not only for the distinction of species of which we only possess the shell, but also for the establishment of generic divisions truly natural. M. Dufo has confirmed, on a rather extensive range of species of the genera (Fusus) Turbenella, Murex, Purpura, Buccinum, &c. that this method of procedure was well founded. Thus he has demonstrated by the operculum of the pretended Buccinum undosum that it was a species of the genus Turbinella, and by that of the Cerithium paulustre, which differs by its composition of imbricated circular elements from that of true Cerithia, that this shell did not belong to this genus. And thus is confirmed the genus Potamida, established by M. Alexander Brongniart for the fossil shells considered before him as Cerithia, the fluvatile nature of the earth in which we find them, as well as certain peculiarities in the form of their opening, led to their separation from the Cerithia, which are marine. In effect the Cerithium palustre, as its name indicates, inhabits fresh water marshes.

Science owes also to M. Dufo the positive fact of the absence of the operculum in the genus Terebellum, which before him was only suspected.

The second point on which the observations of M. Dufo has more essentially been directed, is that of the successive form by which shells pass from the incipient existence of the creature which carries them to their deposition; it is also a point extremely important, and evidently in relation with the fact of diminution of the lobes of the mantle with age, as M. Dufo has again confirmed.

Since indeed that geology, as it were struggling for a scientific existence, admits in organized bodies the remains of which exist in the superficial strata of the earth, one of the elements the most calculated for the resolution of her problems of identity or antiquity, and even the etiology of strata, the study of shells which by their chemical nature may contribute to the formation of extensive rocks; this study should acquire, and indeed has acquired, great importance; but unhappily since M. Lamarck, so justly celebrated, has regulated fossil conchology by the distinction and denomination of species, many geologists, often but little acquainted with natural history, have claimed acquaintance with this department of science, and afterwards, rather elicited by the necessity of combining this branch with geology, than refined by real knowledge in zoology, they have established, and denominated as species a great number of fossil shells, without sufficiently understanding the limits of variation of which these molluscous creatures are susceptible, and indeed, before malacology was itself in a fit state to supply the wants of science.

An individual amongst us during the few years he officiated for M. de Lamarck in the Museum of Natural History, having perceived how much it was important to scrutinize their limits of variation before proclaiming their laws, had commenced to establish groups of shells of the same species, being guided not only by age, but even by sex in diocious species, as well as locality; but M. Dufo directed by these efforts has gone much further. We remark indeed in the collections of shells made by this zealous observer, the succession of a great number of species, the shades of which amount to more than fifty, and their differential shades have not only relation to the size or stature, but also on all the differential peculiarities which the shells can offer. So that in this respect, more especially in the genera Purpura, Ricinula, Turbenella, Murex cypraea, Strombus, Pterocera, the collection of M. Dufo is of great interest, because it permits us to appreciate the limits by variation which a species of shell is susceptible even in climacterical circumstances and others absolutely the same. What, if he had been able to reunite the varieties which the same living species may offer at a more or less considerable distance?

Besides these two important points regarding malacology, M. Dufo has also directed his attention to many others which are not without interest, because they unite certain links in the natural history of molluscous creatures.

Thus the depth and nature of the bottom of the sea which the different species of shell-fish prefer, have been carefully noted by M. Dufo. He has remarked, for example, that the *Bivalved sabulicolæ* descend deeper as they become more aged, that certain species of Cerithia live solitary, and others in society.

He was equally occupied in investigating the variety of nutritive matter preferred by each species; and if after this manner, M. Dufo in a great measure has confirmed the division of M. de Lamarck, viz. Trachelipoda, Zoophaga and Phytophaga, he was also enabled to point out certain errors committed by that learned zoologist. Thus according to him the Cerithia are exclusively phytophagous, as well as the Conus, and the Cypraea, in contradiction to what M. de Lamarck had supposed.

In fine, M. Dufo has gone so far as to observe the manner and velocity of locomotion of a great number of species; thus the Strombi and the Pteroceræ progress by successive skips as it were, and the Coni are slow in comparison with the (Porcelaines) Cypraeæ, which we might presuppose from the great difference in the extent of their locomotive disk.

The time (four years) during which M. Dufo continued his observations, permitted him to judge of the length of life of certain species by the slowness of their development. It is on the Cerithium palustre that this presumption essentially bears. Among the peculiarities which it would be difficult to unite with those already mentioned, we shall intimate the following: The Buccinum arcularia, the operculum of which is finely denticulated at its circumference, seems to serve as a means of defence when we wish to capture it.

The double foot of the Harpae, first made known by M. Quoy, to whom science owes such a number of new facts in Malacology and Actinology, and which appears to replace the operculum of which this genus is deprived, falls and breaks with the least effort, and seems thus a means which the creature has to avoid the verocity of its enemies in abandoning to them this part of its body.

In the (Cypraeæ) the lobes of the mantle are in a singular state of continual trepidation, which does not take place in the (Olivæ), a genus which is so nearly allied to the Cypraeæ.

The air-bearing vescicules of the foot of Ianthinus empty themselves entirely when the creature is at certain depths in the sea.

The Agathinus of Maurice deposits its eggs in columns, forming a train more or less long, but the fact the most remarkable of this genus which M. Dufo has observed is, that the *Helices unidentes* are oviparous, like many species of Littorinæ, the *Paludina Vivipara* of our rivers, the Partul &c. that is to say they hatch their eggs in the extremity of their oviduct, and the little creature leaves its parent in a living state.

Certain species of Calyptræ are provided with a support distinct from the rock on which this creature is placed, while in the Hipponices vivantes, the support makes part of the rock, and is formed at its surface. In fine, M. Dufo appears to be assured that certain byssifirous bivalve creatures detach (the byssus piecemeal), which we had already suspected.

In limiting ourselves to this simple enumeration of facts gleaned by M. Dufo, it will be permitted us to add that if, among the truly immense number of shells collected by M. Dufo we shall only find forty or fifty new ones, a consequence which, although simple, is however generally more appreciated for our collections, he has furnished us on the species which we already know peculiarities which will certainly advance their history, and which was much more difficult to procure.

In fact, to accomplish this, it was necessary to do something other than amass and collect these creatures, and to put them immediately into a conservative liquid, as is almost exclusively done by most travellers? It was necessary to pass days, months, and entire years to observe these creatures carefully in all their peculiarities.

Without doubt the labour of M. Dufo is not a work essentially scientific, its author has not had the pretension, but they are elements of true importance, first in themselves, and secondly because of their variety, which will serve not a little to enrich the works of naturalists and the collections of our Museums.*

We therefore propose that the Academy address its thanks to M. Dufo for the zeal which he has manifested in accomplishing a mission which was self-imposed, by inviting him to continue it, if possible, in which case, to direct his attention to the creatures themselves in their relation with their shell, on the difference of sex, on the ova of each species; points yet very little advanced in the history of molluscous animals, but which must have a great influence on the progress of science.

* We presume it will give pleasure to zoologists when we announce that M. Dufo was quite anxious to present the whole of his beautiful collection to the administration of the Museum.

*Conspectus of collections made by* DR. CANTOR, *Assistant Surgeon, during his employment with H. M. 26th Regt. on expedition to China,* 1840.

*Penang,*—Fishes, Shells, Zoophytes, Insects, Plants.
*Singapore,*–Fishes, Shells, Zoophytes, Crustacea, Plants.
*China Sea,*—Fishes, Molluscs, Zoophytes, Animalcula.
*Lantao (Canton Prov.)*—Fishes, Shells, Crustacea, Plants, Geological specimens.
*Chusan,*—Mammalia, Birds, Reptiles, Fishes, Shells, Crustacea, Annulata, Arachnidœ, Insects, Plants, Seeds, Geological specimens.

Conspectus of Animals observed and collected at Chusan *(Rough draft.)*

1. MAMMALIA. Noctilio?
Canis sinensis.
Felis catus?
Felis ——? (wild cat.)
Manis (the Indian species.)
Sus.
Equus caballus.
——— asinus.
Bos taurus (allied to the Brahmuny bull)
Capra.

None of the larger wild beasts occur, most likely in consequence of a thick population. Of domesticated animals the pig, affording the most favourite animal food, is prodigiously numerous. Few horses and oxen, the latter used exclusively for the plough. Goats numerous.

2. AVES. Few wild birds, (in consequence of the absence of forests,) chiefly gallatores, crows, sparrows, swallows. Of domesticated fowl—geese, ducks, fowl, plentiful,—of large size and excellent quality.

3. REPTILIA. Emys,
Trionyx,
Seps,

REPTILIA. (*Continued.*)

Agama,
Hemidactylus,
Naja,
Python,
Coluber,
Lycodon,
Tropidonotus,
Rana,
Hyla,
Bufo.

Southern and central China is crowded with reptiles beyond description. In Chusan Naja appears the only venomous terrestrial serpent. None of the larger saurians. All the forms of reptiles are tropical, except Rana esculenta.

4. PISCES.

*A. Fresh-water.*

Anguilla,
Synbranchus,
Eleotris,
Gobius,
Ophicephalus,
Anabas,
Cobitis,
Colisa,
Cyprinus,
Silurus.

All tropical forms, with the exception perhaps of Anguilla, which resembles the European species.

*B. Sea and Estuaries.*

Carcharias,
Trygon,
Hemiramphus,
Stromateus,
Platax,

Macropodus,
Trichiuris,
Nebris,
Solea,
Lates.

Little can be said of the pelagic fishes, as unfortunately the fishermen had followed the example of most of the other inhabitants, who deserted the vicinity of the English.

### 5. MOLLUSCA.

*A. Terrestrial, Fresh-water, and Estuaries.*

Limax,
Paludina,
Cerithium,
Ampullaria,
Lymnea,
Succinium,
Melania,
Clausilia,
Pupa,
Helix,
Bulla (Bullæa,)
Vitrina,
Achatina,
Bulimus,
Planorbis,
Anodonta,
Cyrena,
Mytilus.

Considering the limited extent of the locality, the number of genera is remarkable. The Lymnea bears a strong resemblance to L. rivalis, Sowerby; but appears to be the only European form.

*B. Pelagic (inhabiting the Chinese Sea, from the Southern extremity up to Chusan.)*

Terebella, Bulla, Pterocera,
Serpula, Auricula, Strombus,

Spirorbis,
Vermilia,
Balanus,
Lepas,
Anatifera,
Pollicipes,
Aspergillum,
Gastrochæna,
Solen,
Mya,
Erycine,
Amphidesma,
Cytherea,
Venus,
Isocardia,
Cucullæa,
Arca,
Hyria,
Modiola,
Mytilus,
Malleus,
Meleagrina,
Ostrea,
Placuna,
Gryphæa,
Spondylus,
Pileopsis,
Bullæa,
Neritina,
Nerita,
Natica,
Ianthina,
Sigaretus,
Stomatella,
Haliotis,
Pyramidella,
Scalaria,
Delphinula,
Solarium,
Trochus,
Monodonta,
Turbo,
Planaxis,
Phasianella,
Turritella,
Cerithium,
Pleurotoma,
Turbinella,
Canularia,
Fasciolaria,
Fusus,
Pyrula,
Struthiolaria,
Ranella,
Murex,
Triton,
Rostellaria,
Cassidaria,
Cassis,
Ricinula,
Harpa,
Dolium,
Buccinum,
Terebra,
Columbella,
Mitra,
Voluta,
Ovula,
Cypræa,
Terebella,
Ancillaria,
Oliva,
Conus,
Nautilus,
Argonauta,
Pholas,
Tellina,
Cardium,
Donax,
Spondylus,
Chama,
Pinna,
Strombus,

6. ANNULATA.

Hirudo officinalis.
Hirudo ? (Head in the shape of a *hammer*. Also found by Mr. Griffith in the Naga hills in 1836.)

7. CRUSTACEA.

Pagurus,
Crangon.

8. ARACHNIDÆ.

| | |
|---|---|
| Lycosa, | Aranea, |
| Oxypes, | Dictyna, |
| Thomisus, | Phalanginum. |

Remarkable for their specific and numerical strength.

9. INSECTA,

| | |
|---|---|
| Dytiscus, | Apodeus, |
| Hydrous, | Lamia, |
| Gyrinus, | Acrocinus, |
| Cyclous, | Cassida, |
| Elater, | Eumolpus, |
| Silpha, | Chrysomela, |
| Ateuchus, | Coccionella, |
| Ontophagus, | Histor, |
| Phanæus, | Helops, |
| Macraspis, | Coriarus, |
| Cetonia, | Gryllotalpa, |
| Gymnetis, | Gryllus, |
| Lucanus, | Forficula, |
| Mantis, | Blatta, |
| Spectrum, | Vespa, |
| Acrydium, | Apis, |
| Cimex, | Bombus, |
| Helops | Xylocopa, |
| Nepa, | Trigona, |
| Notonecta, | Melipoma, |
| Corixa, | Polistes, |
| Cicada, | Papilio, |
| Libellula, | Sphinx, |
| Æshna, | Phalæna, |
| Agrion, | Culex, |
| Panorpa, | Tabanus, |
| Myrmelion, | Oestrus, |
| Phryganea, | Conops, |
| Sphex, | Musca. |

The greater number not identified. Tropical forms prevalent (strong resemblance to the insects of Asam and Sylhet collected by Messrs. M'Clelland and Griffith, in 1835-6), Nepa, and a few butterflies, apparently European.

## 10. ANIMALCULA,

Not identified, several forms found all over the earth, in the ocean, as well as in fresh water.

*Plants flowering in Chusan in July, August, and September.**

*Ranunculaceæ,*
- Ranunculus,
- R. aquatica,

*Nymphæaceæ,*
- Nymphæa nelumbo,

*Cruciferæ,*
- Thlaspi bursa pastoris?
- Brassica,
- Sinapis arvensis.

*Resedaceæ,*
- Reseda luteola?

*Oxalideae,*
- Oxalis Stricta.

*Hypericineæ,*
- Hypericum montanum,
- H. perforatum.

*Ampelideæ,*
- Vitis vinifera.

*Aurantiaceæ,*
- Citrus (3 to 4 species,)

*Camelliæ,*
- Thea viridis,
- Camellia.

*Malvaceæ,*
- Gossypium,
- Hybiscus.

*Acerinæ,*
- Acer.

*Celastrineæ,*
- Ilex.

*Papilionaceæ,*
- Many species.

*Rosaceæ.*

a. *Amygdaleæ.*
- Amygdala persica,
- (Apricot,)
- Prunus,

β. *Dryadeæ,*
- Geum rivale,
- Rubus idæus,
- R. Chamæmorus,
- Fragaria.

γ. *Roseæ,*
- Rosa sinica,

δ. *Pomaceæ,*
- Pomum,
- Pyrus,
- P. Cydonia.

*Granateæ,*
- P. granatum.

*Myrtaceæ,*
- Myrtus.

*Portulaceæ,*
- Portulaca.

*Crassulaceæ,*
- Sempervivum,
- Sedum acre.

*Araliaceæ,*
- Hedera helix.

*Umbelliferæ,*
- Carum carui,
- Daucus Carota.

*Caprifoliaceæ,*
- Sambucus japonica.

* Note. The greater number, in Dr. Cantor's Herbarium have not yet been identified.

*Cucurbitaceæ,*
Cucumis Melo,
(Water-melon and several other species,)
Momordica balsamina,
*Compositæ,*
Gnaphalium,
Inula,
Senecio,
Chrysanthemum,
Artemisia sinensis, and 2 or 3 more species.
*Labiatæ,*
Rosmarinus officin.
——— ——— ?
Mentha ——— ?
Origanum ——— ?
*Borragineæ;*
Symphytum ?
*Verbenaceæ,*
Verbena.
*Solaneæ,*
Nicotiana tabacum,
Datura metel,
Solanum nigrum,
S. dulcamara,
Capsicum.
*Convolvolaceæ,*
Convolvolus batatus,
C ——— ?
*Polygoneæ,*
Polygonum (several sp.)
Rumex acetosa,
Rheum.
*Chenopodeæ,*
Chenop. bonus Henricus.
*Atrocarpæ,*
Morus nigra,
M. alba,
*Urticeæ,*
Cannabis —— ?
Humulus lupulus.
*Juglandeæ,*
Juglans regia,
*Amentaceæ,*
α. *Cupuliferæ,*
Quercus—— ?
β. *Salicineæ,*
Salix—— ?
S. babylonica.
*Coniferæ,*
Pinus ——— ?
Juniperus ——— ?
*Scitamineæ,*
Zingiber officinalis.
*Palmæ,*
Borassus, Musa, Betel, } attain a small size, produce no ripe fruit, and are all found in gardens.
*Alismaceæ,*
Alisma plantago ?
*Liliaceæ,*
Lilium —— —— ?
*Asphodeleæ,*
Allium (several sp.)
*Irideæ,*
Iris ——— ?
*Gramineæ,*
Triticum,
Oryza,

Zea mays,
Milium panicum.
*Filices,*
*Musci,*
*Fungi.*

European forms much more frequent in the botanical, than in the animal kingdom. Plants characteristic of this part of China are, Tea shrub; Stillingia sebifera (Tallow-tree); Dryandra cordata (varnish tree); Humulus lupulus (Hops). The tropical forms attain but a small size, their fruit do not ripen, and the brilliancy of the flowers is strikingly inferior to that of the Indian Flora. In the month of August the thermometer rises to 115°, in December it sinks to 22°.

The Geological features of Chusan are primary rocks (the highest about 1800 feet), and vallies with alluvial soil. The whole line of coast from Macao to Chusan appears to be primary formation.

*Conspectus of Sketches made on the expedition to China, from May 8th, to October 5th,* 1840.

| Localities. | Objects | Number. | |
|---|---|---|---|
| Penang, .......... | Fish, .................. | 4 Species, | |
| Singapore. ........ | Fish, .................. | 8 Ditto, | |
| Chinese Sea, ...... | Zoophytes, Mollusca, .. .. | 5 Sheets, | |
| Lantao, .......... | Fish, .................. | 3 Species, | |
| | Mollusca, ............. | 2 Ditto, | |
| | Crustacea, ............. | 2 Ditto, | |
| | Animalcula, ............ | 5 Sheets, | |
| Chusan, ........ | Mammalia, ........... | 5 Species, | |
| | Reptiles, ................ | 11 Ditto, | |
| | Fresh-water Fish, ........ | 9 Ditto, | |
| | Mollusca, ............. | 17 Ditto, | |
| | Crustacea, ............ | 2 Ditto, | |
| | Annulata, ............. | 1 Ditto, | |
| | Arachnida, ............. | 7 Ditto, | |
| | Insects, ............... | 9 Ditto, | |
| | Animalcula, ............ | 2 Sheets, | |
| | Plants,................. | 64 Species, | |
| | Geological sketches, ...... | 5 Sheets, | |
| | Anatomical ,, ........ | 2 Ditto, | |
| | Agricultural implements, .. | 7 Ditto, | |
| | Total,.. | 170 Sheets, | |

# Correspondence.

*Extract of a letter from* NATHANIEL SMITH, *Esq. C. S.**

Thinking that you as a geologist might consider the following observations worthy of attention by any skilful professor of the science, who would undertake a survey of the tract of country referred to, I do myself the pleasure of inviting your attention to the subject. My own knowledge of geology is nothing—being confined to the study of Lyell's work, without a mineralogical cabinet.

During a late trip to Darjeeling I was much struck with the character of the country, and the opportunities which it apparently affords of conducting geological researches on a large scale.

There appear to be three distinct fields of observation, all connected; the secondary, the metamorphic, and the primitive and volcanic. On approaching the mountains, three considerable rivers present themselves—the Teestah, the Mahanuddy, and the Balasun; of these the Teestah is the largest, entering the plains from the secondary range, where at its embouchure the mountains are 5 or 600 feet high; they descend abruptly to the river side clothed with forest from top to bottom; there is no track path; the lines of stratification present an angle of 45°, and the levels themselves may be four or five feet thick. The attempt to ascend this river is impeded by constantly recurring rapids. After ascending with a party some years ago about four miles, or perhaps less, we were stopped by two rocks, through which the entire body of water forced its way in a passage not three feet broad. Here the character of the mountains changed, and we came upon slate of a coarse description, and apparently incapable of being quarried; a light canoe might have been lifted over the rapid, but we were not prepared for a further advance.

This was in March, and with the hot winds blowing in the plains, we were glad to use blankets at night—the cold wind of the hills descended in a gale, to find its way into the rarified region below; the wind lulled always in the morning with the rising of the sun. The coldness of the water was intense, and wine placed in it was cooled as it comes from the most skilful Abdar.

* Nothing has been written regarding the geology of the Sekim mountains since Captain Herbert first visited Darjeeling about ten years ago. Mr. Smith's remarks are therefore of much interest, and will we hope draw attention to the subject.—ED.

As the Teestah is shallow in the hills, and only prevented from running dry by constant rapids, which operate as natural flood-gates, or locks, may not the excessive coldness of the water, together with the numbers of the rapids, be taken as indications that the snow is not far off?

They say at Darjeeling that it would take two seasons to reach the snows; on what satisfactory ground I do not know: as no person can talk the Lepcha language, any information derived from the usual interpreters must be meagre and unsatisfactory.* I have always been impressed with the idea that the Teestah is eminently worthy the attention of any scientific and intrepid traveller. No lime is found in the detritus of this river; large boulders of what Mr. Scott called quartz are observed in the bed; they were clearly traceable to the mountains bordering on the river, because we found rocks of the same kind possessing different degrees of induration, as they happened to have been more or less exposed to the action of the air and the water.

The stone did not present the usual crystalline appearance of quartz, as shewn in cabinets; but I read in Lyell that it is very difficult for persons not scientific always to recognize quartz.

The other two rivers enter the plains through considerable vallies, without exposing the strata to observation for the same extent as in the Teestah; they flow also through an entirely different class of rocks, namely the Metamorphic, this is the character of the ranges all the way to Darjeeling. The road from Punkabarry to Kurseeong presents many opportunities for studying the structure of the mountain ranges; many of the most curious observations in Lyell, regarding the bending of strata, here receive practical illustration. The stratification in these gneiss rocks is generally in their laminæ, so much so, that the line of stratification, and the lines of cleavage, are in many places not distinguishable by the inexperienced eye, while in other places they are well marked.†

The oxidation of the iron in the mica is very plain, but I observed a circumstance which I do not remember to have observed in Lyell,

* We should think the snow must be at no great distance from the place where the excessive coldness of the water was observed; but although the direct distance may not be great, yet as travellers in such a country must be guided by passes, the distance to be travelled before reaching perpetual snow may be considerable; but the seasons must be very short at Darjeeling, or the inhabitants bad travellers, to require two seasons to reach perpetual snow, when it is always within sight.—Ed. Cal. Jour. Nat. Hist.

† It is doubtful perhaps whether gneiss is really stratified. The appearances referred to by Mr. Smith are apt to deceive, and belong to the slaty, rather than a stratified character—Ed.

namely, that in E. and SE. aspects, where the sun's rays exercise their greatest power, the mountains are undergoing visible and rapid decay, more or less rapid in different places, according to aspect and composition; when the felspar predominates, more slowly; when the mica abounds, more rapidly; the iron of the mica oxidizing seems to cause it to decompose faster than the felspar; in many places the mica crumbled on the pressure of the hand, and had assumed a kind of clayey consistence: whether the solar ray be homogeneous, or composed solely of light, heat being engendered on the earth's surface, or whether it be heterogeneous, composed both of light and heat, it seems to be a powerful agent in the decomposition of mountains: may not this be the reason why Eastern shores are usually less precipitous than Western?

In the deep abysses of the Snowy range there is apparently a Solfatara in a constant state of activity. I once myself witnessed it from the plains at Silleegoong throwing up vapour to a vast height, which feathered off at the top like the water in a fountain. That it could be nothing but a Solfatara seems evident from the perpendicular column which rose and fell by fits, as might be expected from vapoury ebullition; this continued for half an hour at least. That the action of this Solfatara is permanent, under different degrees of intensity, may be inferred from the fact, that a cloud is constantly seen in one direction moving east from the top of the mountain, particularly during the cold weather. It is usual, I believe, at Darjeeling to account for these appearances by saying it is snow drift; but the objections to this are, first, that snow drift would not be constant in direction, and that the perpendicular column, rising and falling by fits, could hardly be snow.*

Secondly, the precipices of the range when this vapour ascends are, when viewed at sunrise perpendicular, and of frightful depth, where no snow could lie, to be the subject of drift. In the range between the snow and Darjeeling there stands the truncated cone of an extinct volcano, hitherto unobserved; a fact of itself affording strong inducement to believe that in the depths below there may be, as I conjecture, a Solfatara, or volcanic vent.

Kissonegunge,
*near Rungpore, Feb. 6th,* 1841.

* This appearance is probably occasioned by the condensation of vapours by the low temperature of the peak. The effect is always produced on that side of the summit which is sheltered from currents that may at the time exist in the atmosphere, modified by the action of the sun's rays on the peak itself. But this explanation will scarcely account for the intermittent character of the vapour, which may however be occasioned by observing it through a great horizontal distance.—Ed. Cal. Jour. Nat. Hist.

*Extract of a letter from Lieutenant* OCHTERLONY, *Madras Engineers, dated 4th January*, 1841.

I have been so exceedingly unwell since my return to Madras, that I have been unable to attend to business of almost any description. I have however not been unmindful of the promise I made about the specimens which you required from South India, and have now ready some of chromate of iron, copper ore, lead ore, and iron ore of Southern India; but I still require from Salem a good sample of the magnetic ore, and of the cast iron produced at Porto Novo.

I am also anxious to send you, if possible, some specimens of an exceedingly interesting sedimentary formation which has recently been brought to light near Pondicherry, the fossils of which testify to its being equivalent to our cretaceous formation in Great Britain. Echini, Belemnites, Turratiles, &c. and more recently Ammonites, have been found in the rock, a limestone which it is likely will be found to extend in a band as far south as Trichinopoly, where some similar specimens of rock were found some time since, and if I can prevail on the discoverer, Mr. Kaye of our C. S. to send up a few cooly loads you shall have some forwarded.

I shall shortly, I hope, if my health is restored, be able to publish a report upon the metalliferous districts of Southern India, which, from the facts and experience gained by actual mining, will, I hope, throw a proper light upon the real nature of the deposits of the useful metals which exist here, and shew that although a very general diffusion of them actually prevails, in no one single instance or locality is any thing like *concentration* found. In my own peculiar districts—Cuddapah, Nellore, Gunton—the ores of copper, lead, and iron are disseminated through vast extent of rock, but no *true veins* exist in any part, and it would appear as if the electro-chemical or active agency, in a proper degree of intensity, had been wanting to produce that concentration into beds or veins without which no mining adventure can be warrantable. Indeed the same defect in Nature's power, as it were, is evident over the whole of Southern India, where the prevailing ore, that of iron, is found to occur not in beds, masses, or veins, but as a portion of the rock, disseminated throughout the mass, and obtained by breaking away the whole, and washing the sand and other particles clear. In like manner gold occurs disseminated through the sienitic rocks of Cumbatore and the south-west, and being a precious metal, may in that form be worth mining for, but no vein has ever been traced in that, or I believe any other part of igneous rock which forms the terra firma of this part of India.

It is a popular theory now among the geologists of the German School particularly, that the existence and propinquity of a certain relative extent of sedimentary rocks to large igneous formations is necessary to the production of that description of electro-magnetic action by which the segregation of mineral particles disseminated through the mass of either—or both—is achieved; and it is a theory which appears well borne out in this part of India, where in the south sedimentary rocks occur only in the smallest comparative compass, and where such a thing as segregation of mineral particles is in all directions wanting.

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*Extract of a letter from* C. E. Cunliffe, Esq. C. S. *regarding the discovery of tertiary remains near Pondicherry, and announcing the dispatch of a series of the fossils for examination; dated Tripachanoor, district of South Arcot, March* 12*th* 1841.

I have been requested by my friend Ochterlony of the Engineers to forward to you some specimens of the fossil shells obtained by Mr. Kaye, of the Civil Service, and myself, in a limestone deposit situated near the village of Sydapetta, about 10 miles west of Pondicherry. I have dispatched a small basket of them to my agents at Madras for transmission to you, which I hope will reach you in safety. I will now detail the manner in which we became possessed of them. In March last year we saw in the house of a friend at Pondicherry a few shells that had been sent in from the neighbourhood by Lieut. Newbold, of the Madras army, and Mr. Kaye and myself then determined to visit the site at an early opportunity. None offered until October, when we went to the spot and picked up a few Ostrea, Baculites Spatangi, Echini, and what were supposed to be portions of Belemnites, and a few bivalve shells. A report of the visit has been written by Mr. Kaye for the Madras Literary Journal, together with drawings of the shells, which are I believe to appear in the next number; a copy of this work I should suppose easily procurable in Calcutta, and as the deposit and its neighbourhood is accurately described therein, I will refer you to it. In December we again visited the spot, and obtained more and finer specimens of the above shells, and one morning as my companion and myself had by accident separated during our search, I returned to the tents by a circuitous route. I had the good fortune however on my way, in a deep gorge, to fall upon some Nautili, specimens of which I have sent you. On returning to the spot in the evening, we picked up great numbers; in short, almost every round stone was either the cast of, or accompanied a portion of one. We then procured one or two specimens of Ammonites, Gryphœa, Voluta, and other shells, drawings of which I believe Mr. Kaye is preparing for publication. I have since procured other Ammonites, and one a remarkably fine one with markings very distinct, but I must await my return to my station at Cuddalore to define its species by a reference to Buckland and Mantell. We have not been able to decide upon the above Nautilus, so that you see we have but little advanced in geology, but if you should be able to do so, I hope you will inform me. Direct to me at Cuddalore; on my return there I will select for you some better specimens. We have not been able as yet to persuade any of those better acquainted with the subject at Madras to pay a visit to the spot, so that in fact it has not received justice. I am so thoroughly unacquainted with the science, as to be able to give you no information regarding strata or any other point which doubtless a geologist would immediately fix upon, but if you will give me a few hints for particular observance at my next visit, I shall be happy to pay attention to them. The Nautili when divided longitudinally shew the chambering very beautifully; I hope I have forwarded you good specimens. I think I have procured a Scaphite, which is imbedded in very hard lime. Very few Ammonites are on the surface, those I have were the greater part obtained by breaking up large blocks of limestone, when the cleavage exposed them. I have sent you spiral and other shells, and shall be glad to find that you have fixed their species, &c. I am possessed also, I believe, of portions of Turrilites, but the Siphuncle is not clearly exposed. The limestone masses held great quantities of Baculites, Turbinolea, Gryphœa Ostrea, bivalve and spiral shells, of which I think that I have sent you portions. A quarry has long been worked in the neighbourhood, the stone taken to Pondicherry, the streets of which town are paved with it, and the natives are partial to its use, as it is not so slippery as granite. By the bye, can you determine what those pear-shaped Zoophytes are which I have sent? We generally found that each shell was to be found in greater abundance at one particular spot than at another, or rather that different sites were marked by a superabundance of one particular fossil. I have written this letter in a hurry, and have therefore, I dare say, omitted many important facts which it is desirable you should be acquainted with to arrive at a correct idea of the deposit, or to enable you to offer any remarks upon it; but, as I said before, if you will make me acquainted with your wishes, I shall be happy, as far as lies in my power, to satisfy them. I may mention before I conclude, that I picked up from this deposit the Nucula pectinata, Trochus linearis, and the unknown cardiform bivalve as delineated in Mantell's Geology of Sussex, tab. xviii. and xix.

*Note by the Editor.*

This is one of those discoveries which, as Sir J. Herschell remarked regarding that of the raised beach at Cherra Ponji, is calculated to produce a powerful effect in exciting further inquiry. It would be desirable to know the elevation of the place where the fossils have been found, the topography and limits of the limestone, and other beds with which it is associated, whether it occurs in continuous or detached masses, the direction of the beds, their thickness, the rocks on which they rest, whether any and what fossils are found in them—the overlying beds, and their fossils if any. We do not think the inquiry could be in better hands, and we shall be happy to afford all the assistance in our power in the way of advice, and in the examination of any of the fossils with which we may be favoured; we are looking with anxiety for the arrival of the specimens, which we hope to receive in time to report upon in our next number.

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*Extract of a letter from Assistant Surgeon* HINTON.

*Kyouk Phyoo, 4th February,* 1840.

I have the pleasure of sending you specimens of coal, which from their apparent extreme purity may be worthy of an analysis.

I send you these as the most crystalline of a number of specimens procured in the immediate vicinity of this station.

About three miles to the South-westward of the Northernmost part of the island of Ramree are two islands, connected to each other and the main land by ridges of sandstone rock, visible at low water, the largest and outermost is called Saddle island, the other is named Cap island; both of them are chiefly composed of sandstone of different degrees of density and colour. Many shells, fossil plants, and branches of trees are seen embedded in it.

On Cap island, which is about a mile in circumference, a bed of coal lying in slate clay, and pointing nearly due west so as to impinge upon the Saddle island, is readily distinguished, and in the opposite direction points with a slight curve towards the main land.

Here at present our information stops; Colonel Hervey, who procured these specimens by slight excavation during low water on the island, informed the head natives in the neighbourhood of the value to themselves and others should they succeed in the discovery of it in the interior part of the island of Ramree.

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*From the same, dated 10th March.*

1. In November 1840, Lieut. Colonel Hervey sent some natives to Cap island, two or three miles to the S. W. of the mouth of the above harbour, to procure him some coal, having from previous inquiry ascertained from them that it was to be found there; they succeeded in procuring a few large lumps, and on subsequently going there himself, brought away about a ton of coal, procured by digging near the water's edge for it.

2. This island is about two miles from, and runs parallel with, the Saddle island, the strata of sandstone extending in a north and by west direction.

3. The rocks called the Terribles, about ten miles more to the westward, appear to run in the same direction, these parallel ridges extending northerly would run into Combermere Bay, southerly would intersect the island of Cheduba.

4. At the westernmost extreme of the island of Ramree a ridge of sandstone stretching at a right angle with these is gradually submerged; its extent could be easily ascertained by soundings on a calm day.

5. From part of the coal on the Cap pointing towards the nearest point of land on the Island of Ramree, Colonel Hervey went to that place on the 10th February 1841, and succeeded immediately in detecting the same slate-coloured soil as that in which he found the coal lying on the Cap island, and after digging to the depth of three feet found good crystalline coal, equal to that I forwarded last month.

6. A hill about a quarter of a mile in extent, and 250 or 300 feet in height, extends in an easterly direction from this point of land, which I have denominated Cap Point.

7. Oblong masses of hard brown-coloured sandstone rock runs along the southern base and side of this hill; the northern face is more exposed from an upheaving or sinking of the soil, and exhibits the roots of some of the forest trees with which the hill is covered; the soil here, as far as is exposed is sandy, and in a slight nullah near by, shingle is seen to the depth of three or four feet.

8. Extending his research a few days after nearer the base of this hill than at first, which was just at the water's edge, the coal was again met with.

9. I have also observed it on the surface in the basin between the ridge of Saddle-shaped hillocks immediately facing the cantonments, called Prospect Hill, and that called Wood's Lookout; the latter is a narrow perpendicular wall rising from sixty to a hundred feet, and about a quarter of a mile in length.

10. These, and the previous discoveries in the neighbourhood are sufficient to indicate that coal prevails to a great extent in the northern part of the island of Ramree, and when it is added that Captain Williams, the Senior Assistant Commissioner of the District has forwarded to the Committee a quantity of coal brought to him by the natives from the southern part of the island, and that the conveyance by water is available from most parts of the island, I trust that Government will soon send a qualified geologist to ascertain how far these coal beds are capable of being worked with profit.

11. Colonel Hervey has brought with him to Calcutta a dozen boxes containing specimens of the coal and surrounding soils, which he will be happy to place at the disposal of the Committee.*

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*Extract of a letter from* Dr. Spry, *dated 25th March* 1841, *regarding the Cap Island Coal.*

The first thing I did after landing at the picturesque station of Kyuk Phyu, was to inquire after the progress made in the Coal discovery. I found that the principal locality was not on the island of Ramree itself, but on a rock off the island, about a mile distant, known by the name of "the Cap island," but that minute traces of it had been found at a point of the main island which is nearest in contiguity to this rock. I took an early opportunity of availing myself of the kind offer of Mr. Brown the Marine Assistant of the Commissioner of the Province, and Col. Hervey, to whose exertions this interesting discovery I believe belongs, to visit the Cap island and examine the formation. I found it partaking, as might be expected when the general character of the line of coast is taken into consideration, of all the features which denote active volcanic agency. The rock itself is in great part made up of sandstone, but so distorted are the strata by the upheaving force that in places they

* Under the impression that the Cap island coal was that long since found by Lieut. Foley, on an island opposite to Kyuk Phyu harbour, and which has been found after repeated trials of inferior quality, we did not analyse it. Dr. Hinton has however since pointed out to us the situation of Lieut. Foley's coal on the East coast, while Colonel Hervey's is on the West coast of Ramree. The specimens presented shall therefore be described, and Colonel Hervey's coal marked as a new locality in the proceedings of the Coal Committee.—Ed.

appear at an acute angle, and even vertical—while they are so oppositely placed as to convey the idea that at this point some confined force had found an outlet and split the incumbent bed. The rock runs up to a peak.

On one face of the peak a thick deposit of marly earth is seen, and on it an abundance of vegetation thrives. At the seaward point of the rock, and barely above high-water mark, the coal is found. The sandstone strata here, though not so highly distorted as in the more central part, is still at an acute angle. It is intersected by a bed of fatty marl, of about a foot in thickness, and amidst its substance, and sometimes in a shaley deposit, the lumps of coal are found. I say lumps, for as yet no continuous seam of coal has been discovered, but all is yet in its infancy, for, besides scratching the surface soil for a few inches, nothing has been done to test the extent of the formation. I confess when I look at the position of the place I see no immediate prospect of a supply of coals, and taking the difficulties of keeping out the water into consideration, (even supposing that a continuous seam was found) with the great dip of the strata, nothing but an outlay for machinery could fairly test it. Specimens of the rock and the coal I herewith forward. They are marked respectively. Leaving the Cap island, the next locality that I visited was the point of land on the island of Ramree most contiguous to the Cap island. From the direction of the out-cropping coal strata at the Cap island it was inferred that similar indications might be found at the point of land now adverted to, and a close search being made by Colonel Hervey a formation identical with that at the Cap island was found with thin traces of coal. The dip here is equally great with that at the Cap island, and would require a shaft to be sunk through the intervening sandstone stratum to enable the searcher to ascertain if a bed of coal of any consistence did exist.

At the point of land here referred to, a range of sandstone hills abut, and it is on the plane piece of land to the north-east of these hills, taking the direction of the dip of the strata into consideration, that I would propose that a trial should be made, if any such be hereafter resolved on.

Every disposition exists on the part of those in authority at Kyuk Phyu to carry out the wishes of the Coal Committee, but they say, and say justly, that they have no funds placed at their disposal for doing so, and out of their own pocket it is too much to expect that they should defray the charges. The consequence is, as I have before remarked, the poor labourers are left to go unpaid, and great dissatisfaction is felt accordingly. Should these few remarks prove of any value to your Committee, I shall be glad.

P.S.—In the course of my experience of coal formations, and I have visited several of the collieries in South Wales, I recollect seeing nothing *at the surface* so promising as the indications presented at the Kyuk Phyu coal localities.

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*List of Plants found in the Eastern portion of Zillah Goruckpoor, compiled from Native information.**—*By* David Liston, Esq.

*Sukhova or Val*—tree; *a* in *s*, fine timber.

*Am (Mango)*—found in all jungles, though not a native; I think it requires care in rearing, though it springs readily from the seed.

*Muhowa*—*a* in *s*, yields a sweet fruit, from which a spirit is distilled; wood useful.

*Koosoom*—*a* in *s*, *r* in *c;* tree grows to a great size; the wood used for pestles, for native sugar mills, axles for carts, &c.

*Kutaee*—tree; *r* in *s*, and in *c*.

*Useedh*—tree; *a* in *s*, in *c*.

*Jamoon*—*a* every where, tree used for jumoots or frames on which the brick work of wells is built, and for agricultural implements, charcoal, &c.; juice mixed with goat's milk held good in dysentery.

*Kekar*—tree; *r* in *s*.

*Jigna*—tree; *r* in *s*, and *c*.

*Hura* } *Buhera* } *r* in *s*, said to possess purgative and at the same time astringent properties.

*Mootmovree*—tree; *a* in *s*.

*Aouna*—tree; *a* in *s*, said to possess astringent properties.

*Agee*—tree; *a* in *s*.

*Buryut*—tree; *r* in *s*, *a* in *c;* bark and hanging roots afford matches for matchlocks.

*Peepur*—tree; *r* in *s*, *a* in *c*.

*Peear*—tree; *a* in *s*.

*Khurhuree*—tree; *a* in *s*.

*Koreea*—tree; *a* in *s*.

*Bhuwar*—tree; *r*, bark used for calking boats, and for matches for matchlocks.

*Fulsa*—tree; *r* in *s*, and in *c;* wood fit for ploughs, and mucilage of bark said to be cooling and diuretic.

* The economical and supposed medicinal properties being added so far as learned, the abundance or rarity of plants and soils where they flourish are marked as follows—*a* abundant; *r* rare; *s* silicious soil; *c* calcareous soil.

*Dewras*—tree; *r.*

*Peerar*—tree; *r* in *s,* and in *c.*

*Turkool*—tree; *r* in *s,* more so in *c;* this is the tar or toddy tree.

*Kheer*—tree; *r* in *s,* fruit edible.

*Furend*—tree; *r* in *s.*

*Khyra*—tree; *r* in *s, a* in *c;* this tree yields khut, or terra japonica.

*Seerees*—tree; *r* in *s, a* in *c;* timber fit for ploughs.

*Burhur*—tree; *r,* occurs also in *c,* has a subacid fruit.

*Bel*—tree; *a* in *s,* and in *c;* wood apple.

*Cheetwun*—tree; *r* in *s, a* in *c;* bark supposed a remedy in fluor albus.

*Seemul*—tree; *r* in *s, a* in *c;* cotton tree.

*Puras*—tree; *a* in *s, r* in *c;* bark used for calking boats; seed a bean which is used medicinally.

*Bhoorkoond*—tree; *a* in *s.*

*Pandur*—tree; *r* in *s.*

*Panun*—tree; *r* in *s.*

*Seeahe*—tree; *a* in *s.*

*Egur*—tree; *r* in *s,* and in *c;* called also *Puneea,* affects small rivers and sluggish streams; bark used for calking boats and for poisoning fish.

*Ræna*—tree; *a* in *s,* and *c;* red dye, called *Seederee,* got from dust of the berries of this.

*Khemuna*—tree; *r* in *s.*

*Seehor*—tree; *a* in *s,* and *c;* back of the leaf used for polishing horns.

*Koochyta*—tree; *a* in *s.*

*Bunlooreea*—tree; *a* in *s,* and in *c;* medicinal.

*Bhela*—tree; *a* in *s,* nut used for marking cloth; used as a remedy for leprosy, given also to elephants; said to be caustic, and the smoke said to cause the body to swell.

*Gumbhar*—tree; *r* in *s,* and in *c;* said to be the satin wood.

*Kurma*—tree; *r* in *s,* occurs also in *c;* wood yellow, combs, drums, &c. made from it.

*Ambhar*—tree; *r* in *s.*

*Kulan*—tree; *r* in *s, a* in *c.*

*Kurownd*—tree; *a* every where; fruit edible, subacid.

*Mukœpa*—tree; *a* in *s.*

*Hynsa*—tree; *r* in *s, a* in *c;* medicinal; is a shrub rather than a tree; and very thorny.

*Goolur*—tree; *r* in *s,* is met in all soils; fruit an edible fig.

*Beleakund*—*r* in *s,* met with in *c;* medicinal; a bulbous rooted plant.

*Suntawur*—tree; *r* in *s, a* in *c.*

*Seeahmooree*—herb; used in fevers as a medicine; *r* in *s*.

*Sufea moosuree*—herb; *r* in *s*.

*Asgundh*—herb; *r* in *s*, *a* in *c*; medicinal.

*Doormee*—tree; *r* in *s*.

*Cheet*—tree; *r* in *s*, *a* in *c*; medicinal.

*Nagurmitha*—herb; *r* in *s*, given in fevers.

*Purora jungulee*—shrub; *a* in *s*.

*Chutel or Kheksha*—shrub; *r* in *s*, root used for poultices.

*Cimeeruttee*—shrub; *r* in *s*, and in *c*; is a creeper; fruit used in curry.

*Dhoodheabowur*—shrub; *a* everywhere.

*Dhuaee*—shrub; *a* in *s*, *r* in *c*.

*Kurerrooa*, or *Bugunuha*—shrub; root held to be a cure for horses gone in the loins; *r* in *s*.

*Dhame*—tree; *a* in *s*.

*Mahinee*—shrub; *r* in *s*, occurs in *c*; root medicinal.

*Seearova*—herb; *r* in *s*, occurs in *c*; root medicinal.

*Belroowa*—herb; *r* in *s*, occurs in *c*; root medicinal.

*Maltagona*—shrub; *r* in *s*, and *r* in *c*; medicinal.

*Kineearee*—tree; *r* in *s*, also in *c*; medicinal.

*Dhourbhurowa*—tree; *r* in *s*, also in *c*; medicinal.

*Kourajaoor*—shrub; *r* in *s*.

*Bunaroowa*—herb; *r* in *s*, also in *c*; prescribed in fevers and affections of spleen.

*Phuroosa chota*—tree; *a* in *s*, also in *c*; fruit and bark reckoned cooling.

*Sunkusar*—shrub; *a* in *s*, also in *c*: seed prescribed in fevers.

*Gundpusar*—shrub; *r* in *s*, also in *c*.

*Aroos*—tree; *a* in *s*, also in *c*; a preparation from prescribed in hooping cough.

*Cheecheeree*—tree; *a* in *s*, also in *c*.

*Bureear*—tree; *a* in *s*, also in *c*; seed prescribed in gonorrhœa; root in hydrophobia.

*Guduhpooruna*—shrub; *a* in *s*, also in *c*; a cure for swellings of spleen and of joints; thus says an informant—strip the bark from the roots; put it on the end of a metal pipe, which heat in the fire, then blow through folds of cloth upon the diseased part, a blister is caused, and a cure effected.

*Pakur*—tree; *r* in *s*, also in *c*; new shoots eaten in curry.

*Bhunmooree*—herb; *r* in *s*.

*Emeelee*—tree; *r* in *s*, also in *c*; the tamarind.

*Toon*—tree; *r* in *s*, also in *c*; flower affords a yellow dye; wood rather valuable.

*Bans (Bamboo)*—tree; *r* in *s,* abounds in *c.*

*Ukool*—tree; *a* in *s,* also in *c.*

*Kupooree*—tree; *r* in *s,* also in *c.*

*Tyree*—tree; *a* in *s,* also in *c.*

*Pukeea*—tree; *a* in *s.*

*Bhantee (or) Lumkuna*—shrub; *a* everywhere; charcoal for gunpowder made from this (smell not unlike that of black currant.)

*Dantee*—shrub; *a* in *s.*

*Surpooka*—tree; *r* in *s,* also in *c;* a preparation from given in ghonorrhœa.

*Bent (rattan)*—shrub; *r* in *s, a* in *c.*

*Nurkut*—herb; *r* in *s, a* in *c;* mats, &c. made of this.

*Gond*—herb; *r* in *s.*

*Buboor*—tree; *r* in *s,* also *r* in *c;* gum valuable, bark used in tan-wood for ploughs.

*Buborree*—tree; *r* in *s, a* in *c.*

*Seemeena*—tree; *r* in *s.*

*Muhoolan*—shrub; *r* in *s,* also in c.

*Lusora*—tree; *r* in *s,* also in *c;* fruit edible, bark used for calking boats.

*Dhameena*—shrub; *r* in *s,* there is also a tree of this name in *c;* the wood of which makes good buggy shafts, and is used by Dangers for banghys.

*Koombhee*—tree; *a* in *s,* a weed of this name is also met with in tanks, the ashes of which when burnt are given internally to reduce swellings.

*Cheetuha*—tree; *a* in *s,* also in *c.*

*Bokwa*—tree; *r* in *s,* also in *c.*

*Duheegun*—tree; *r* in *s,* also in *c.*

*Sendoowar*—tree; *r* in *s,* leaves used for fomentations; also in *c,* but *r.*

*Kuloojeek hajhee*—shrub; *a* in *s.*

*Muwunphur*—tree; *a* in *s, r* in *c*; medicinal.

*Neem*—tree; *r* in *s,* also in *c;* leaves used in fomentations; flowers powdered a tonic.

*Jumalgota*—*r* in *s,* a purgative.

*Dhutoor*—shrub; *r* in *s, a* in *c;* medicinal.

*Mudar*—shrub; *r* every where; leaf of white variety useful in ague; dose from 2½ to 3 leaves mashed.

*Red*—tree; *a* in *s.*

*Pooranpatee*—shrub; *r* in *s.*

*Putjeeoo*—tree; *r* in *s, a* in *c;* seed made into necklaces.

*Genthee*—shrub; *a* everywhere; root eaten by the poor.

*Kooat*—shrub; *a* everywhere; dog rose.

*Detoo huree*, or *Kurung*—tree; *r* in *s*, also *r* in *c;* seed yields oil useful for burning in lamps.

*Kurringa*—tree; *r* in *s.*

*Seesoo*—tree; *a* in *c;* takes the place in calcarious soils of the Sukova in siliceous soils.

*Koos*—herb; *a* in *c;* root affords kuskus.

*Jurakoos*—herb; *a* in *c;* infusion useful in fever.

*Buheelor*—tree; *a* in *c.*

*Mothee*—herb; *a* in *c.*

*Khookhoondee*—tree; *a* in *c.*

*Byt*—shrub; *a* in *c.*

*Chuledeea*—herb; *a* in *c.*

*Peepuree*—shrub; *a* in *c;* medicinal; root known in Bazars as *pepul moor* (a pepper).

*Kedut*—tree; *r* in *c.*

*Bhudaree*—tree; *r* in *c.*

*Akasbowr*—Parasite, *a* everywhere.

*Bunpeatee*—*r* in *c.*

*Dhar*—tree; *a* in *c;* flower affords a dye.

*Toot (Mulberry)*—tree; *r* in *c.*

*Sureefee jungulee*—tree; *r* in *c.*

*Hondee jungulee*—herb; *r* in *c*; medicinal.

*Bada jungulee*—herb; *a* in *c;* medicinal.

*Man jungulee*—herb; *a* in *c;* medicinal.

*Kota*—tree; *a* in *c.*

*Bukæn*—tree; *r* in *c;* medicinal.

*Keooan*—herb; *r* in *c.*

*Mahur*—shrub; *a* in *c.*

*Adhukparee*—shrub; *r* in *c.*

*Jhuteewun*—tree; *a* in *c;* medicinal.

*Goheeabowur*—shrub; *a* in *c.*

*Gooreech*—shrub; *a* in *c;* medicinal.

*Guneear*—tree; *a* in *c.*

*Bunbusooree*—tree; *r* in *c.*

*Jhurbyreea*—tree; *a* in *c;* wild plumb.

*Rutaroo*—shrub; *a* in *c.*

*Padur*—tree; *r* in *c.*

*Asok*—tree; *a* in *c.*

*Burahoora*—herb; *a* in *c.*

*Neemta*—shrub; *a* in *c*.
*Pujgooreea*—shrub; *a* in *c;* med.
*Talporraee*—herb; *a* in *c;* med.
*Peelrakund*—herb; *a* in *c;* med.
*Paljhur*—herb; *r* in *c;* med.
*Doomur*—tree; *a* in *c*.
*Khoorhorr*—herb; *a* in *c;* med.
*Senpat*—tree; *r* in *c*; been prescribed in dropsy.
*Dhunpas*—tree; *r* in *c*.
*Bhang*—herb; in *c* a troublesome seed, more rare in *s*.
*Budu*—parasite found on the mango; used for tanning hides; occurs in all soils.

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My attention having been turned to the distribution of soils in the eastern portion of Goruckpoor district, it struck me that the vegetation, though in many respects the same, did not completely correspond throughout; as circumstances enabled me to obtain from intelligent natives lists of plants occurring in the forests of the two prevailing descriptions of land, I availed myself of this advantage to have such compiled. The foregoing catalogue formed of the materials now mentioned, proves the stores of the different portions of the country to vary in many points. It would have been satisfactory to have had the position which the different plants hold in the Linnæan system pointed out, but this my want of knowledge of the subject does not enable me to attempt. Mr. Piddington's Index of Indian plants will help the student to effect this; and in many instances, but not in all, for some of the names being local, and the pronunciation of others being provincial, will render it difficult, or impossible, in a variety of cases to discover in that gentleman's lists, the names even of common plants here enumerated.

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*Note by* Mr. Liston, *regarding Salts in the soil of the Eastern portion of Zillah Goruckpoor.*

In the India Review for November, I observe Captain Campbell, Assistant Surveyor, Madras, desires to be made acquainted with the salts in the soils of this portion of Goruckpoor district. I regret the means at my command do not enable me to answer this demand satisfactorily; but the following memorandums of the effect of such re-agents, &c. as I have access to at present on the watery solutions from the soils and waters of wells, may go some way towards the object Captain Campbell aims at.

| | Water from Perowna soil (calcareous). | Water from a well in calcareous soil noted for causing goitre, &c. | Water from Sullempoor, soil (silicious). | Water from a well at Sullempoor. |
|---|---|---|---|---|
| With Mur. Barites. | Clouded. | Milky white. | Cloud. | Cloud. |
| With Nit. Bar. | Slightly ditto. | Ditto ditto. | Little or no effect. | Ditto slight. |
| Infus. Turmeric. | Discoloured. | Discoloured. | Discoloured. | Discoloured. |
| Prus. Potash. | No effect. | No effect. | No effect. | No effect. |
| Boiled. | Deposit. | Deposit. | Deposit. | Deposit. |

[In each case the water acidulated, and gave a deposit with muriate of barytes, insoluble in muriate acid. From their general prevalence, I should conjecture the principal salts to be carbonate, sulphate, and muriate of soda. I acidulated Nos. 1 and 2 with sulphuric, and boiled half an hour with a piece of gold leaf in each, but no appreciable effect was produced, and thus I believe I am entitled to conclude there were no nitrates present.]

Perhaps the bad effects resulting from the use of the water No. II is caused by the excess of salts in it. The specific gravity is not however great; I make it 1·0001011, but this is only to be reckoned an approximation, my balance not being very delicate, and must vary according to the period at which the water is drawn from the well. The Sullempoor water appears to contain the same ingredients, though in less quantity, which is shewn as well by its being less affected by the re-agents as by its being lighter, but neither is it quite innoxious, there are cases of swelled neck in the village, though not many.

It might be worth while to have the water No. II minutely examined, in which case the evil ingredient might be detected. I may mention that *sujy* (carb. soda) is reckoned an antidote to its injurious effects. I have heard of one case where a goitre was removed by the continued use of this salt in the water when drank, and of another in which a person affected in like manner had the swelling partially discussed by residing a month or two in a quarter where *sujy* abounds in the soil.

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*Notice of three Trap Dykes in the Burdwan district, and of the effect produced by them on the coal which they pierce. Extracted from a letter of* MR. MORNAY, *dated March 7th,* 1841.*

In all the accompanying diagrams, the same signs represent the same things, viz.

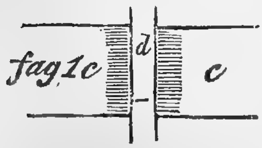
| | |
|---|---|
| d | the Dyke. |
| c | the Coal. |

The striated part of the diagram represents that part of the coal which is of a different character from the rest of the bed.

The corresponding specimens from the different localities are marked with the same letters, and have numbers besides to distinguish them: thus c. 1; d. 1; are from the dyke represented in fig. 1, &c.

* The specimens which accompanied this communication are deposited in the Coal Committee's collection—ED.

The dyke represented by fig. 1 was met with in the mine of Sallunchee, at a distance of about 70 yards from the entrance; No. 1, in an Easterly direction. It runs SE., and NW. and dips about 84° to the NE, while the coal dips about 10° to the SSE.




The diagram No. 2 represents a dyke which I discovered in the bed of a torrent which runs close by the same mine of Sallunchee, a few yards above the new bridge. This one, I think the most interesting of the three, on account of its peculiarities. It is divided into several branches, and some of these are again united by cross veins, as in the diagram. Another of its interesting points is its containing small pieces of coal, entirely enveloped in its mass, and converted into a substance in every respect the same as anthracite, and columnar.

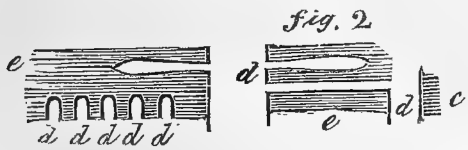
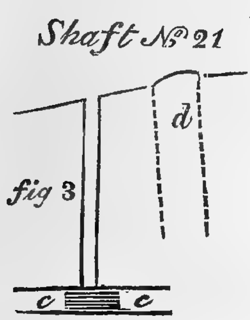



Fig. 3 represents the cropping out of the third dyke. It is at Ranigunge mine, and lies between the Shaft No. 21 and the new Engine Shaft. It has not been reached by the underground workings, but can be traced on the surface in an ESE. direction. It most likely dips to the SSW. for a contrary dip would throw it so far from the foot of the Shaft No. 21, that it would be too far off to affect the coal there in the manner it has.




The rock of which they are composed is, I think, the same in all, but its characters are too confused for me to give it a specific name, so that I have contented myself with the generic name Trap.—It partakes of the nature of porphyry in some parts, in others it has more resemblance to greenstone, while specimens from No. 1 appear to be amygdaloid. However these rocks are so nearly allied that it is of little importance to separate them.

The Dyke No. 3, I suppose to be of the same rock as the other two, because that part of it which is near the surface, and partially decomposed, bears a sufficient resemblance to the others in the same position to warrant the inference.

It has however its peculiarities. It contains in some parts a great number of small nodules of crystalline carbonate of lime, some of which are covered on their surface with very small crystals of iron pyrites.

The effect produced upon the coal by the dykes is, in all the three cases precisely the same: in their neighbourhood it is of a lighter colour, duller, though in some parts it has a semi-metallic lustre, tougher, porous, and its seams are bent, in every respect resembling coke, except in its specific gravity and hardness, which are both greater. But as these two circumstances may fairly be attributed to the weight of the superincumbent strata, they do not oppose the hypothesis of the heated state of the rock, supported by the other appearances. The specimens marked A, corroborate the hypothesis of the fluid state of the dykes at the time they pierced the coal, as they were taken in situ, above the uppermost bed, and contain angular fragments of coal in a charred state. Indeed in the one marked A. 2, the coal, or rather anthracite, is columnar, a form produced by heat upon coal, as well as some other substances, as is to be seen at all the Railroad coking furnaces, where the whole mass of coke divides into columns, standing normally to the surface of the furnace.

The quantity of effect, or the distance to which the effect extends, is not equal in the three cases, but, as was to be expected, proportionate to the thickness of the dyke. In the case of No. 1, the coal is not altered more than 11 or 12 inches from the surface of contact, while in the other two, it is to a much greater distance.

Generally the coal adheres so firmly to the dyke, as to break with it, like one stone.

Besides the specimens properly belonging to the above description, I send you a piece of coal which I took from the bed alluded to in the descriptions of Figs. 1 and 2, within a few feet of the dyke No. 1, to serve for comparison with the charred part, to shew the degree of alteration which the latter has suffered.

7, BANSHTOLLAH GULLY,
*March* 14*th*, 1841.

# Miscellaneous.

*Statistical Notes on Chusan. By Lieut.* Ouchterlony, *Madras Engineers.*

*Geographical position.*—A flag staff erected in the Engineer Camp, near the extremity of a range of hills running into the bay of Ting-hae and forming its Western arm, was determined by Lieut. Collinson, R. N., after a series of observations extending over two months, to be in latitude 30° 0′ 10″ North, and longitude 122° 14′ East. The point on which the Observatory was erected has been called Harbour-Point, and bears about N. by W. from the deck of a ship after rounding Kee-to point and entering the passage.

*Extent.*—Not in any way determined, but judging from excursions made in certain periods of time, and from observations from points commanding the various extremities of the Islands, I should estimate it as not exceeding 500 square miles.

*Population.*—Is much over-estimated in Mr. Gutzlaff's works. Estimating the *Villages*—

At 10 of the first class, containing 1 to 200 houses,

100 second „ „ 50 to 80 „

and allowing 10 inhabitants to each house, and 20,000 persons as dwelling in the town of Ting-hae and its sea-port suburb, the total amount cannot be made to exceed 100,000 souls, giving a population of 200 to a square mile, which far exceeds that usually assigned to the Empire of China, which is 200 millions to 1,300,000 square miles.

*Cities.*—Ting-hae is the principal and indeed the only city or walled town on the Island, though the suburb or sea-port town adjoining it may be ranked under this head.

The ramparts of Ting-hae are in most parts exceedingly well built, having a good escarp revetment and strong retaining walls of stone surmounted by a parapet of brick, and defended by small flanking square bastions at intervals, and by a broad canal which is carried round three of its faces: the fourth, from being carried over the slope of a hill exposes the town to be surprized, and as the height of the ramparts is inconsiderable, it is open on all points to escalade. The gateways, four in number, are strong, and the gates, which are double, well placed in flanked returns or zig zags. By converting a portion of the town into a small fort by separating the angle furthest removed from the command of the adjacent hills, by means of ramparts thrown up to form a gorge, and surrounded by a ditch, or by constructing a block house on a hill which is included within the walls, and which overlooks the city, Ting-hae could be successfully defended by a small garrison against any surprize by Chinese troops.

Ting-hae is considered as belonging only to the third class of Chinese cities, and the style of its streets and habitations does not induce the belief that its inhabitants are wealthy, or that they comprise amongst their numbers many of the better class. It contains four principal temples, or Joss houses, some of which exhibit considerable magnificence in decoration, and skill in the sculptured figures which are preserved in them, also several smaller ones and places for theatrical exhibitions, three arsenals, one store for gunpowder, and one or two rather extensive buildings for the public service and principal Mandarin's dwellings.

*Bays, Gulphs, &c.*—Ting-hae (or Chusan bay) on the South coast, and Sin-kong on the Western. Of the former a detailed description is unnecessary, as the advantages it possesses from its perfectly landlocked situation and excellent anchorage are now generally well known, The bay of Sin-kong is formed by an arm of the sea or strait as it were, about 6 to 800 yards in breadth, and six to seven miles in length, having an excellent entrance channel both from the North and South, and good anchorage for the largest class of vessels throughout its whole extent, being perfectly sheltered in most parts by high land. There are several springs of good water in the neighbourhood of the town (or village) of Sin-kong, and every facility is afforded for building docks and slips, and for its establishment as a favorable depôt for trade. The neighbouring portion of the Island is hilly and rather barren, but the advantages from its immediate vicinity to the Chinese coast, and the little danger attending a ship's passage into it which it possesses over the bay of Ting-hae, may be considered as sufficient to point it out as a more favorable site for a port. On the main coast, immediately opposite, and distant only 10 to 15 miles, are Chin-hae on the Ningpo-river, into which a large portion of the southern trade appears to pour, Cha-poo, frequented by the richly-laden Japan and Corea junks, and Hang Chou foo, the second city in point of commercial importance in the empire: nine miles to the northward is the mouth of the important river the Yang-tze Keang. Ships approaching from the southward after rounding Kee-to point by a safe passage have only to steer westward round Poplar Island, and, with the tide enter Sin-kong harbour with the greatest security.

*Rivers*—There are none, but streamlets descending to all points of the Island, and plentifully watering its numerous and beautiful vallies, abound; their waters being led on the lower levels into shallow canals, branches from which extend in all directions throughout the cultivated lands, returning generally into a common channel near the coast by which the surplus water is discharged through a sluice in the bund which confines the valley, and prevents its soil from being washed by the rains, which are in this latitude doubtless heavy, into the sea. In the beds of these canals, from the rapid decomposition of the trap rocks of the upper ranges, vast accumulations of mud are taking place, and their capacity for retaining water of irrigation in the present state of their banks is circumscribed: much vegetable matter also finds its way into them from the free drainage of the paddy fields, and from this and other causes the water is rendered unwholesome for drinking, unless after passing through the filter. Excellent supplies however of this important necessary will always be readily obtainable by leading watering streams from the higher levels, where it is of course pure and sweet: many springs also can be readily cut by wells at no great depth.

*Agriculture.*—The products of the Island appear to be chiefly, Rice, Millet, Barley, Indian corn, Sugar Cane, Sweet Potatoe, Brinjall, Spinach, Lettuce, Tobacco, Ginger, Rhubarb, and a few other varieties of vegetables; while of fruit trees, the Pear, though of poor quality, Peach, Plumb, Orange, Lime, Palm, Loquots, and a species of Cherry were seen. The capabilities of the Island however for the growth of almost every description of vegetable and fruit in common use both within and without the tropics would seem indisputable, although the seasons at which they would be brought to maturity might be peculiar: that the great standards of European life, Wheat and Potatoes, would thrive admirably no doubt can be entertained, and with the most ordinary gardening skill Cabbages, Cauliflower, Peas, Beans, Vegetable marrow, &c. &c. would soon be produced in abundance. With regard to the implements of husbandry made use of by the Chusan agriculturists, little that is new can be said, they being precisely similar to those seen in the Canton province, which have been more than once fully described. Their plough appears an exceedingly good one, the share, which is of well wrought iron, being deep and of the proper curve and blade, and unlike the system pursued in India, by which only the upper surface of the soil is turned over, and by constant use exhausted of its fertilizing properties—the ground is penetrated by its furrows to a considerable depth, and a fresh stratum as it were continually brought to the seeding. Their winnow, working with a crank and fans closely resembles that used by the Dutch, their hoes, forks, &c. are their own plan, and of spades or mamoties none were seen. I should observe that *cattle* are very scarce; the few bullocks found being evidently barely sufficient for the uses of husbandry, viz. tilling the ground, and working the mills by which water is raised. These machines, which are invariably on the chain-pump principle, are worked in an inclined position, some by cattle, but the greater number used for raising water from the canals to the trifling height required for the irrigation of the fields, by hand, the labourer standing in an erect posture holding in either hand a handle attached by a flat rod to a little wooden crank fitted on the axle of the upper roller of the pump, and by this means turning the chain with far greater ease and celerity than when stooping to the work. The pump barrel is square, and the chain merely twisted rope with square boards knotted on at intervals of nine inches: there is of course much friction and escape of water, but when worked with proper speed these irrigation machines appear to be exceedingly effective and economical. To raise water from wells in the vallies where dry cultivation prevails, the pump is worked by a bullock, turning a large wooden horizontal wheel with a pinion, on whose axle the upper drum is driven. Of sheep there are none, but goats are plentiful: pigs abound as also poultry of all descriptions. As it appears however that the lower slopes and ridges of the hills produce a pasturage rich enough for sheep, while in some of the higher vallies and meadows grass might be grown to any extent, there can be little doubt that both these and bullocks of the best breed could be reared in sufficient numbers to supply all the wants of a garrison, and such amount of shipping as would be likely to frequent the port.* Peas and Beans, Mangel Wurzel, Clover, &c. could also be grown, and horses be well cared for in all respects.†

The rice-crop which was standing when the Island was occupied by H. M. Forces was cut in the month of August, and it was understood that only one crop was produced during the year: owing however to the difficulty of acquiring information, I was unable to produce evidence regarding this, but should imagine from the abundance of water that two could easily be grown.

*Roads.*—There are absolutely none deserving of the name, the lines of communication between the villages being kept up by means of simple footpaths along the banks of the paddy fields, which is accounted for by the total absence of wheel carriages of any description whatever

* The few ponies found in Ting-hae were evidently importations: no mares or foals were seen.

† Provided roads were made.

—military or civil: to widen them however in an efficient and permanent manner would be a work of but little expence, as the lines are very direct, excellent road materials procurable in all directions, the drainage perfect, and the bridges for the most part of breadth sufficient to allow of the passage of a field piece, or so built as to be with facility widened.

*Commerce.*—Manufactures—the principal appears to be the spirit called Sam-shew, which is distilled from rice, flavored with a certain addition of an infusion of Juniper bark: it contains much alcohol, and some found in store was observed to be highly rectified, evidently improving in strength by age. It is packed in one and two gallon jars closed with bladder for exportation, and from the quantity found in various parts of the sea-port town, must employ a great proportion of the working class during the winter in its preparation. Salt is made along the coast wherever the elevation of the beach admits of it, but it did not appear to me to be produced in considerable quantities. Some coarse cordage is made in small quantities out of a poor description of hemp (probably imported,) chiefly for fishing nets and hauling lines, but none for the service of the trading junks, or those of the emperor, for the refitting or repair of which no slip or dock channel, nor any naval arsenal was observed.

Several average samples of the gunpowder found in the arsenals of Chusan, produced on analysis a mean of the following results—

| | | |
|---|---|---|
| Nitrate of Potash | 77 | 100 |
| Sulphur | 13 | |
| Charcoal | 9 | |
| Water | 1 | |

Some appeared to be granulated and even glazed with considerable care, but much unevenness and inequality are discernible in the greater portion, and the result of experiments on its strength by the Madras Artillery was generally unfavorable.

Some saltpetre was also found, together with a small quantity of sulphur part of which was evidently native, and not sublimed from sulphureous ores: the saltpetre was well refined—up to 4 to 9 refraction, and was principally in the state of coarse prunelle not entirely freed from water of crystallization.

The art of casting in iron seems to be familiarly known to the Chinese, and although the guns and shot found in store in the island may be pronounced rude and clumsy in the extreme, the strength, finish, and even elegance of some of the tripods, incense-burners, &c. seen in certain Joss houses afford evidence of the skill which they have the power of exerting, when the views of their Government may permit of its display in the manufacture of the more ponderous engines of war. Some sword blades in the arsenals also appeared to be of sound material and well cutlered and tempered: the major part however where of common wrought iron.

That the art of sculpture has obtained a very high place amongst those studied and practised by the Chinese of these parts, is proved conclusively by the appearance of an exceedingly striking and interesting group of figures carved in wood found in one of their principal temples, the attitudes of which, and the variety and beauty of expression of the countenance stamp them as a production of no ordinary merit. There are also several exceedingly well executed figures and ornamental pieces in stone, which sufficiently testify the skill and taste possessed by the artists, and encouraged by the people.

The Sea-port town, or suburb, is extensive, and contains many good one-story warehouses and Sam-shew distilleries. A wharf wall runs along the margin of the bay contiguous to it, with hards or sloping piers running at various points into the water for landing cargo, &c. from boats: a pier however could readily be carried out into deep water which is found at not more than 100 to 150 yards from the shore. The tide runs through the bay with great velocity, but its " rise and fall" is not so considerable as has been stated by some, being at springs 12 ft. 8 inches, and at ordinary tides about 7 feet.

A very interesting discovery was made in some warehouses in the Sea-port town of rock salt, gypsum, and flints, all of course evidently imports, and indicating (probably with the exception of the latter, which may be of English origin, and brought up from Canton) that rocks of a secondary or tertiary formation are not far distant. Here again the want of interpreters or of the means of rendering available for the purposes of science such advantages as in that respect existed, become a serious obstacle in the path of inquirers, and in this instance prevented them from acquiring any information as to the locality—even of the port—whence these minerals were brought.

The exports appear to be confined to Sam-shew, and possibly a small quantity of salt, although it is doubtful whether more of this condiment is raised than is needed for the supply of the population of the island.

The imports, considering as such the articles found warehoused in the Sea-port town, are wheat, (of small grain, but good quality) barley, alum, rock-salt, gypsum, bones, timber (principally fir and camphor wood) pottery, bricks, and cloth. Of all these the quantity found was but inconsiderable, and neither their amount, variety, or the capacity of the warehouses induced the belief that the Sea-board trade of Chusan was of any importance.

*Ice*—should not be omitted in the enumeration of the articles which bore the appearance of imports: seven or eight rather extensive ice-houses were discovered on the island near the town of Ting-hae, though one only was found to contain any of this valuable lnxury: in this the ice was preserved in the most simple manner between layers of twisted straw on a well drained stone floor, around which were mud walls of great thickness surmounted by a roof of high pitch thickly thatched. The use which the Chusan islanders and even the inhabitants of the main make of ice appears to be confined almost exclusively to the preservation of fish caught during the hottest months of the year.

Three rather extensive timber yards, well stored with spars and planks, were found in the Sea-port town, but as there appeared no indications of any Junk building, or of any projected increase to the town, it seems probable that the Port is used as a depôt for the supply of the article to southern ports.

*Climate.*—Upon this point it is most difficult, under existing circumstances and impressions, to hazard an opinion, and as the Medical Officers now employed with the Force will doubtless ere this have reduced to the form of a report the numerous data which must have been furnished to them in the course of their practice in the unfortunately crowded hospitals, established in the island during the past year, it may be rendered as unnecessary as it may be proved to be incorrect. So general an impression appears however to have gone abroad regarding the insalubrity of this most lovely island, and one which, though founded on the deadly facts furnished by the sad reports of sickness and death from the spot, I believe to be most ill-founded, that I cannot refrain from briefly stating here, that it is by no means shared by any, or very few of those whose lot has taken them to Chusan in 1840; and who I think will be found generally of opinion that with proper treatment, both in diet, labour, and lodging, no more healthy or even agreeable spot for European troops could be found (on the common continent level) in the British possessions in the East. On the arrival of the force there in the month of July, one of the hottest months in that latitude, 86° was the maximum which the mercury in the thermometer ranged to, in a tent at noon: in August the range was greater, reaching 89° on some occasions, while on others it stood as low as 76°, the mornings and evenings being agreeable, with a temperature of 72°

and 74° ;* in September, in the early part of the month, it was variable, the average being about 82°, while towards the end it became considerably lower and more settled, 74° being the average of the last few days and early part of October, when the cold season was evidently regularly setting in to last, (say those who have voyaged in the higher latitudes on the coast,) till near the close of the N. E. Monsoon, that is, till about the end of March, when the warm weather again takes precedence, increasing the temperature until June, July, and August, which are the hottest months of the year. The best support to this opinion is furnished by the return of the Officers as contrasted with that of the men, during the first four months of our occupation.

Had these evils pressed less heavily upon the troops, had measures been resorted to to keep both mind and body in a state of activity without overpowering the latter with a labour to which it had long been unaccustomed, and had the means which the island afforded of furnishing a certain description and quantity, though limited, of fresh provisions, been fully availed of, there appears little room to doubt that the men would have exhibited no more deterioration in efficiency than the first exposure to a new climate must entail, and have been found at the termination of the winter season ready, and fully equal to any exposure and privation which the service might have called upon them to endure.

*Geology.*—The prevailing rock of the island belongs to the ancient volcanic class, and comprises many varieties, but principally clay stone, clay stone porphyry, felspar, compact and porphyritic and trachyte.

In portions of the cliffs on the S. and N. coasts the rocks are observed to assume a columnar structure, and dykes and masses of greenstone burst through the beds of claystone on various points, indurating and altering them to a considerable extent. On the W. coast the claystone porphyry assumes a slaty or laminated structure, and appears to be quarried extensively both for use on the island and for exportation to the main land, affording excellent slabs for paying and for floors, and good blocks for common building purposes. A coarse conglomerate is also to be seen intervening between beds of the claystone, embedding angular fragments of many descriptions of igneous rocks, and passing into a compact and workable porphyry, which is also quarried and made use of for pillars, blocks for corn mills, basement slabs, &c. &c. The very best materials for road-making and repairing are readily

* During this month the vicissitudes in the temperature were occasionally considerable, as for example on the 18th the Mercury stood at 96°· at noon, while on the 19th in the same locality and under similar circumstances it registered 75°.

procurable in most parts of the island, and for buildings of any descriptions in the Sea-port town of Ting-hae, such as barracks, warehouses, docks, &c. stone could be quarried to almost any extent from the neighbourhood of Sin-kong, on the Western coast, and delivered in Chusan bay by water conveyance at an economical rate. No limestone is of course procurable on the island, and the small quantity of this material which is used by the Natives is obtained from shells of the ostrea tribe, which it is probable abound among the islands of the archipælago. Sand also is not procurable on any of the coasts, but a supply may be obtained from several of the islands which are exposed to the direct wash of the sea; it is however scarce, and generally speaking not well adapted for making mortar. The clay formed by the decomposition of the trap ranges, and washed down by the numerous streams, will make excellent bricks, but it appears that those used in the island are imported from the main land, no trace of a brick maker's shed or a kiln having been observed, which probably arises from the scarcity, indeed the utter want, of fuel in Chusan. The bricks used in the parapets of the town walls and in the buildings of the towns and villages, are remarkably good, made of a most tenacious and well ground clay, and cast in moulds of 12 inches by 5, by 3: they are generally said to be half burnt, but from the absence of any appearance of oxidization of the iron which would be caused by exposure to flame, I should be disposed to say that they are sun-dried.

*General Remarks.*—Regarding the island of Chusan as a spot destined henceforward to be ranked amongst the Eastern possessions of the British Empire, and to become the home and abode of a portion of our fellow subjects, it cannot but be admitted that it presents features of attraction sufficient to render it in many essential respects as important a fief as has of late years been added to the Crown. The nature of its coasts, and the peculiarity of its internal physical features, render it a place easily defensible by a comparatively small garrison of disciplined troops against such forces as the Chinese could send to invade it: on the W. Coast, at the debouchre of several vallies, troops might be landed with ease, but martello towers, or small forts mounting a long gun and one or two small mortars, which could be erected at a trifling cost, would serve to keep them effectually in check, while the alarm spread to the neighbouring town of Sin-kong, where a fort with a proper garrison would, in the event of our permanently occupying the island, be of course established (under existing circumstances indeed a strong post should have been established long since at this point), and a body of troops in the course of a few hours could be concentrated to repel them. On the

Northern Coast, again, great difficulties are presented to a landing, as the whole line is more or less composed of rugged lofty cliffs, having but few accessible points: alarm posts here would alone be required, and the presence of a few gun-boats in the harbour of Sin-kong would be always sufficient to ensure the destruction of a Chinese flotilla, if a cruizer were kept on the main coast to report its approach. By means of a fort on a commanding hill, forming one of the arms of the bay of Ting-hae, the anchorage is rendered perfectly secure, a command obtained over the town at a distance of only 900 yards, and the approaches by the island swept in all directions, while a gun-boat or two would effectually prevent the entrance of Junks into the harbour by the W. passage, which is not readily under the guns of the fort. In like manner the E. and S. Coasts may be placed in a state of defence or alarm without difficulty or expence of any magnitude; and a garrison of 3000 men, with a proper proportion of artillery, would amply suffice to keep possession of the island against all the efforts that could be made against it by the Chinese. As a residence for Europeans it is undeniably most desirable; with almost every article of luxury or necessity for the table readily procurable, with a climate allowing many absolutely cold months during the year, and the greater part of the remainder temperate and not oppressive, with the most lovely landscape meeting the eye wherever it rests, with the advantages of healthful exercise, including the great essential of sea-bathing, and many others that need not be enumerated, it affords every promise of becoming, in the course of time, and that a very short one, one of the most popular, interesting, and salubrious stations offered to H. M. Troops in the Eastern Colonies; while as a place of trade —should it be ever practicable so far to overcome the prejudices and fears of the Chinese, as to allow of our retention of it with a fair prospect of the ports on the main being opened to us—its value is undoubtedly great.

A new system introduced into the towns and neighbourhood of our posts, whereby the filthy and pestilence engendering accumulations now existing would be got rid of, and cleanliness and drainage attended to, airy barracks, attention to the water, and the care and fore-thought which a wise Government would bestow, must ensure not only health, but enjoyment and comfort to any troops stationed there, and very speedily, by a proper administration of affairs in the island, convert it into as flourishing a tract of land, and with as prosperous and contented a population, as Singapore, or any island settlement now in our possession.

## *Appendix to the foregoing.*

Little as is known, or as for many years is likely to be known of the geological structure of that vast tract of country comprehended within the limits of the Chinese Empire, it cannot but be interesting to bring together into one focus the scanty items of information which I have been able to glean from personal observation or otherwise, during the progress of the Eastern Expedition. These notes, however brief and imperfect, will at least throw some little light upon a subject hitherto veiled in obscurity, and may form a first step in facilitating the labours of future observers. It would not be possible to give a complete or connected description of the Chinese coast from the Southern Provinces to the Bay of Petcheelee, but various links in the chain have fallen under our examination, from which data we may, at least conjecturally, supply the rest.

Commencing then with the Southern Province, called Quangtung, the capital of which is Canton, we may observe in the promontory and head-land of Macao the extremity of a range of granitic hills, which appears to run to the north-eastward, being there connected with higher and more important chains at the distance of about 70 miles inland. Extending from the boundary of this province, and forming the sea-coast as far as Namo, there appears to be a continuous but rugged range of igneous rocks, much dislocated and broken up in various parts, but preserving the same general characters throughout. Further north these rocks assume, as at Amoy, a trappean appearance, and the provinces of Tchekiang and Kiangnau as far north as the estuary of the Yang-tze-Keang, seem to be traversed by lofty but irregular ranges of hills and mountains of an igneous or perhaps volcanic nature, having a direction nearly due north and south.

The group of islands forming the Chusan Archipelago, has already been described as composed of ancient volcanic rocks. Our information now becomes imperfect as far as the Shan-tung provinces, but from analogy it is reasonable to suppose that the same system of rocks continues along the coast, as far as the north-eastern extremity of that province which forms the southern arm of the bay of Petcheelee. The continuity of the same rocks seems evident from the geological character of the Ta-koa and other scattered islands in the narrow gorge at the entrance of the bay, indicating a connexion with the high ridges in the opposite district of Leo Tong in Tartary.

The great alluvial plains of Petcheelee next require notice: they are bounded by the trap ranges of Tangchuo-foo to the South-east, and to the Eastward by the Bay, and by lofty Alpine ranges seen in N. latitude 40, beyond the line of the great wall, and trending away to the North Westward. It is in Foochao that a most interesting discovery—that of coal—has been made, which will presently be noticed.

On the subject of ores and minerals, but little information could be expected from a hasty examination of a line of sea-coast, nor are deposits of this kind likely to exist in the volcanic hills, and alluvial plains which prevail throughout the tract of country visited by the Expedition. As regards organic remains, and for nearly similar reasons, I have little to communicate. There are however raised beaches near Canton, which contain bivalve shells of the genus *ostrea*, presenting a remarkable feature of resemblance with those elevations of lines of coast prevailing so generally in Europe, and recognized also in America. These raised beaches have probably been produced by the latest upheavings or expansions of igneous rocks before noticed, as existing on this part of the coast.

The existence of coal in China, and its being worked by the inhabitants has long been known, and two localities of this mineral have come under my notice—one near Canton, and the other in Chinese Tartary.

The former of these carboniferous deposits is situated to the North-west of Canton, where a chain of hills running East and West separate the province from the low lands of central China.

One of the most interesting geological facts elicited during the progress of the Expedition to the northward, was the existence of the second of these carboniferous deposits. The locality of the mineral, though not actually visited, was pretty accurately ascertained, being about latitude 39° 10' North, and longitude 121° 25' East, and is situated within a mile of the sea coast. Some junks were found laden with this coal, of which it is rather difficult to form a correct opinion from the small quantity brought away: I should however pronounce it anthracite of inferior quality. Some specimens of the rocks prevailing on the coast, were brought away by the parties who visited this district, and prove that igneous rocks prevail there also. A slaty rock of the nature of shale, was said to have been found in the water courses, but unfortunately no specimens were preserved. The mere existence of this rock would however imply the occurrence of a regular coal series, in which beds of better quality may be found.

No metallic ores of any description were seen in any spot visited by the Expedition during the past year (1840), nor does the general appearance of the country to the Eastward convey an impression of their existence, excepting that iron might perhaps be met with in the mountains. The gold and silver produced in China, are obtained, exclusively it would seem, from the Western Provinces bordering on Thibet; but upon this point no information as to the precise locality of the mines, has been obtained. Veins of the metallic ores are however very unlikely to be found among the igneous rocks of the Eastern coast, so far at least as they came under my observation.

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*Remarks on Apostasia. By* R. Brown, Esq. D.C.L. &c. *From the Plantæ Asiat. Rariores.*

Apostasia. *Blume Bydrag. p.* 423.

*Perianthium* limbo sexpartito, regulari. *Stamina* antherifera 2, quorum *Filamenta* foliolis lateralibus interiorum perianthii opposita, infra, connata cum basi *Styli* suprá cylindracei, et vel nudi, vel hinc *Filamento Tertio* castrato, altiús adnato, foliolo antico exteriorum opposito, appendiculati. *Anthere* biloculares, longitudinaliter dehiscentes. *Pollen* e granulis simplicibus, solutis. *Stigma* obtusum, obsolete bi-trilobum. *Capsula* trilocularis, polysperma. *Semina* ovata, testâ nucleo conformi." Brown MSS.

Classis Linneana: *Gynandria Diandria.*

Ordo naturalis: *Orchidearum* Trib. *Apostasiea* Br.

Obs. "This very remarkable genus, founded on *Apostasia odorata,* was first published in 1825 by Dr. Blume in the work referred to; but in 1821 a nearly related species was discovered in the valley of Noakote in Nipal, by the plant-collectors of Dr. Wallich, who, in his manuscripts, which I have had the advantage of consulting, named it *Mesodactylis deflexa,* and at the same time had the drawing made which is here given.

I have followed these two distinguished botanists in regarding *Apostasia* as belonging to, or at least as most nearly related to, *Orchidia.* It exhibits, however, very few of those characters generally considered as essential to that family of plants.

In its antheræ, pollen, style, and stigma (all which parts are so remarkably modified in *Orchidea) Apostasia* does not materially differ either in form, structure, or economy, from the more regular-flowered families of *Monocotyledones;* and in its trilocular ovarium it is distinguished from all other genera of the order to which it is here appended.

On the other hand it agrees with *Orchideæ* in the structure, as far as I am able to ascertain, of its minute seeds; in the reduced number of stamina, and probably, with some genera of the family, in the order of their reduction; in the filaments being at the base connate with the lower part of the style; and in a great degree in habit. In endeavouring to estimate the importance of the several points of resemblance and difference here enumerated, with a view to decide on the degree of relationship *Apostasia* bears to *Orchidea,* it is necessary to consider the relative position of the parts of the flower in that order, and also in *Scitamineæ,* the family most nearly allied to it.

The relation of stamina to the parts of the floral envelope in *Apostasia* is in the first place to be determined. The two antheriferous filaments, which I have more particularly examined in the unexpanded flowers of *Apostasia nuda,* appear to be opposite to the two lateral segments of the inner series of the perianthium; and the sterile filament in *Apostasia Wallichii,* and no doubt also in *odorata,* is opposite to the anterior segment of its outer series.

Several years since I advanced the opinion, 'That in a complete flower, whose parts are definite, the number of stamina and also of pistilla is equal to that of the calyx and corolla united in *Dicotyledones* and of both series of the perianthium in *Monocotyledones.*'[1]

It may be further observed, that in cases of reduction of pistilla it is generally found, that the remaining carpella when more than one, but inferior in number to that of our series of the floral envelope, correspond in position with parts of both series, and with very few exceptions, whether distinct or confluent, are all equally developed. Stamina, on the other hand, in cases of equal reduction, generally belong to one of the series only, or, if corresponding with parts of both series, are usually in different states of development, as they are here described to be in two species of *Apostasia.*

This appearance of part of the inner series of stamina has not hitherto been expressly remarked in *orchidea.* It is not improbable, however, that the same relation to perianthium exists in the lateral antheriferous stamina of *Cypripedium,*[2] as well as in the sterile petaloid

1 In 1826, in appendix to Denham and Clapperton's Travels, p. 237
2 Prodr. Fl. Nov. Holl. 1. p. 309.

processes similarly situated in other genera, as in *Diuris.* And the third stamen of the inner series, still more altered in form, may be considered as present in certain New Holland genera, especially *Glossodia,* where this supposed stamen is placed within the labellum, but entirely distinct from it, in *Epiblema, Pterostylis,* and *Chiloglottis,* in which an analogous appendage similarly situated coheres in various degrees with that division of the perianthium; and perhaps it may be considered as indicated in all cases where the labellum is furnished with a process, however minute, arising from its axis.

If the view here taken of the position of the lateral filaments in *Cypripedium* and *Diuris* be adopted, it may be remarked that indications or rudiments of the two stamina necessary to complete the number in *orchidea,* of those, namely, corresponding with the lateral segments of the outer series of the perianthium, have not yet been observed in the regular structure of any plant of the order. They have however been occasionally met with in monstrous flowers of *Habenaria bifolia,* in more than one spike of which I have found the greater number of flowers triandrous, the three anthera being equidistant, and placed exactly opposite to the three divisions of the outer series of the perianthium, the inner series of which remains in its ordinary state.

In 1826, in appendix to Denham and Clapperton's Travels, p. 237.... ... } Prodr. Fl. Nov. Holl. i. p. 309.

M. Achille Richard[3] has given an account of an analogous monstrosity in *Orchis latifolia.* In this case of a triandrous *Orchis,* M. Richard having adopted the opinion, which I believe I was the first to advance,[4] of the origin or nature of the auricula of the anthera of many genera of *Orchidea,* considers the additional anthera as formed by the perfect development of these auricula. This view however cannot be taken of the monstrosity of *Habenaria bifolia,* in which not only the auricula of the anterior or ordinary stamen are distinctly present, but two other similar processes, one on the anterior side of each of the additional anthera, also exist, a fact which throws considerable doubt on the correctness of the view here referred to of the nature of these processes in *Orchideæ,* unless the same hypothesis could likewise be extended to all cases of trifid filaments, as those of *Allium* and *Dentzia,* to which the auricula in *Orchidea* may be said to be analogous.

In *Scitaminea,* the family most nearly akin to *Orchideæ,* the complete number of stamina may be considered very generally present. Only one, however, is antheriferous; and this perfect stamen, instead

3 Mèm. de a Soc. d'Hist. Nat. de Paris i. p. 202.
4 Prœd. Fl. Nov. Holl. i. pp. 309 and 311.

of corresponding, as in *Orchideæ*, with the anterior segment of the outer series of the perianthium, is placed within the posterior segment of the inner series, the two remaining barren stamina of the same series being the epigynous glands or filaments existing in all the genera of this order except *Castus*;[5] while the outer series of stamina, very differently modified, form the innermost, or supplementary series of the perianthium.

This view of the origin of that series was many years ago communicated to me in conversation by the celebrated Correa de Serra; but was first, I believe, published in 1836 by Professor Lestiboudois in a Memoir[6] in which the correctness of the opinion held, namely, that *Scitamineæ* and *Canneæ* possess rudiments or modifications of six stamina, is remarkably contrasted with the erroneous views taken, or rather adopted, of the greater part of the structures adduced in support of it.

A more accurate account of the relative position of parts was given in 1828 by my ingenious friend Professor Von Martius. In confirmation of the opinion, I may remark, that the cells of the ovarium, whose relation to the floral envelope appears to be very uniform in *Monocotyledones*, are in *Scitaminea* opposite to the supposed petaliform stamina, and to the divisions of the outermost series of perianthium. I have formerly pointed out the difference in position of the antheriferous stamen in *Scitamineæ* and that of *Canneæ* or *Maranteæ*, and have remarked that this difference is in some degree analogous to that existing between *Cypripedium* and the other genera of *Orchidea*.[7]

*Apostasiæ* in its trilocular ovarium differs from all the genera of *Orchideæ*; but an analogous difference occurs in *Scitamineæ*, in which *Globba* is distinguished from every other genus in having its ovarium unilocular, with three parietal placentæ. And in both these families it may be proved that the constituent parts of the compound ovarium, whether unilocular or trilocular, agree in position, or in their relation to the division of the perianthium.

Lastly, *Apostasiæ* in the economy of impregnation, or the state of the pollen, and the manner of its application to the stigma, probably differs essentially from all *Orchideæ*, except perhaps *Cypripedium* and possibly *Vanilla*. But a similar difference, and in a degree still more striking, exists between *Apocineæ*, as I have formerly proposed to limit that order, and *Asclepiadeæ*, which can only be regarded as a subdivision of the same natural class.

5 Prodr. Fl. Nov. Holl. i. p. 305.

6 Memoire Sur le canna Indica et des Sur les Familles des Balisiers et des Bananiers.

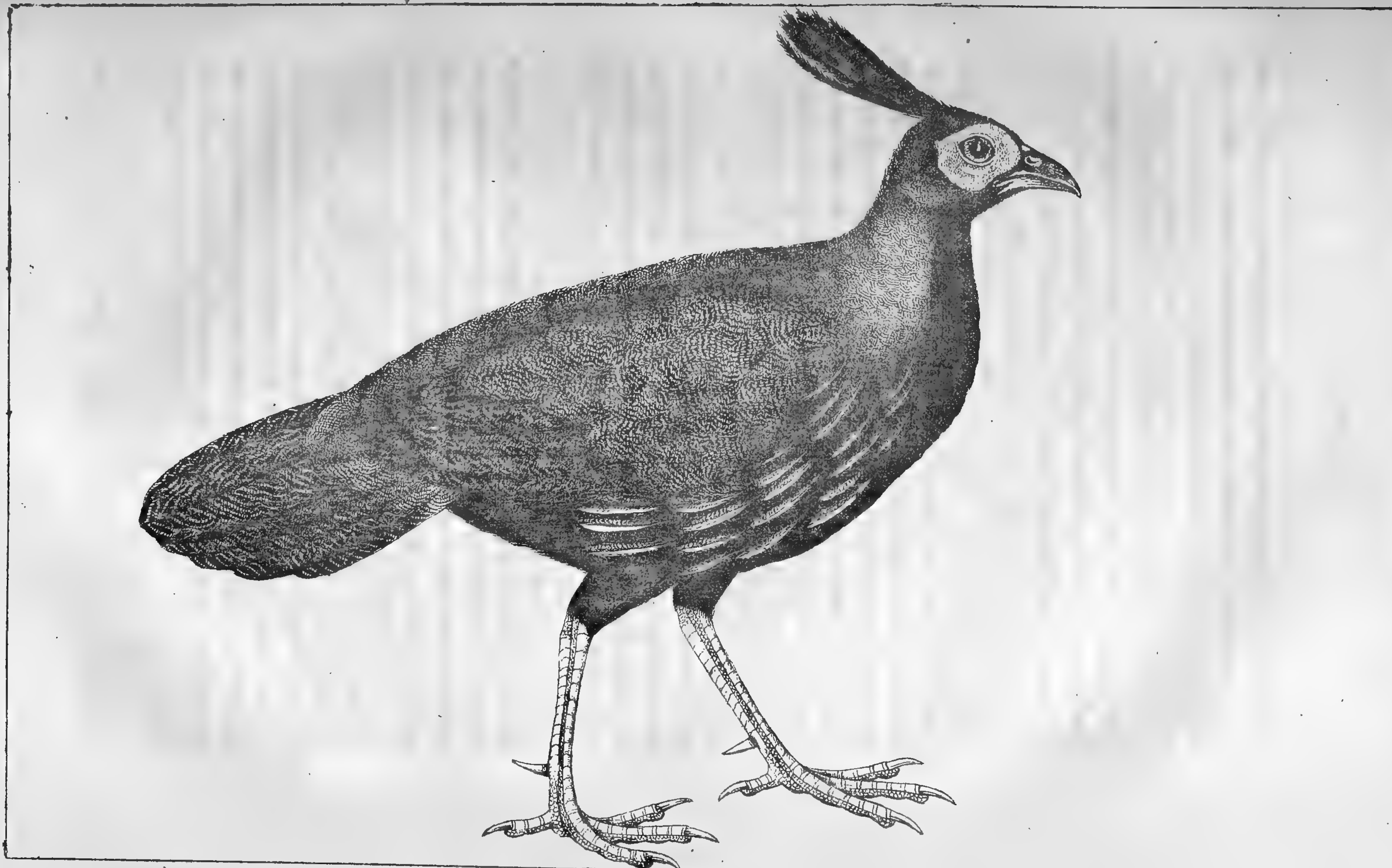
7 Appendix to Denham and Clapperton's Travels, p. 243.

8 Gen. Remarks on Bot of Terra Austr. p. 43.

### *Remarks on Collections—also on a new species of Pheasant —a species of Ambassis and Cestreus—a new genus of Thoracic Fishes. By the Editor.*

The first dispatch of animals for the Zoological Society, according to the new arrangements under the patronage of Lord Auckland, to which we alluded in our last number, was forwarded in February last on board the Duke of Argyll, and consisted of a pair of green peafowl (*Pavo muticus*) to which we referred before, obtained by Mr. C. W. Smith, at Chittagong. This bird is about the size of the common peafowl, *Pavo cristata,* but instead of the uniform metallic green colours of the head and neck, so beautiful in the latter species, the *Pavo muticus* has the extremities of each feather terminated by a light golden green zone, while the head is crossed transversely by two broad zones of pure gamboge yellow and bright purple, and the crest, which in the common peacock consists of a tuft of feathers with naked shafts, terminating in lunar vanes at the extremity, in this species has each feather clothed laterally from its attachment to the apex, which is narrow and pointed; all the rest of the body presents various shades of green. These birds are doubtless known in England, but they are not known in southern or central India, nor in Ceylon; Chittagong may therefore be regarded as about their western limit. They are also unknown in Sylhet and Assam. From Chittagong their province in a wild state extends to the eastward, and as they are commonly called *Japan* peafowl, we may suppose that their eastern range is very extensive.

The next species we have to notice is a pheasant, of which Captain Bogle sent to Barrackpore five male and two female birds, together with a third, which although described by Mr. Gould, Proc. Zool. Soc. Jan. 3. 1833, p. 13, as the lineated pheasant (*P. lineatus,* Lath.) is unquestionably the female of some other species, which we



hope, through the zeal of Captain Bogle and his friends, soon to be made acquainted with.

It is therefore probable that we shall be indebted to the very first step in the new arrangement that has been made for the transmission of animals to England, for a knowledge of two species of pheasant previously unknown, or in other words, that two out of the three kinds sent by Captain Bogle from Arracan to the Barrackpore Menagerie are likely to prove new to science. One of these appears to have been forwarded to the Zoological Society in 1833 by George Swinton, Esq. a corresponding member; and was noticed by Mr. Gould as the lineated pheasant of Latham, vid. Proc. 1833, p. 13.

"The beak," says Mr. Gould, "is strong, and considerably arched, the naked space round the eye bright red, and covered with numerous *papillæ:* the head crested with long bluish black feathers; the back of the neck, and the whole of the upper surface delicate grey, very numerously barred with fine zigzag lines of black, which are broader than the quill feathers; the throat, breast, and belly, black; the sides of the breasts and flanks having white lanceolate feathers with black edges; the tail of eighteen feathers, very much graduated and arched as in the silver pheasant *(Phasianus nycthemerus, Lin.)* The outer edge of the centre feathers, and the tips of the two next being white, the remainder are alternately marked with irregular lines of black and white; the black predominating, and the legs strong, *of a reddish flesh colour,* furnished with conical sharp spurs." This is an accurate description of the birds received from Arracan, except the remark regarding the colour of the legs which is grey; and had Mr. Gould at the time been acquainted with the *Phasianus lineatus,* Lath. figured on the authority of Mr. Gray and General Hardwicke, Illust. Ind. Zoology, he would have seen that the subject of the above remarks was a distinct species. Two males and females of this species have been forwarded to the Society. The females are somewhat smaller than the males, of olive brown colour, with lanceolate feathers on the sides of the breast; the breast and throat dark brown, and the plumage of the upper part of body finely barred as in the male. These pheasants are about the size of the common fowl, and become perfectly tame and contented in a domestic state; the males however fight desperately if confined together, and for this reason it is necessary to keep them apart.

Another bird which formed a part of the collection on board the Duke of Argyll is the *Phasianus pavonius*, or *Polyplectron Hardwickii*. We are not sure that the hen of this species is well known. One specimen only has as yet been received from Captain Bogle.

A young violet Stork, *Ciconia umbellata*, Wag. has also been received, and forwarded by this opportunity.

Two small wild geese (*Anser melanotos*,) with dark legs and beak, as well as wing coverts.

Six green-winged pigeons, (*Columba indica*.)

Two Shrikes, *Ioxus jocosus;* and a pair of small psittaceous birds. Of mammalia, *Viverra melanurus*, Hodgs. (in Cal. Journ. Nat. Hist. April, 1841;) two civets, a porcupine, and three martens (*Paradoxuri*), a monkey, and two specimens of *Felis* are all that have been forwarded by this opportunity.

The following is a description of the new pheasant, *Ph. fasciatus*. J. M.

Throat, breast, and lower parts of the body black; crest black and slightly recumbent at the base: lanceolate white streaks on the sides of the breast; body above grey, and plumage finely vermiculated with zigzag white lines crossing obliquely from the margin to the shaft of each feather; red naked spot on each cheek descending below the commisure of the mandibles. Tarsi and beak grey.

The tail and wings of the specimen described were cut, but notwithstanding, its appearance was remarkably graceful, and its manners in the cage perfectly quiet, so as to render confinement unnecessary. Conceiving that the five male birds were of the same species, three only were forwarded to the Zoological Society, and two were reserved for the Barrackpore collection. One of these was afterwards found to be quite different, having the feathers on the lower portion of the back terminated with apical white zones, as in *P. leucomelanos,* the white striæ on other parts of the body more faint, so that the colour generally was much darker than that of *P. fasciatus,* in which the feathers of the lower portion of the back were vermiculated with minute white bars, without the white apical borders. This second variety may probably be regarded as a hybrid between *P. fasciatus,* and *P. leucomelanos.* Two consignments of animals have since arrived from Arracan, one of which we had an opportunity of inspecting. It consisted of the mother and a young brood about a month old of *Gymnura Rafflesii, (?)* a monkey, a gibbon, four monitors, a marten, a porcupine, and three lemurs. Two toucans died on board. Mr. Sconce of Chittagong has forwarded to Mr. C. W. Smith, for the Zoological Society, two very fine Gyals, or wild cattle of the Tipperah hills. They are a perfectly distinct breed from any of the other numerous varieties that have been noticed, and although the Gyal has been long known from the description of Buchanan and others, yet we are not aware of any live specimens having been transmitted to England, where they must, from their size and form, as well as their tractable disposition, become objects of much interest. We expect much from the interest taken by individuals in the collection of live animals, and from the patronage of this object by the Governor General, and the Zoological Society of London.

We are happy to announce the receipt of a parcel of tertiary fossils from Madras, alluded to in our correspondence. These remains appear to be of a more recent character than those of Cherra Ponji, but as most of the specimens are sufficiently perfect to be identified and described, we hope to be able in a future number to notice those that have been forwarded to us in detail.

We have received two specimens of fish from Dr. Campbell, the political agent at Darjeeling, taken from the elevated source of one of the rivers in the Sekim mountains; they both proved to be species of *Schizothorax*, namely *Schizothorax plagiostomus*, and *S. Hugelii*, Heck. which were first discovered by Baron Hügel in Cashmere. We must still defer our notice of the two species alluded to in our last number, p. 559, as received from Arracan.

We have the pleasure to acknowledge the receipt of a collection of fishes from Mr. Hodgson of Nepal, in which we observe the following species; *Ophiocephalus morulius, Cyprinus semiplolus, Silurus paba, Leuciscus brachiatus, Barbus marocephalus, Orienus progastus, Plotosus canius, Ophiocephalus guacha, Platycara nasuta, Psilorhynchus variegatus, Silurus singio, Opsarius anisocheilus,* and some others, which will require examination, particularly of the genus Barbus, a group which in India is both numerous and important. The species of this genus are all inhabitants of the large rivers near the base of mountains where the streams are rapid. We shall be glad to hear from Mr. Hodgson whether these fishes were taken in the valley of Nepal, or at the foot of the mountains; most of the species are similar to those which inhabit the Brahmapootra near the rapids. Mr. J. W. Grant, to whom we have had frequent occasion to express our obligations, recently directed our attention to the peculiarities of several beautiful transparent fishes, which had been brought to him as microscopic objects, the largest being little more than half an inch in length. None of these minute species escaped the notice of Buchanan; one of them, fig. 1, plate IV. belongs to his genus *Chanda*, the other, fig. 2, plate IV. he supposed to be an *Atherina,* and which he described as *Atherina danius* in the Gangetic Fishes, page 222, leaving a drawing of it with his collection at the Botanic Garden.

The Chanda of Buchanan are so well marked, that they are distinguished as a group by the natives. Buchanan describes them as possessed of sharp teeth in both jaws, with some of the bones of the head distinctly indented on the edge; with prickles in some of the fins; and with the body more or less diaphanous and much compressed, the sides being nearly perpendicular. Cuvier, in the *Histoire Naturelle des Poissons,* makes a species of this group which was found by Commerson in the Isle of Bourbon the type of a new genus, to which he gave the name Ambassis. The genus is placed by Cuvier among the Percoides, and is distinguished by a short, compressed, and transparent body covered with large thin scales which are easily detached; protractile jaws, fine crowded teeth, a double serrated margin to the preoperculum, the post operculum terminating in a point. These parts we have represented as they occur in one of the species partially defined by Buchanan, figs 1, 2, plate V.

They are distinguished from the Surmullets whose opercula are also dentated, by their dorsals being placed close together.

Cuvier remarks that one of the species, *Ambassis commersonia,* is highly esteemed in the Isle of France, where a lucrative trade is carried on by the fishermen, who prepare it after the manner of anchovies. The same species he remarks is common at Pondicherry, from which M. Lechenault sent numerous specimens to France, also on the Malabar coast, from which Cuvier also received specimens. Also on the coasts of Java, from whence numerous specimens have been sent to the Royal Museum in Holland.

The Bengal species are numerous, but they require to be investigated, particularly as Buchanan's characters are not sufficiently explicit. The species we have figured is probably his Chanda lala, which we may describe as follows: —*Embassis lala.* Cuvier.

The body (fig. 1, pl. IV.) is short, and much compressed, translucent, with a silvery lustre and various iridescent lines occasioned by reflected light on the sides. The operculum (fig. 1 a. pl. V.) with a bifurcate point directed backward. The orbitary bone (1. b.) with three points directed obliquely downward, and the sub-operculum 1. c. with four spinous processes on its inferior margin. Three rays in the branchial membrane (1. e.) mouth (fig. 2 pl. V.) directed obliquely upward, with a single row of serrate teeth on the intermaxillaries. Fig. 1. a. Pl. IV. represents the dorsal fins, 1. b. the caudal, 1. c. the anal, 1. d. the pectoral, 1. e. the ventrals all magnified. The fin rays are,

D. 7.—1/14; P. 9; V.1/4; A 1/16; C.; 20.

The ventrals are situated opposite to the commencement of the anterior dorsal, and behind the pectorals. The fin rays are marked by minute cross bars, and the body with microscopic star-like dots. The stomach and intestines (fig. 1. Pl. IV.) taken together are about the length of the body, without cecal appendages. The stomach is dilated irregularly at its anterior extremity a. a. fig. 1 f.; b. the liver, c. the gall vessel and duct.

The scales 3. plate V. are perfectly translucent, and exhibit five concentric rings or canals.

*Remarks on a new genus of Thoracic Percoid fishes.*—The second species we have to notice fig. 2, pl. IV. is represented and described by Buchanan as an *Atherina*, as already stated, but the pectoral fins are round as in the Gobies, and the ventrals are placed immediately below them, so as to refer the species to the thoracic, rather than the abdominal Percoids, to which last *Atherina* belongs. The general form of this species however renders its resemblance to *Atherina* liable to deceive, particularly as its small size occasions some difficulty in the examination of its real characters. The genus to which it appears to present the greatest resemblance is *Sillago,* but the rounded pectorals and the short flat muzzle to which the eyes are approximated, and the absence of serrate margins to any of the opercula are decided distinctions from that genus.

The following are the characters of this new genus :

*Cestreus,** J. M.

Head oval and flat in front ; eyes prominent, and situated in the anterior part of the head ; jaws flat, and directed upward, with minute conical teeth in the intermaxillaries. Four branchial rays, and two rough ridges terminating in blunt points on the upper and posterior corner of the operculum. Pectorals round, placed over the ventrals which are preceded by a spine. Dorsals widely separated, a fleshy prominence in front of the anal fin.

*Cestreus minimus,* J. M.

The head (2 h. pl. IV.) is depressed anteriorly, and without scales. The eyes are prominent, and placed so high as to approximate towards each other slightly on the crown. The mouth is directed upwards with a double row of minute hooked teeth in adult individuals, placed in irregular clusters of two or three. The body is compressed, diaphanous, with only twenty-six vertebræ. The air-vessel large and silvery, with variegated margins ; the stomach situated in front of the air-vessel is simple, soft, and continuous, with a short intestine without cecæ. The rays are

D. 5—9 : P. 16 : V. 1/5 : A. 12 : C. 13.

The first dorsal consists of soft pointed rays connected by a thin, transparent membrane, the second dorsal as well as all the other fins composed of soft branching rays except the ventrals, in which the first is spinous. The pectorals, as in the Gobies, are inserted square with the sides into a soft fleshy pedicle ; they are rounded at the extremity, and long.

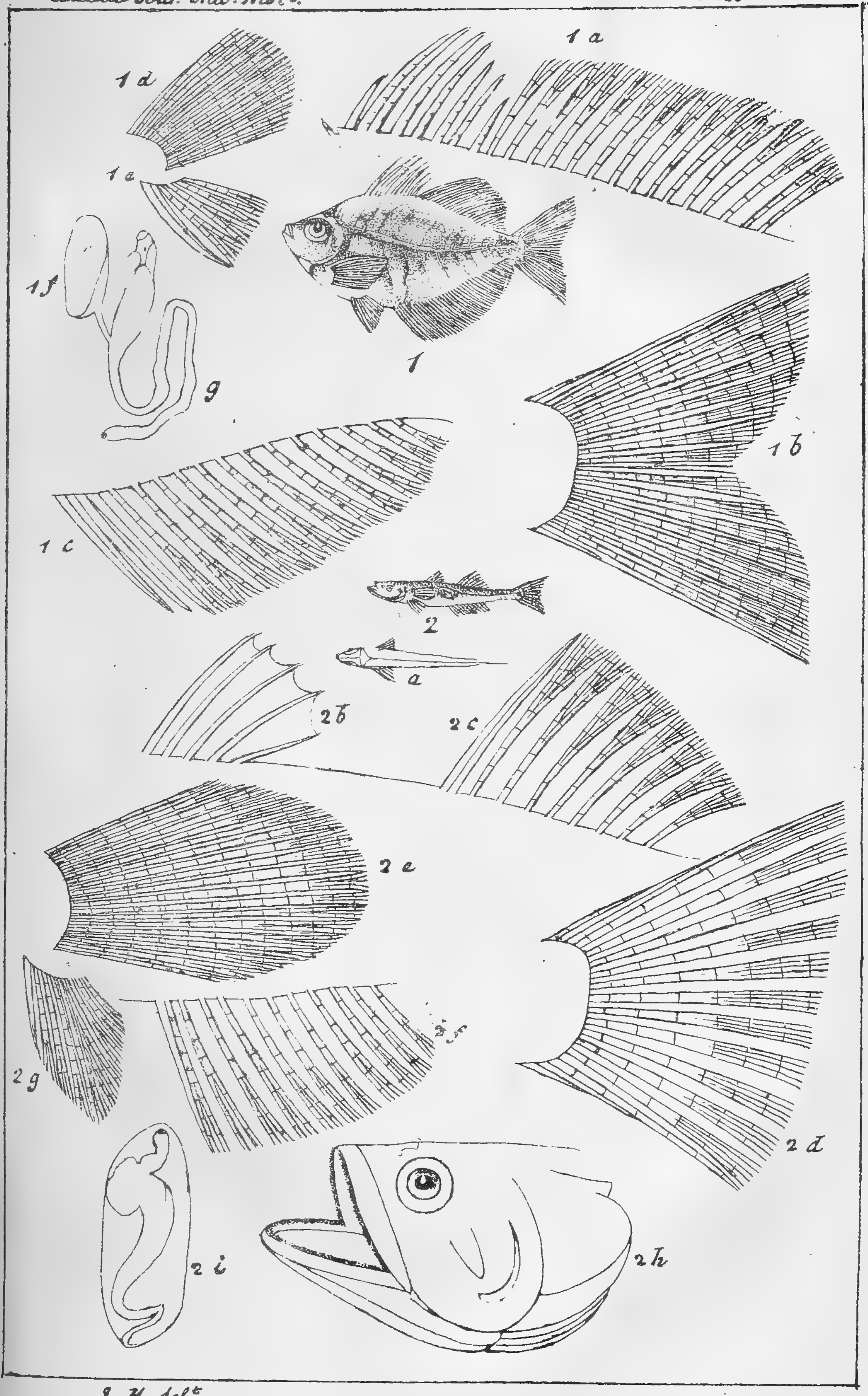
* The Greek name of a kind of mullet.

The caudal is square, but entire. The scales (f. 4. pl. V.) are large, soft, and transparent; terminating in a posterior denticulated margin.

The ovarium of the female (f. 7. pl. V.) is situated beneath the air-vessel (b), and with that organ occupies a large proportion of the abdominal cavity. The oviduct as well as the aperture of the intestine is situated in a soft fleshy prominence in front of the anal fin. The ova are large, and do not amount to more than a few hundred: when the ovarium is fully developed, the ova are pentangular from pressure; but when discharged they assume an oval form. The males appear to be far more numerous than females, and are easily distinguished by a small red oval body (d. f. 8) situated behind the air-vessel. There is the same protuberance in front of the anal fin in males as in the females.

The investigation of these minute diaphanous species requires to be conducted under the microscope while they are alive, or immediately after they have died in water. If immersed in spirits they become so opaque and contracted as to render their examination unsatisfactory. The subject is very important, and its investigation is calculated to cast much light on the natural affinities of larger and more important species. We have been indebted to Mr. J. W. Grant for most of the specimens examined; they were obtained from tanks in the vicinity of Calcutta during the month of March.

Note. Fig. 6, plate V. is probably a distinct species, but I was unable to discover any thing in its general form and structure distinct from the others, except the head and teeth. The specimen when examined was somewhat dry and shrivelled, which may in some degree account for its peculiarity of form, except in the teeth, which are large and conical, in a single row connected to each other by a membraneous ridge, as in Fig. 5, plate V. while in all the other individuals the teeth were hooked in the front of the jaw and straight towards the angle of the mouth, as in the lower figures. Fig. 7 is a magnified representation of the form of the ova in the ovarium.

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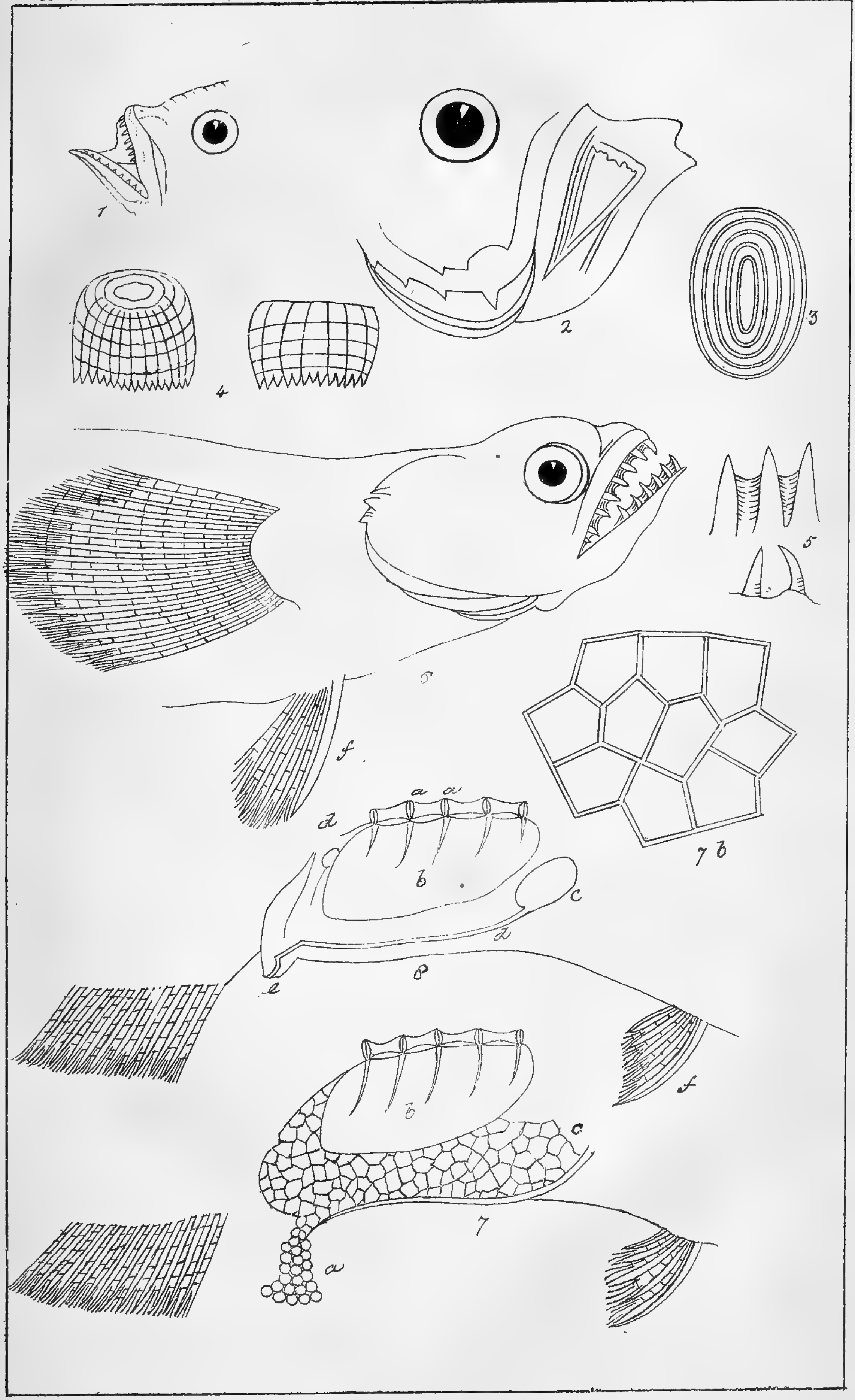
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THE

# CALCUTTA JOURNAL

OF

# NATURAL HISTORY.

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## *On the Granite formation of the Salem and Barramahal District. By Captain J. Campbell, Assistant Surveyor General, Madras Establishment.*

Granite, we are informed by Dr. Turnbull Christie,* is the most prevailing rock in the Peninsula of India. I do not find, however, that its specific characters have been generally described by writers with so much minuteness as to enable us to recognise the rock with exactness; but where I find descriptions which will agree exactly with what I have seen myself, I shall allude to them, although my purpose is principally to describe the granite formations of the Salem and Barramahal, and the adjoining districts.

The Barramahal is a rocky and mountainous tract of country, which commences on the east at Vaniambady, and extends west as far as Oossoor, where it is separated from the red marle formation of Mysore by a sudden break in the levels of about 200 feet in height. On the north it is separated from what are generally called the Eastern Ghauts by the hills of the district of Congoondy, and south it extends as far as a break in the level at Topoor, where there is a little ghaut, called generally the Topoor Ghaut. The plains between the foot of the mountains are generally nearly

* Edinburgh New Philosophical Journal.

level, and in consequence a road traverses it, (from Vaniambaddy to Oossoor,) being part of the road between Madras and Bangalore, on which there is no Ghaut, the rise being quite gradual until close to the Mysore country, where the only slightly abrupt ascent occurs. The principal towns are Vaniambaddy, Trippatore, Dorampoory, Pauleode, Kistnagherry, Denkanicottah, Kellamungalum, and Oossoor. The general level is about 2500 feet above the sea. Salem is much lower than the Barramahal, and is separated from it at Topoor. Broken rocks are common to it; but although it has several very elevated tracts of table land, yet granite is not so frequent as in the Barramahal.

The granitic tracts of Great Britain are not of great extent, and they are besides so much enveloped by schists, as to prevent their connexion being observed. On the continent of Europe also, there is no great development of any continued granite formation, and we have therefore no complete account of any granite tract, as it appears most probable that the whole of the Peninsula of South India is a continued granitic formation, on which in most parts the superformed schists and arable soils are so shallow as to afford us admirable opportunities of examining and following out this extensive formation in all its changes and variations of structure, it is, therefore, desirable that the attention of observers should be turned to this subject.

For this purpose, a complete account of some particular granite formation is very desirable for the purpose of reference; but unfortunately there is not in print (that I am aware of,) any which can be useful. McCulloch's Western Isles is meagre in its details of granite, in consequence of the rock occurring only in Arran, Mull, and the Isle of Man.* His account of granite in the classification of rocks, and

* The rock of St. Kilda appears from the description also to be hornblende in granite, although from its connection with trap, it is classed with the syenites, (McCulloch's overlying rock.)

his system of geology do not apply perfectly to that of India, and in many points is at variance with Indian observations. Dr. Boase's primary geology is very useful, and is the best we have; but that also, for many reasons, does not perfectly apply to India.

In drawing up the following descriptive account of the granite of this district, all the accessible works of authors (excepting the costly volumes of the Geological Society, which are a sealed book to most persons in India,) have been consulted and digested; and such geological and mineralogical terms have been adopted as appeared least objectionable. It has been impossible to append to all the terms made use of accurate definitions and considerations of the propriety of their use; because, if this had been done, the paper would have been a treatise on petrology, instead of a descriptive account. As an instance, the term syenite may be misunderstood, which is here made use of, not as applied to a granitic rock, but to a speckled granular aggregation of hornblende with some felspar and quartz, which definition will agree with Jameson's, if its application to a granitic rock is excluded.

*General appearance of Granite.*

The general appearance of granite is very variable, and I think it probable that it will be found that its outward form is connected with its mineralogical composition and mode of aggregation.

Dr. Christie's description appears well adapted to the granite of the Barramahal; he remarks: "Rugged hills with "bold denticulated outlines lie heaped together in the "greatest irregularity, or occasionally form an obscure ridge, "the crest of which, when interposed between the spectator "and the evening or morning sun, presents the most fan- "tastic forms. Some of these ridges, when their dark "outline is seen at twilight against a ruddy western sky, "emulate in their varied forms the capricious shapes of "summer clouds, and we can then trace along their summits the appearances of castles, trees, men, and various fantastic groups. Many of the hills have the appearance of collections of large fragments of rocks thrown confusedly together by some convulsion of nature; while frequently larger masses, piled with great regularity on each other, look like the gigantic remains of Cyclopean architecture. Huge insulated masses, forming considerable hills, in many instances, rise abruptly out of a plain, to a height of several hundred feet, and present nearly perpendicular faces on several of their sides: thus affording situations of immense strength, which have almost invariably been taken advantage of by the natives for the erection of forts;"—and it is from this that the Barramahal takes its name; twelve of the highest, most smoothly scarped eminences having been selected for the erection of fortifications, which garrisoned by a few determined troops might, even without the aid of artillery, defy the efforts of an army. In these a set of marauding ruffians had formerly established themselves, desolating the surrounding country by their depredations, until it became abandoned to the tiger and the elephant; and where the latter held their undisputed sway until the British rule, by suppressing the petty chieftains, gave the jungle again to the axe of the ryot, and the arable land to his fertilising plough.

When attentively considered, the appearance of granite hills may be particularized as follows:—the first and most striking is the Mamillar, or dome-shaped form.—In the Barramahal this is very common, the eminences are of immense size, some rising as high as 1400 feet above their bases, consisting of one solid mass of granite. The second is that of a loose pile of globular masses, thrown apparently together by chance. Some of the masses are sometimes of very great size, nearly 50 feet in diameter occasionally, and as they repose the one upon the other, rising at a high angle to a great height, present an appearance which seems to threaten every moment a descent into the plains below.* Such hills afford one of the most sublime appearances of the granite formation, when viewed from a spot near their bases. The third is that of a pile of loose crags of variable, irregular shape, thrown loosely together, forming innumerable cells and cavities, in which bears are particularly fond of making their dens. The fourth is an approximation to an irregular columnar structure, which is not common; but may be seen in the Kollymally hills, north of Trichinopoly. Instances of this columnar structure are sometimes seen in single masses of granite, projecting perpendicularly from the summits of hills; and one of these may be seen at Pennasomoodrum, five miles south east of Caverypatam, which last is ten miles south of Kistnagherry. The column appears about 150 feet high, and 50 feet in diameter, (but I had not leisure to take the measure); its sides are quite straight and smooth, and its shape is irregular; but it rises suddenly from the summit of a little hill of loose granite stones. Altogether it much resembles, except in size, McCulloch's drawing of the Scur of Egg, (Western Isles.) I have little doubt that the colossal granite statues in Mysore, so often described, have been hewn from similar columns. The fifth, exactly resembles a hill of projecting crags, covered nearly to the summit by dirt and rubbish, having been shovelled on, until the summit is only left visible, and occasionally the point of a crag from the sides. This appearance is common in those hills which have been described by Dr. Benza as syenite.† Of this kind are the hills of Pallicondah, near Vellore, Amboor, and the hills near

* An instance of the descent of one of these masses occurred while one of my sub-assistants was upon the Shavavoy hills, when a huge mass rolled from its seat near the hill top, clearing the forest trees and jungle, into a wide road along its course to the plain.

† Madras Journal of Science, volume iv. p. 18.

Paulcode, and the long range of hills between Cavery, Pooram, and Colligal in Coimbatore. In general, hills of this kind present long slopes covered with grass, and apparently smooth, and have a reddish appearance, while granite hills of piled blocks and crags, are generally covered with large trees and green bushes, which find root between the stones.

In the Barramahal, a common form of granite hills, that of a conical heap of round blocks, with a solid craggy mass of granite projecting from the summit, and sometimes also the Mamillar masses, may be also seen surrounded with round blocks, as if they rolled down from its summit.

Ranges of granite hills, with table lands on the summit, are very common in the Salem and Barramahal districts; the slopes of these ranges differ not at all in appearance from the conical ridges, shewing sometimes all the varieties of appearance above described: but the most common is that of a regular slope of large blocks. This runs up generally at an angle of 45° until it meets the almost level plain which crowns the summit of the range. The description of these table lands will form the subject of a separate paper, and need not therefore detain us now. I have before alluded to the occurrence of soil on the summits of the Mamillar masses of granite in Mysore. In this district every one of the Mamillar granite hills is crowned with soil of a reddish colour, filled with angular portions of felspar and quartz, and some other minerals, in which large trees, sometimes of very considerable size, are growing. It is easy to see that mixed with this soil, and sometimes forming a layer upon its surface, is a quantity of mould produced by the decomposition of vegetable matter; but this is easily to be distinguished from the mineral soil. That granite, an almost purely silicious rock, can be decomposed into a ferruginous arenaceous soil, is an absurdity too gratuitous to require discussion, particularly as the granite does in no case ever shew the slightest sign of any decomposing action; and it is also an absurdity glaringly evinced in the convenient way in which granite, by some writers, is made to decompose into white kaolin, and by others, into ferruginous earth. It is possible the soil may be derived from the decomposition of a softer rock, formerly superposed upon the granite, and from this it may be inferred that these granite hills have once been covered to their summits, and have been gradually denuded by detrital action. The impossibility of referring the denudation to diluvial action is apparently proved by the soil, &c. having been left in its present situation, because any violent action of this kind would have removed it.

A very uncommon variety in the appearance of granite is that of gigantic masonry formed of flat masses in the shape of parallelopipedons lying regularly one upon the other, in rows in the same horizontal line, with narrow seams of softer portions interposed, exactly as a wall is made with bricks and mortar. Itticuldroog, four miles north of the village of Codagoor, on the road between the Kistnagherry and Royacottah, is the only instance I know of this kind of granite. It is a mass with mural sides, about a quarter of a mile wide in its longest diameter. The base is surrounded for thirty feet with a sloping pile of debris; but above this the mass is quite perpendicular. It rises suddenly out of a stony arable plain, formed as those generally surrounding granite hills are, of imperfect schists. Near it are some common granite hills, and granite rocks are common in the surrounding plain. The structure of the rock is very visible on all sides, and presents to view what are apparently the edges of flat masses, about three feet thick, and ten or twelve feet long, disposed horizontally with open seams several inches wide, from which apparently a softer part has been removed by the disintegrating action of the weather. The whole appearance is much like a pile of the flat pieces of sandstone, as seen at the back of the Isle of Wight.

No signs of disruption or disturbance are visible any where; and that the flat tables have not been displaced, is made visible by some waving veins of a lighter coloured portion of the rock, which run vertically down through several of the horizontal courses. The summit is nearly quite flat, and is covered with soil on which grass and large trees are growing, and several blocks of common granite are lying about on the surface. The rock is the common grey hornblende granite, varying much in aggregation and composition; being in some parts a nearly perfect syenite, and in others a soft porphyritic rock. The structure of the seamed parts I was unable to examine minutely, from their being inaccessible. About the locality there was nothing remarkable to describe, and the only uncommon minerals found, was a piece of schistous white sandstone, (or fine grained white pegmatite,) interlaminated by a conforming thick vein of black syenite.

### *Situation and Rocks associated.*

The manner in which the granite hills rise from the plains which surround them is most striking; for the plains being nearly quite flat, the appearance is exactly like that of rocky islands, with abrupt slopes rising above the surface of the sea. There is no gradual alteration of the slope, so as to blend gradually with the plain; there is no change in the structure of the hill, nor in the composition of the soil of the plain in the vicinity of the hill; but the plain preserves its level, and the slope of the granite its angle of elevation, until the two meet abruptly, and the granite is hidden by the soil which surrounds it. These plains (except in the red marle formation of Mysore), are invariably formed of confused jumbled series of beds of gneiss, friable gneiss, white quartz, syenite, greenstone, kunkur, wacké, and pegmatite, in the most utter confusion, not shewing any signs of disturbance; but such as to defy the slightest possibility of being produced by sedimentary action. The full description of this formation, which I shall call *schistous series,* will form the subject of a future paper. This formation does not appear to be of any great depth, and seems, when I have had opportunities of observing its depth, always to rest upon a bed of solid granite.

Most authors seem to agree in describing a bed of granite as underlying, at various depths, the whole of the plains of South India; and it appears indeed probable that all the prominent granite hills are connected below the surface plains with the same bed of granite. Where small rivers run between granite hills, I have generally been able to observe that the beds were cut down to the solid granite, and I have also seen this over an extent of many miles in the bed of the Cavery river.

Some authors have endeavoured to shew that the granite ranges of India have been produced by mechanical elevation, and have even pretended to have observed the corresponding elevation of the schistous beds towards the hills; but the latter assertion is contrary to fact, and if it is true that the granitic eminences are all projecting portions of the same granitic bed, it does not seem very probable that any of the granitic has been mechanically elevated, unless it is assumed, that the whole mass of the continent has been elevated at once.

Bakewell* remarks, that in the eastern parts of the United States and in Canada, granite occurs near the surface uncovered by other rocks. This would appear to resemble in some measure the beds of granite in India; but I am not able to find a similar formation described any where in Europe, where the granite generally occurs as a sort of central cone in the hill ranges, and from this has, in a great measure, arisen the elevation theory. In the map of

* Geology, page 90.

this district, the granite ranges generally take a ramified form; spurs branching off form the sides of the principal ridges, and these again branch off into other spurs.

Associated with the granite rocks and hills, and answering in every point with the peculiarities of general appearance and outward form of granite, are found in several points, hills of white quartz near Denkanicottah; of black trap at Yepsundrum and Rasheegootah, four miles south of Royacottah; of hornblende rocks and greenstone at Soodnoor in the same direction; of syenite and porpheritic syenite near Salem; of pegmatite largely laminated with black mica at Arnagherry; but as these hills rise from the plain of the schistous series by which they are surrounded, I have been unable to find any clue to the mode of junction with the granite, except in the case of the hornblendic rock and greenstone hill at Soodnoor, and the black trap hill at Yepsundrum; in both of which the junction is by a sudden division between the two, without the slightest graduation or alteration of either rock in structure, mode of aggregation, or composition.

*Structure of Hills.*

I have above remarked that a common structure of granite hills is of rounded blocks piled together, of a loose heap of irregular masses. Dr. McCulloch, and writers in general, have referred the origin of these piles of loose block to the prismatic division of the granite by joints, and to the rounding of these masses by the action of the weather upon the angles.

Dr. Christie, in his description of the Marhatta country, has referred the origin of this structure to erosion of the softer parts of the granite, and has pointed out that the rounded blocks, although apparently thrown together by chance, are still in *situ;* for that veins of quartz may be traced through all the blocks, intersecting them all in the same line. An accurate examination of these hills would have shewn that the blocks shew no signs of disintegration nor erosion, and that where traversed by quartz veins, (on which the weather has no action,) these will never be seen in any case projecting more than two inches above the surface of the block, and in almost all cases do not project at all.

Further examination would have disclosed the fact, that the original structure of these granite hills is formed by a series of spheroidal masses, embedded in a friable mass of crystalline grains of quartz and felspar, mixed with arenaceous earth, and some mica; arranged with their angles fitting and conforming, and evidently perfectly undisturbed and in *situ*. This, which may be aptly termed " primary gravel," fills the interstices between blocks, and embedding these, rests upon the central nucleus of granite, which appears generally as a crag at the top. Where the spheroids of granite are near to each other, the interstices are often filled in these hills with coarse kaolin earth, an instance of which may be seen at the fort-gate of Royacottah. There is no possibility of this kaolin having been lodged as a detritus, nor derived from the decomposition of the granite; for it is intersected often by vertical and horizontal veins of cracked quartz, with corresponding angles, (as described in the Mysore red marle formation.)

At the junction between the masses of granite and the primary gravel and kaolin, the division is always perfectly distinct and sudden, the granite being unaltered in texture, composition, or mode of aggregation; the only visible change being a very slight indication of scaliness. The gravel and kaolin present also no change of appearance, and the slight alteration described between the kaolin and granite in Mysore, I have never observed in granite hills. Among the irregular crags and masses of granite, other evidences of the form being original may be constantly observed, if attention is given to the examination; for it may be seen that the chinks and apparent fissures have not been produced by mechanical separation, but by a soft portion having been washed or fallen out, and the end of the fissures generally end in a rounded-shape.

In the vicinity of these fissures the granite on the sides may often be seen to be somewhat loose and friable in aggregation; but I have never had an opportunity of observing a graduation between such portions and the kaolin.

It would seem from Bakewell's remarks, (Geology,) that a similar structure is found in granite hills in Europe, for he remarks: "where hard and soft granite are intermixed in the same mountain, the softer granite is disintegrated and falls away, and the harder blocks remain piled in confusion on each other, like an immense mass of ruins."

*Composition and Varieties.*

The composition of the granite of this district is the same as that which appears to prevail over all South India, being formed of a crystalline aggregation of quartz, felspar, and hornblende. Micaceous granite is found sometimes, but not often. Talcose and schorlaceous granites I have never met with.

Accurate definitions of the composition of granite are not common in authors, but Phillips (Encyclopedia Metropolitana, art. Geology 759,) has given the following as the probable composition:—

20 parts of felspar.
5 parts of quartz.
2 parts of mica.

I have had no means of ascertaining the probable proportions of the composition of the granite of this district; but I should be inclined to think, that it contained a great deal more quartz than the above. I have found that it is easily fusible by the heat of a powerful wind furnace; but on breaking the fused mass, it appears as if the greatest portion was composed of quartz, which had been divided into minute crystalline portions, which were agglutinated by a clear glassy frit: probably arising from the fusion of the felspar.

That variety of granite before alluded to, which forms the Pallicondah hill, is a felspathic kind, which contains both hornblende and mica in small quantity. The felspar has a dull earthy appearance, while that of the common granite of the Barramahal is always resplendent and vitreous, and never in the least earthy in any part of the fracture. Dr. M'Clelland* seems to describe a granite in Kemaon similar to that of Pallicondah, though his specimens seem to have been imperfect.

The Pallicondah variety of granite is correctly described by Dr. Benza as being associated with trap veins and dykes, which are much more common in its vicinity than near any other kind. As eurite, according to Dr. Boase's definition, (Primary Geology, page 17,) is a felspar "fine, granular, and rather soft," that is, earthy in fracture, it will exactly apply to the composition of this granite, and it may be therefore distinguished as "euritic granite," a term which had been used by Dr. Benza himself as applied to it, though the eurite to which he perhaps alludes, would seem not to be that mineral, but a hard and compact silicious variety, with a fracture so finely granular, as to be almost smooth.

On the north side of the Tallymally, north of Trichinopoly, occurs a low ridge about 100 feet high, and 200 in breadth, formed of cubic blocks of what may be called "ferruginous granite." It is composed of quartz, felspar, and magnetic iron ore in crystalline aggregation, with a veined structure; the iron ore being distributed in veins, and is very firm and tough. It presents an inclination to cleave into cubes, and parallelopipedons, and is therefore commonly used as a building material. The length of the ridge where this rock occurs I cannot state; but I have seen it running in a direction nearly east and west for eight miles.

* Geology of Kemaon, p. 44.

This is the principal place where it occurs; but in small portions it is common in the Salem district, though not in so firm and solid a state of granitic aggregation as at the Tally-mally. About the sides of this ridge the aggregation of the rock is loose, and the magnetic iron ore is in greater proportion than in the centre blocks, and it can therefore be profitably mined, and the ore extracted from the matrix by pounding and winnowing it; and it is from this source that the Port Novo Iron Company procure much of their ore.

A schistous variety of this rock is also found about Kist-nagherry, and in various parts of the Barramahal, among the schistous series, differing from the ferruginous granite principally in being richer in ore, and being looser in aggregation.

### *Structure and Aggregation.*

The mode of aggregation of the granite of the district is very variable; generally it is of a greyish colour, and formed of shining grains like the granite of Aberdeen; but it is sometimes so fine in grain, as to be almost earthy in fracture, as about Namcull. In other localities it is composed of crystals a few inches in diameter; of this kind a singular variety may be seen near Roycottah, in which the crystalline quartz and felspar radiate apparently from centres three or four inches apart, and in the middle of these centres is a crystalline portion of magnetic iron ore, about half an inch in diameter, with projecting portions partly disseminated into the crystals.

Near Trippatore, the Yailgherry hills present a continuous formation of porphyritic granite embedding crystals of felspar, about two inches long. The whole mass of these hills, which extend about ten miles in length, is formed of this kind of granite in confused piled round masses, and differing in no other particular in structure or association from other granite hills, except in the instance just mentioned; the trap and greenstone present occasionally the same porphyritic character, containing the same identical crystals of felspar embedded in their masses.

Near Indoor, some granite may be seen in large round masses, with a perfect spheroidical structure, separating in concentric lamina of an inch thick or more. This is the only instance I have met with of this kind of structure in granite, and as it is rather dark in colour, and its manner of aggregation approaches to that of greenstone, in the partial mixture and confusion of the ingredients, it might perhaps be considered as a granitic variety of greenstone, in which rock this structure is common. It is possible a similar rock is alluded to by Dr. Ure, (Dictionary Chemistry, art. Granite,) which he calls rolling stones. Bakewell also alludes to a similar structure in granite, where he says: "Granite is occasionally found in globular masses, which are composed of concentric spherical layers, separated by a granite of a less compact kind, and enclosing a hard or central nucleus. These globular masses are often three or four yards or more in diameter, and are either detached or embedded in granite of a softer kind."

The whole of the granite in the Barramahal is more or less striped or veined; the hornblende being occasionally collected into stripes of a dark colour, in which hornblende is in so large a proportion as to form a perfect syenite. These veins are contorted and twisted in all directions; sometimes in perfect zigzags, and sometimes are so perfectly parallel as to impart a slaty character to the cleavage of the rock, and thus transform it into a gneiss. Occasionally masses of porphyritic syenite may be seen embedded in the mass, and sometimes the separated portions of the embedded rock may be traced easily, as being parts of the same broken mass, by their conforming and similar masses. In some cases the veins of the granite are bent round conformably to the portions of embedded syenite, as figured by McCulloch in gneiss of Coll (Western Isles, plate 27, fig. 1);

and then again similar portions of syenite, as if half melted, may be seen fining out, and mingling into veins of the mass; and it is not uncommon to see in a vast mass of granite a mixture of veins, fragments of syenite, of hornblende slate, of quartz veins, granite veins, and portion of gneiss, contorted and mixed together in a degree of complete confusion, which might emulate, if not surpass, that represented by McCulloch in Cape Wrath (Western Isles.)

Where the granite is of a dark colour, from containing a larger proportion than common of hornblende, the rock has then the appearance of being intersected and striped by white veins, which contain sometimes so little hornblende as to approach to a pegmatite.

As small portions of a perfect gneiss are found in the mass of the granite, caused by the parallelism of the veins, so also in the vicinity of granite masses a perfect graduation may be seen between the granite and masses of gneiss; which are perfectly and largely lamillar in structure, and which is most commonly seen between the junction of the schistous series which form the plains with the granite ranges.

On the round surface of many of the large masses of granite, both at the level of the plains and on the highest summits, pointed oval-shaped cavities are found, often of great size, sometimes (as at Anchitlydroog,) 30 feet in length. Half a mile east of the base of the Royacottah hill is a large mass of granite, in which a great number of these cavities, between two and three yards in length, may be seen, and where the structure of the rock is very plainly shewn; they are caused by the disintegration of portions of friable gneiss, which have been embedded in the structure of the rocks, and which may be seen by the portions still remaining to have been blended into the veined and waving structure of the granite. It is remarkable, that the direction of the longitudinal axis of these cavities is generally north and south, coinciding with the direction of the lamination of gneiss formations, and other stratified rocks in general. I have never seen one of these cavities on the side of a rock; but wherever I have seen them they have been generally so situated as to serve as tanks for containing water; and in the hill forts they have been enlarged and walled round to contain the supplies for the garrison.

Similar cavities, but of smaller size, are sometimes produced by the decay of portions of porphyritic syenite, and both these and the gneiss cavities often have the shape of the print of a bull's foot, when they have often been made the subject of adoration by the Hindoo natives of the country.

When these cavities occur in the granite in the beds of rivers, they are frequently enlarged and worked into circular vertical holes by the action of the torrent, giving the stones and sand which lodge in them a revolving motion: thus making what have been called "rock basins" in England, and have been mistaken for works of art. Dr. Benza (Madras Journal, vol. iv., page 292) gives a complete description and dissertation upon them, and therefore it is only necessary for me here to mention, that in the bed of the Cavery I have often traced the progress of the erosion of these basins through all the stages, from the commencement of a hole not four inches long, to where they have been eight feet and more in depth.

### *Rocks and Minerals embedded.*

Besides the syenite, a schorlaceous felspar, porphyry, or grains of black schorl, disseminated in a paste of earthy felspar, may be frequently seen embedded in the granite; but generally in such small quantities, and the grains of schorl so minute, as to render it difficult to distinguish the mineral from the hornblende porphyry; but it may be identified by its action before the blowpipe, before which it melts much easier than hornblende and entumeces very much and bubbles up. In the vicinity of granite hills, a porphyry of black schorl in quartz is also found ; but I am doubtful if it is ever found in granite, the rock being very scarce, and I have only met with it in any quantity a few miles south of Paulcode, and there only, not in situ.

Dr. Boase* and some other writers have endeavoured to shew, that the brecciated appearance of rocks embedded in granite, are only concretionary varieties separated by segregation ; but I conceive that the fact of these fragments being connected with the veins of the granite, and being also intersected by fissures containing granite, and further, from the answering angles of the fragment, these will be received as a sufficient proof of their being true fragments.

It is pretty generally believed, and stated by most writers on Indian Petrology, that the iron sand from which almost all the iron made in South India is smelted, is derived from the disintegration of trap rocks. But I have in no case ever been able to find iron sand in the vicinity of trap formations, and on the contrary, have constantly found it in the vicinity of granite ranges, particularly near those of euritic granite. I have not been able to determine from what part of the hills it is derived, but I am inclined to believe it is embedded in the primary gravel, which forms a part of the structure. This iron sand has been called "iserine" by Dr. Heyne, but it differs in many essentials from that mineral, and particularly in being attracted freely by the magnet. To my analysis it gives but a small proportion of titanium. Dr. Malcolmson (Madras Journal, vol. xii. page 71) states, he was unable to detect titanium in it. In mine it precipitated by boiling, and I think there may be two kinds of the iron sand.

In many granite hills also, small grains of magnetic iron ore may be detected, disseminated through the mass of the

* Primary Geology, page 345.

granite, as about the base of Royacottah hill. It seems probable, that the granite of Arran, which Dr. McCulloch mentions as being magnetic, may have owed this property to a similar ingredient.

*Cleavage.*

In describing the red marle of Mysore, I have remarked that the mamillar masses of granite split into concentric lamina, upon heating the surface by a fire of wood. This is maintained for several hours, and is then swept away, and several large wedges are inserted under the edge of the scale, which has separated. These are driven in by degrees, until the plate has been bent up as far as its elasticity will admit of. A workman then goes upon the surface with a large hammer in his hand, and tapping upon it is able to tell by the sound how far the fissure has run in; at this point he commences a series of heavy blows on the surface, following up the fissure, as it runs on, assisted by the wedges, until the plate gives way with a loud crash, rather startling to any one who does not know what will happen, and it is rent into several pieces, which are often scattered about; the man on the surface escaping by springing nimbly aside. If the edge from which the plate is detached presents a square corner, and a further fissure, a fire is again made upon the surface, and a further scale detached, which is generally thicker the further it is carried on. But at last the broken part no longer presents a sharp corner at bottom, but a rounded curve with the concavity upwards, and the rock will then cleave no further, either by fire or wedges. But if a fire is again made beyond the upper corner, a thin scale may be detached from the surface, which can be followed up as before. The lamina are not therefore exactly concentric, but lie on the surface like the leaves of an artichoke, with a sort of *qûa qûa* versal dip, and the surface of the rock after a frequent repetition of the operation, presents a scalar appearance in steps sloping downwards, sometimes three feet high.

With precaution, the plates separated are sometimes of considerable length and width. They appear to have a tendency to cleavage across the length, but not a decided one in any other way.

No appearance of seams or any natural separation into lamina is ever visible in the granite, and the surface of the separated lamina presents not the slightest visible difference from the mode of aggregation of any other part of the mass.

The masses of granite which have a prismatic form, or which occur in crags, do not cleave by the action of fire, and though they yield square blocks to a series of chissels applied in a row, yet I have not observed that they cleave better in one direction than another; altogether blocks generally have one face parallel to the stripes, and one at right angles to them. The euritic granite has no cleavage whatever, rending in a most irregular manner, and is therefore never used for building, nor any other purpose.

*Veins embedded.*

The masses of granite are often intersected by straight wall-sided veins of a large grained kind of granite; the crystals being sometimes two or three inches across, and these frequently contain packets of dark coloured mica, formed of thin leaves, sometimes three inches across, which are embedded in and cut into the substance either of the crystals of felspar or quartz. These veins are generally from six inches to a foot in width, and they cut sheer through the mass, without apparently deviating in their course, and in this they answer the definition of dykes. Veins which cross their course are sometimes shifted; but on carefully examining the sides of the vein, it will be seen, that there is a perfect, but rapid graduation between the vein and the mass. Occasionally I have observed that these veins branch off, continuing in the deflected direction as straight a course as the non-deflected portion; and I have also occasionally observed that the deflected and separated vein becomes *diffused* into the mass of the granite, by a gradual spreading and mingling of the substance of the two.

Irregular-shaped portions of a rock perfectly similar to the veins, occur frequently embedded in the mass of the granite of large hills; sometimes as tortuous, broad veins, which gradually fine out, or which sometimes gradually mingle in the mass; and both these irregular veins and masses, and also the dyke-like veins, always contain embedded in their substance grains, or fine veins, or sometimes large pieces of magnetic iron ore.

I think from what has been stated, there is pretty good ground for considering all these as veins of segregation, or at least as veins cotemporary with the mass.

Lenticular-shaped veins of quartz, two feet in length, and an inch or two in width, are also common, and the disruption of veins which cross these diagonally, may be sometimes also seen.

In some places I have observed narrow tortuous quartz veins, which run many yards through the mass; but disrupted in the manner represented in the sketch,* the ends finishing in fine stripes, and sometimes are even connected by a fine thread, as if they were portions of a single vein, separated and altered and compressed by some peculiar movement in the parts of the mass.

On looking over Dr. Boase's accurate description of the lodes which contain the minerals of Cornwall, (Primary Geology, chapter ix.) it will be seen, that these veins and embedded irregular masses answer nearly exactly to the description of the lodes, except in being on a much smaller scale.

* Sketch not received.—Ed.

### *Basalt Veins.*

Veins and dykes of basalt, and also masses of basalt diffused into the mass, occur in the granite of this district, and in other localities in south India. This phenomena is a point of some consequence in Petrology. Basalt dykes in granite appear to be very uncommon in Europe, indeed it may be doubted if they have ever been seen. For although mentioned by Thomson, Mineralogy vol. ii. p. 222, yet Bakewell and Phillips (Encyclopedia Metropolitana, Geology, page 752,) contradict him, both calling the rock gneiss; and on collating the remarks of Phillips and Bakewell, it will be seen that they contradict each other; the one asserting that the gneiss is changed to hornstone, the other that the basalt is so changed.

The rocks to which the term basalt has been applied by different writers are so various, that I must enter on the subject by defining my own application of the term, which may be very well inserted here, as basalt in south India is found in granite masses principally.

McCulloch* proposes to confine the use of the term to a minute aggregation of hornblende; but if this is done, I shall be left without a name for the rock in question.

Black granite (hornblende rock) is an aggregation of hornblende and quartz or felspar, with the hornblende in such large proportion as to give to the rock a black colour, and to render the grains of quartz and felspar invisible, unless examined closely.

When the structure is so minute as to be almost invisible without a lens, and when its fracture is semi-conchoidal, it will be best termed basaltic hornblende.

A minute aggregation of hornblende alone, which shews no glistering grains of quartz or felspar, will be best termed

* Geology, vol. ii. page 103.

"granular hornblende," and where the grains are so large as to deserve the name, and render visible the form of the crystals, it may be termed "crystalline hornblende." The above descriptions are not, I think, likely to be misunderstood, and their use is not at variance with the application by other writers.

Basalt, the rock in question, may be defined thus:—

Colour black or greyish black; fracture irregular or semiconchoidal and smooth; structure compact, homogeneous and massive, and the lens shewing no apparent aggregation; streak none; hardness, does not yield at all to the knife; very tough, resisting a very heavy hammer, and flying into sharp fragments, to the great danger of the knuckles and shins; melts easily into a clear black glass, by which it is distinguished from Lydian stone or bassanite or flinty slate, which occurs also in this district, but is *quite infusible.*

It is found in granite as long veins, sometimes many yards in length and only an inch in width, which run through the mass with a tortuous course, sometimes interrupted, as above mentioned, in quartz veins, the ends joining as if disrupted, and drawn out by some motion in the parts of the mass, and the ends occasionally are seen merely slipped on one side, with a very fine thread joining them. Sometimes it is seen embedded in the body of a mass of granite, enclosing an entangled breccia of granite, the body of the basalt being diffused into the granite by fine, irregular and tortuous veins. In this manner it also occurs in gneiss; sometimes it is seen as very fine and thin short veins, which fine out at each extremity; insulated in the body of the granite and in the same way in gneiss, crossing and sometimes coinciding with the lamination.

The above may be observed in the granite hills three miles S. E. of Salem, and in a small range of hills two miles from Royacottah, on the right and left of the road to Kistnagherry. Dr. Benza has described basalt dykes in the Koondahs; but the only dykes I have seen are at Deonhully and at Boredurraputty, two miles south of Coorrumbaputty, on the road between Kistnagherry and Oossoor. This last locality is well worth the notice of a geologist, as also a spot two miles east, further up the little river, where the long veins may be seen.

These basalt veins and dykes have been considered by most observers in India as having been irrupted into the mass of the granite; but in this I cannot agree with them. Lieutenant Newbold, (Madras Journal, vol. xi. page 134,) has generally correctly described the dykes at Deonhully, but has omitted some particulars, and some of his remarks are contrary to my observations, and his inferences are altogether so.

In the first place in every case of these dykes no evidences of disruption or violent action has ever been observed, beyond the presence of the dyke itself. Secondly, in every instance there is undeniable proof of the granite having been in as soft a state as the basalt, for the most minute fissures are filled up without the slightest vacuity, and the adherence between the basalt and granite is complete; also the veins fine out, and are separated by fine threads, and at Deonhully, in Lieutenant Newbold's own words, "short, parallel veins are observed at a little distance from, but having no connection with the main stream"—these fine out at each end, or are lenticular, and one of them ends abruptly; also lenticular veins run across the lamination of gneiss. Thirdly, the veins in granite shew undeniable evidence of the stone not having been split while solid, for the veins are branched and separated, fining out as they run on; now, converging diminishing fissures may be produced in a solid stone, but I contend that it is impossible to produce in a solid mass diverging diminishing fissures. Fourthly, the structure of the granite is in no way ever altered in the slightest degree in the vicinity of the basalt, nor is there any change in the basalt. Fifthly, there is evidence that the basalt was not in motion; because in the dyke at Deonhully, granite veins parallel to the sides may be seen in the basalt in the same way exactly as the basalt is in the granite; and in the dyke at Boredurraputty a fine point of granite, about twelve inches long, may be seen projecting into the dyke of basalt, and as in no case are these dykes ever connected with any mass of basalt, and as the proportion of their mass does not exceed that of a million to one, as compared with the granite, and as therefore no heat which they would have afforded could have softened the granite, I therefore think there is strong evidence of these dykes being but large veins, cotemporaneous with the granite itself.

At Namkull, however, in the base of the rock, there may be seen a dyke of basaltic hornblende, about two feet in width and many yards in length, which shews strong evidence of having been run into the fissure in the solid granite, the edges answering all along, and a piece of the granite separated in the division, and now lying across the fissure, may be seen exactly to answer to a contiguous cavity in the side.

In the Boredurraputty dyke it is a curious fact, that the dyke, which is about nineteen feet wide and runs exactly north and south, may be traced on the surface of three miles to where it is embedded among the schistous rocks in the plain, and it is there changed into hornblende rock, (black granite,) in globular masses.

This might seem to prove the similarity between black granite and basalt, as is generally believed; but as the granite which is hornblendic is not at all altered in structure in the vicinity of the basalt, the hornblende preserving its crystalline form and characteristic appearance, it is plain that the basalt and hornblende cannot differ from each other merely in the manner and rapidity of cooling, as is sometimes supposed by Mineralogists, because both in this case must have cooled at the same time.

Chemical analysis of both minerals which I have made, also shew a considerable difference between them; but I have not yet had time to make an analysis sufficiently correct for publication.

*Graduation.*

In the huge granite masses of this district, granite may be seen graduating into all the varieties of hornblende rock, hornblende slate, gneiss, friable gneiss, sometimes micaceous granite; but these changes are most distinctly visible about the junction between granite ranges and the schistous series.

Specimens can be procured shewing a most perfect graduation between the granite and hornblende rock, (black granite,)* and as this rock is found in the midst of granite formations, exhibiting all the characteristics of granite, it cannot be well doubted that black granite is but a mode of hornblendic granite, and that the term trap, sometimes applied to it, is improper, if by it is meant a rock intruded posterior to the granite.

I have above remarked, that the granite graduates into gneiss, and as portions of gneiss retaining their fissile cleavage are found embedded in the granite, it is plain that the change from gneiss into granite cannot have been produced by the action of heat, as seems to be the opinion of some writers.

Dr. Benza (Madras Journal, vol. iv. page 285) has remarked, that granite does not graduate into basalt, in which, as far as my observation goes, he is certainly quite correct; no direct graduation between granite and basalt ever taking place.

* The graduation here alluded to, may be called a "Mineralogical graduation." A "Geological graduation" may have place in the gradual change between two masses or formations on a line which joins the two; such however I have never seen anywhere, nor do I recollect a *perfect* description of such a change.

Basalt graduates into basaltic hornblende, and granite into hornblende rock, but beyond that the series is imperfect, and I have never seen, nor have been able to trace in any series of specimens from black granite or from greenstone or syenite, any graduation towards basaltic hornblende as might be expected, if basalt and hornblende are different minerals.

### *Application of the Name.*

Although it is my intention in this paper to confine myself as much as possible to description, without wasting time in entering upon endless considerations of imperfect theoretical distinctions, yet it is necessary to offer a few remarks regarding the propriety of the application of the term granite to the formation in question. From its graduating into gneiss, some Geologists would consider it as granitic gneiss, from its graduating in trap, by some it will be called syenite, and not one of the true primary granitic formations.

Independent altogether of what its true geological position or origin may be, I consider it best, as Dr. Boase has done, to consider the term granite as a proper designation of any ternary compound of quartz, felspar, and mica, hornblende schorl, or chlorite, united together in a confused crystallization, mutually penetrating and interfering with each other, without considering whether it is striped or veined, or has any other peculiarities in its mode of aggregation, as long as its granitic character is preserved. Almost every person has an idea of what is like and what is not like granite, and I do not think it necessary, therefore, to attempt to define any further, except to confine the application to within a certain proportion between the ingredients, which is easiest done by colour. Granite at a distance has a bluish grey colour; closely examined it is a regular mass of shining particles, with some black specks in greater or less quantity disseminated through the mass. As the quantity of these black specks of hornblende increase, the rock takes a speckled appearance, the quantity of the black nearly equalizing the quantity of the other true ingredients, it is then a syenite;* and when the hornblende is in still greater quantity, so as to give a black or very dark grey appearance, it becomes hornblende rock, the common black granite of India, of which all the Hindoo idols are made.

The difficulty of a definition of granite is very great, and while writers on geology have failed, it is not to be expected that I should be able to supply the deficiency; and the best way both to save time and further attempts of explanation, is to refer to published descriptions. The granite of Cornwall, as described by Dr. Boase, appears to be more felspathic than that of this district, containing much earthy felspar or eurite, and it resembles therefore in some measure the Pallicondah granite. I have been unable to identify any granite in Dr. McCulloch's works; but by his definition of syenite, (Western Isles, vol. i. page 371,) and the points in which it resembles granite, it would seem that no such granite, forming hills or extensive formations, occurs in this district; but that such a rock as he seems to allude to occurs frequently in beds and insulated masses among the schistous series, and is a loosely aggregated collection of grains of different minerals, without any of that mutual penetration or interference which appears to give the characteristic solidity to granite.

I shall therefore, with Dr. Christie and most other writers on India, consider the rock as a true granite, and reserve the term gneiss as applicable to any lamillar or schistous variety,† or to what McCulloch would term granitic gneiss;

* The aggregation or structure becoming at the same time no longer confused, but distinct and separate.

† As Bakewell has done, (Geology, p. 93,) where he distinctly defines gneiss as a "schistose granite," independent of the arrangement of its component parts.

while the rock in which the mica is in considerable proportion, and in which the mica is arranged conformably to the lamination, I shall term "friable gneiss," following Dr. Benza, who has so applied that term, in consequence of every Indian variety of such rock being always so finely lamillar as to be fissile and soft. I have here anticipated further and more complete explanations for the sake of preventing any misunderstanding from a neglect, (but too common in writers,) in not defining their terms, which is often productive of serious inconvenience; as for instance, where we are informed by Dr. Graham, that the common rock of Ceylon is "gneiss," while we have reason to believe, that any extensive formations of gneiss is as rare in Ceylon as in the Peninsula of India.

### *Outlying Boulders of Granite.*

Rounded blocks of granites may frequently be observed far detached from any range, and embedded among the schistous series of the formations of the plains, or even embedded in red ferruginous soil. By many geologists these would be considered as travelled boulders; but although I have seen many of them perfectly insulated among the matrix which embeds them, yet they may in many cases be seen to be in *situ*, by their being intersected by veins of white quartz, which run completely through the blocks, and to some distance (for a yard or more) into the matrix. In the block these veins are solid; but in the earthy matrix, they are cracked into small portions with regular answering angles, as has been several times before remarked. This interesting fact, Mr. F. Burr, (a well known geologist at Madras,) has informed me that he has also observed in the road between Cannanore and Bangalore; but whether he draws from it the same inference as myself, I am not aware. Wherever gneiss occurs as a formation near granite ranges, large flattened spheroids of granite, sometimes three yards wide and three feet thick, may very frequently be seen embedded among the lamination of the gneiss, conformably with the strata. The composition of these blocks is hornblendic, while the gneiss contains both hornblende and mica, and no graduation or change is apparent between the two; at first sight therefore the blocks appear like eratic boulders, embedded in the sedimentary rock; but as on the Jowandy hills, S. W. of Vellore, I have seen these blocks surrounded by concentric layers of gneiss, answering exactly to the shape of the stone, and because in other parts a graduation may be traced between the same gneiss and the larger masses of granite, I am inclined to consider them parts of the original structure of the rock, although I have not observed any satisfactory proofs of their being so.

Dr. Boase* appears to allude to similar embedded blocks in Norway and Sweeden, in consequence of which, the granites of these countries have been called "granitic gneiss," while by some it is insisted that they are true granite.

Dr. M'Clelland† appears to describe similar masses of granite embedded in gneiss in Kemaon, at Chourapany, and refers their denudation to the action of the air on the saline constituents of the gneiss.

I have not had an opportunity of proving that any portion of the granite formation of this district does contain a superabundance of saline matters; but conceive it not improbable that the whole of the salts, which are plentiful in the plain of the Barramahal, may be derived from the granite ranges.

### *Differs from Granite of Europe.*

It will be seen that the granite of India differs very materially in many essential points from the granite of Europe. In the first place, it forms a vast and continuous bed at a

* Primary Geology, page 33. † Geology of Kemaon, page 47.

small distance below the surface of an extensive peninsula. In the second, it never shews any evidence of having been irrupted, intruded, nor forced by mechanical action in among prior existing rocks. Thirdly, it is very durable and persistent, the solid masses never shewing the slightest sign of decay, nor action by the weather; the oldest known structures retaining their angles and inscription as perfect as at the time of construction, and the tors and crags on the summits of mountains exhibit sharp corners, and surfaces, which appear to have defied the action of time for countless ages, while, according to McCulloch, (Western Isles, vol. i. p. 217) it is remarked that "granite is a rock not often remarkable for bearing the effects of time and weather." Fourthly, and in the last and most important point, it never forms veins into the adjacent rocks, nor does it even shew any signs whatever of exerting metamorphic action upon adjacent rocks.

This last point is of considerable importance, as upon it rests principally the evidence of the intrusion of granite in a state of fusion; and although we are not as yet sufficiently well acquainted with the characteristics of Indian granite to attempt to disprove the European theories, yet it is to be hoped that observers will in future bear in mind, that it is not necessary for the advancement of our knowledge of the works of nature, to assume that the prevailing theories of the origin of the primary rocks have been deduced by correct inference, and that they will in future give more attention to the exact description of facts, and devote less time and ingenuity in accommodating the results of observation to preconceived theories, which every one who has learnt the true spirit of philosophy, will at once acknowledge *may be all wrong*.

I have not myself had opportunities of observing the conjunction of the granite of the south of India with the perfect series of schists which are found as we advance northward; but I do not find mention made by any writers of granite veins in these formations, but still it appears to me that the points of difference are so considerable as to permit ground for the supposition that the granite of India may be the *true* granite, and should be assumed as the type or normal of that formation; while the granite which occurs in Great Britain, and such as we have the best description of, may not be itself the lowest and basic formation, (as indeed is known by volcanoes being ejected from beneath it,) and that the phenomena of its intruded veins and metamorphic action, may have been caused by the fusing power of some other formations on which it rests;* of which also evidence may be derived from the fact of slate veins being intruded into granite, as well as the veins of granite into the slate, vide Boase and other authors.

Dr. McCulloch (Geology, vol. i. p. 161) remarks upon the desquamation of the Scottish granite, and that of Africa; a fact which is corroborated by another writer (Phillips) I think, who observed it in the balusters of a bridge. In Indian granite, however, this phenomenon is quite unknown, nor does it occur in any other rock; for it will be shewn elsewhere, that what has been supposed by some to be the desquamation of spheroids of trap, is an original structure in the rock.

### *Derivation origin.*

As the syenite and porphyritic syenite, and other rocks found embedded in granite occur, forming a large proportion of the schistose series, and as quartz rock and pegmatite, and in short all the minerals and rocks necessary for the formation of granite are there found in beds, it is plain that to disintegrate the components of the granite, and re-arrange them in beds to form the schistose series, would be a somewhat too improbable theory. It seems most probable, there-

* Or it may be in fact only a variety of a trap rock, and such appears to be the opinion of Phillips, Encyclopedia Metropolitana.

fore, that the granite rocks have been formed by the fusion and consolidation of the schistose beds; but it will be quite unnecessary to follow out the theory any further, as the subject has been already sufficiently dilated upon by much abler and better informed writers.

The basalt veins and dykes in granite will also serve to corroborate this theory, for they also occur in the schistose series, most commonly in the shape of wall-sided dykes.

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## *On Solar Radiation. By Captain* J. CAMPBELL, *Assistant Surveyor General.*

Solar radiation, or the heating power of the sun's rays, is a subject on which very little is still known, and which ought to receive more attention in India, where we have a considerable range of latitude, a generally clear sky, and opportunities for observation hardly equalled in any part of the world.

As I have not opportunities of regularly seeing the periodical scientific publications, and the latest standard work I have to refer to is of 1835 only, I shall therefore not attempt to give an account of the present state of our knowledge on this subject, but confine myself to pointing out the advantage of collecting experiments, and the mode of making them; for which purpose it will be necessary to commence with a sketch of the subject, for the sake of explanation.

In 1823, Daniel, in his Meteorological Essays, pointed out the difference of the heating powers of the sun's rays in different latitudes, as shewn by exposing to their full action a mercurial thermometer with the ball blackened. He compares the results obtained by Captain Sabine, himself, and Captain Scoresby in the Arctic regions, and shews that the utmost power of the sun's rays in different latitudes, only raised the blackened thermometer above one in the shade as follows: —

At Rio Janeiro, Lat. 12°——47° }<br>
London, Lat. 69°——69° } of Farhenheit.<br>
Arctic Regions, Lat. ——90° }

From this he drew the following conclusion: "That the force of solar radiation increases from the Equator to the Poles." For this inference, which he had supported by many experiments, Daniel has been severely censured by some of the continental physicians, and accused of advancing his remarks with confidence and presumption.

The inference from Scoresby's observations does not appear to have been warranted, from the last observations made with proper instruments by Franklin, Back, and Richardson in the Arctic circle, who have shewn that the maximum radiating power is not more than 53.° It is possible some contingent circumstances, such as evaporation or proximity to a surface of snow may have affected these results; but, however, that may be true or not, yet Scoresby's observation stands as an incontestable fact. He remarks that when in the Arctic regions, he saw the pitch melted out of the seams of a ship by the heating power of the sun's rays impinging on the black exterior, when on the opposite side, in the shade, the temperature was 20° of Farhenheit. As Daniel found pitch to melt imperfectly at 136°, he therefore estimated the solar radiation at about 90°. When it is remembered that in India the utmost power of the sun's rays can hardly melt the pitch off a gun or a tarpaulin, and only slightly off the new tarred rigging of a ship, even when the temperature of the air is 90°, there is strong evidence for supposing that the sun has a greater heating power near the Poles than near the Equator.

The correctness of Captain Sabine's experiments has been questioned, because he laid the blackened thermometer exposed to the sun's rays on some dry plants, raised only a few inches above the surface of the earth; and because it has been proved by experiment by Mr. Foggo, (No. 27, Edinburgh Phil. Journal,) that a thermometer so laid upon a grass plat, shewed only 119°, while another not in contact with the earth, rose to 150°.

This objection is not however a valid one, for it must be remembered, that in England the soil is always wet and damp, and the evaporation of moisture from its surface would alone be sufficient to account for the depression of temperature.

In the case of Captain Sabine's experiments, it is probable the soil was perfectly dry, not having perhaps for six months been moistened with a shower, and it is well known in the tropics that the soil is always hotter than the air, and therefore that the experiments, if erroneous at all, must have shewn a result on excess of the true power of solar radiation.

Mr. Daniel's experiments shew a maximum result of 65° for solar radiation, the blackened thermometer being at 140°, while in the shade the temperature was only 75°. Mr. Foggo's experiments instead of disproving Daniel's theory, serve very satisfactorily to confirm it; for he says that the blackened thermometer rose to 15° in the sun's rays near Edinburgh; while in India no such high temperature has ever been observed. At Chicacole in October 1836, in very dry hot weather, I made some experiments with thermometers prepared with every care, with black wool, Indian ink, black varnish, and the highest result I ever obtained was 127° in the open air, while the thermometer in the shade was 84°, or 43° only for the *maximum* effect of the solar radiation, in latitude 18° 15′ N. at the time of year of the observation; and Dr. Baikie has shewn that on the Nielgharry hills in January, the maximum radiation is 24° only.

The best instrument now recommended for observations on solar radiation is Herschell's actinometer, an instrument which I have not had an opportunity of observing with.

But the following extract from the report of the Committee of the Royal Society may be useful:—

" This instrument consists of a large hollow cylinder of glass, soldered at one end to a thermometer-tube, terminated at the upper end by a ball drawn out to a point, and broken off, so as to leave the end open. The other end of the cylinder is closed by a silver or silver-plated cap, cemented on it, and furnished with a screw, also of silver, passing through a collar of waxed leather, which is pressed into forcible contact with its thread by a tightening-screw of large diameter enclosing it, and working into the silver cap, and driven home by the aid of a strong steel key or wrench, which accompanies the instrument.

" The cylinder is filled with a deep blue liquid, (ammonio-sulphate of copper,) which ought to have been prepared some months beforehand, as it deposits a sediment when fresh, however clear or carefully filtered. This sediment, if deposited in the interior of the instrument, may be washed out with weak muriatic acid, which should itself be removed by water before refilling the instrument, and the ball at the top being purposely left full of air, and the point closed with melted wax, it becomes, in any given position of the screw, a thermometer of great delicacy, capable of being read off on a divided scale attached. The cylinder is enclosed in a chamber blackened on three sides, and on the fourth, or face, defended from currents of air by a thick glass, removeable at pleasure.

" The action of the screw is to diminish or increase at pleasure the capacity of the hollow of the cylinder, and thus to drive, if necessary, a portion of the liquid up into the ball, which acts as a reservoir; or, if necessary, to draw back from the reservoir such a quantity as shall just fill it, leaving no bubble of air in the cylinder.

" *To use the instrument*, examine first whether there be any air in the cylinder, which is easily seen by holding it level, and tilting it, when the air, if any, will be seen to run along it. If there be any, hold it upright in the left hand, and the air will ascend to the root of the thermometertube. Then, alternately screwing and unscrewing the screw with the right hand, as the case may require, it will always be practicable to drive the air out of the cylinder into the ball, and suck down liquid, if any, from the ball, to supply its place, till the air is entirely evacuated from the cylinder, and the latter, as well as the whole stem of the thermometer tube, is full of the liquid in an unbroken column. Then, holding it horizontally, face upwards, slowly and cautiously unscrew the screw, till the liquid retreats to the zero of the scale.

"The upper bulb is drawn out into a fine tube, which is stopped with wax. When it is needed to empty, cleanse, and refill the instrument, liquid must first be forced up into the ball, so as to compress the air in it. On warming the end, the wax will be forced out, and the screw being then totally unscrewed, and the liquid poured out, the interior of the instrument may be washed with water slightly acidulated, and the tube, ball, &c. cleansed, in the same way, after which the wax must be replaced, and the instrument refilled.

"*To make an observation with the actinometer*, the observer must station himself in the sunshine, or in some sharply terminated shadow, so that without inconvenience, or materially altering his situation, or the exposure of the instrument in other respects, he can hold it at pleasure either in full sun or total shadow. If placed in the sun, he must provide himself with a screen of pasteboard or tin plate, large enough to shade the whole of the lower part or chamber of the instrument, which should be placed not less than two feet from the instrument, and should be removable in an instant of time. The best station is a room with closed doors, before an open window, or under an opening in the roof into which the sun shines freely. Draughts of air should be prevented as much as possible. If the observations be made out of doors, shelter from gusts of wind, and freedom from all penumbral shadows, as of ropes, rigging, branches, &c. should be sought. Generally, the more the observer is at his ease, with his watch and writing-table beside him, the better. He should have a watch or chronometer beating at least twice in a second, and provided with a second hand; also a pencil and paper ruled, according to the form subjoined, for registering the observations. Let him then grasp the instrument in his left hand, or if he have a proper stand, (which is preferable on shore or in a building,*) otherwise firmly support it, so as to expose its face perpendicularly to the direct rays of the sun, as exactly as may be.

"The liquid as soon as exposed, will mount rapidly in the stem. It should be allowed to do so for three or four minutes before the observation begins, taking care, however, not to let it mount into the bulb, by a proper use of the screw. At the same time the tube should be carefully cleared (by the same action) of all small broken portions of liquid remaining in it, which should all be drawn down into the bulb. When all is ready for observation, draw the liquid down to zero of its scale gently and steadily; place it on its stand, with its screen before it, and proceed as follows:—

"Having previously ascertained how many times (suppose 20) the watch beats in five seconds, let the screen be withdraw at ten seconds before a complete minute shewn by the watch, suppose at 2h. 14m. 50s. From 50s. to 55, say 0,0,0, —at each beat of the watch, looking meanwhile that all is right. At 55s. complete, count 0,1,2, up to 20 beats, or to the whole minute, 2h. 15m. 0s. keeping the eye not

* This may consist of two deal boards, eighteen inches long, connected by a hinge, and kept at any required angle by an iron, pointed at each end. The upper should have a little rabbet or moulding fitting loosely round the actinometer, to prevent its slipping off.

on the watch, but on the end of the rising column of liquid. At the 20th beat read off, and register the reading (12° 0), as in column 3 A, of the annexed form. Then wait, watching the column of air above the liquid, to see that no bulbs of liquid are in it, or at the opening of the upper bulb (which will cause the movement of the ascending column to be performed by starts), till the minute is nearly elapsed. At the 50th second begin to watch the liquid rising, at 55s. begin to count 0,1,2, up to 20 beats as before, attentively watching the rise of the liquid, and at the 20th beat, or complete minute (2h. 16m. 0s.) read off, and instantly shade the instrument, or withdraw it *just out* of the sun and penumbra. Then register the reading off (43° 3) in column 3 B, and prepare for the shade observation. All this may be done without hurry in 20 seconds, with time also to withdraw the screw if the end of the column be inconveniently high in the scale, which is often required. At the 20th second prepare to observe; at the 25th begin to count beats, 0, 1, 2, 20; and at the 20th beat, *i. e.* at 2h. 16m. 30s. read off, and enter the reading in column 3 A, as the initial shade reading (45°.2). Then wait as before till nearly a minute has elapsed, and at 2h. 17m. 20s. again prepare. At 17m. 25s. begin to count beats; at 17m. 30s. read off, and enter this *terminal* shade reading (42°.8) in column 3 B, and if needed withdraw the zero.

"Again wait 20s, in which interval there is time for the entry, &c. At 17m. 50s. remove the screen, or expose the instrument in the sun; at 55s. begin to count beats; and at the complete minute, 18m. 0s. read off (14°.8,) and so on for several alternations, *taking care to begin and end each series with a sun observation.* If the instrument be held in the hand, care should be taken not to change the inclination of its axis to the horizon between the readings, or the compressibility of the liquid by its own weight will produce a very appreciable amount of error.

In the annexed form, column 1 contains the times, initial and terminal, of each sun and shade observation; column 2

| 1. Date and times of observation. Feldhausen, 30th Oct. 1837. | | | | | 2. Exposure sun (⊙) or shade + | 3. Readings of the Instrument. | | 4. Change per minute. B. A. | 5. Radiation in parts of scale. | 6. Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Initial. | | | Terminal. | | | A. Initial. | B. Terminal. | | | |
| H. | M. | S. | M. | S. | | | | | | |
| 2 | 15 | ,, | 16 | 0 | ⊙ | + 12.0 | + 43 3 | + 31.3 | ........... | The times are reduced to apparent time, or to the sun's hour angle from the meridian. |
| | 16 | 30 | 17 | 30 | + | 45.2 | 42.8 | — 2.4 | 34.75 | |
| | 18 | 0 | 19 | 0 | ⊙ | 14.8 | 48.2 | + 33.4 | 35.40 | Zero withdrawn. |
| | 19 | 30 | 20 | 30 | + | 28.0 | 26.8 | — 1.4 | 34.85 | |
| | 21 | 0 | 22 | 0 | ⊙ | 9.4 | 43.9 | + 33.5 | 34.75 | |
| | 22 | 30 | 23 | 30 | + | 46.6 | 45.5 | — 1.1 | 34.95 | |
| | 24 | 0 | 25 | 0 | ⊙ | 9.0 | 43.2 | + 34.2 | ........... | General mean per formula = 34.73 for 2h. 20m. 0s. of apparent time. |

expresses by an appropriate mark, ⊙ and +, the exposure, whether in sun or shade; column 3 contains the readings initial and terminal (A. and B).; column 4 gives the values B—A, with its algebraical sign, expressing the rise and fall per minute. And here it may be observed, that if by forgetfulness the exact minute be passed, the reading off may be made at the next 10s. and in that case the entry in column 4 must be not the *whole* amount of B—A, but only 6-7ths of that amount, so as to reduce it to an interval of 60s. precisely; column 5 contains the radiations as derived from successive triplets, ⊙ + ⊙, + ⊙ +, ⊙ + ⊙, &c. by the formula presently to be stated; and in column 6 are entered remarks, such as the state of the sky, wind, &c. as also (when taken) the sun's altitude, barometer, thermometer, and other readings, &c.

"The formula of reduction is as follows:—Let ⊙ + ⊙, + ⊙, ×, &c. represent the numbers in column 4 with their signs, in order, as they stand, or the values of B.—A. then will the numbers in column 5 be respectively,

$$+\frac{\odot + \odot'}{2} - \times$$

$$-\frac{\times + \times'}{2} + \odot'$$

$$+\frac{\odot + \odot''}{2} - \times'$$

$$-\frac{\times' + \times''}{2} + \odot'',$$

and so on the algebraic signs being carefully attended to, thus,

$$34.75 = +\frac{31.3 + 33.4}{2} + 2.4$$

$$\frac{2.4 + 1.4}{}$$

$$35.30 = + \frac{\qquad}{2} + 33.4, \&c.$$

"The mean of a series not exceeding three or four triplets may be had by the formula

$$\frac{\odot + \odot' + \odot'' + \&c.}{n.} \quad \frac{\times + \times' + \&c.}{n,-1}$$

Where $n$ is the number of sun observations, the time corresponding being the middle of the middle shade observation.

"A complete actinometer observation cannot consist of less than three sun and two shade observations intermediate; but the more there are taken the better, and in a very clear sunny day it is highly desirable to continue the alternate observations for a long time, even from sunrise to sunset, so as to deduce, by a graphical projection, the law of diurnal increase and diminution of the solar radiation, which will thus readily become apparent, provided the perfect clearness of the sky continue—an indispensible condition in these observations; the slightest cloud or haze over the sun being at once marked by a diminution of resulting radiation.

"To detect such haze or cirrus, a brown glass applied before the eye is useful, and by the help of such a glass it may here be noticed, that solar halos are very frequently to be seen when the glare of light is such as to allow nothing of the sort to be perceived by the unguarded eye.

"It is, as observed, essential that the instrument be exposed a few minutes to the sun, to raise its temperature in some slight degree; if this be not done, owing to some cause, not very obvious, the first triplet of observations (sun, shade, sun,) will give a radiation perceptibly in defect of the truth, as will become distinctly apparent on continuing the series. But it may be as well for a beginner to commence at once reading as soon as the instrument is exposed, and reject the first two triplets, by which he will see whether he has all his apparatus conveniently arranged, and get settled at his post.

"When a series is long continued in a good sun, the instrument grows very hot, and the use of the liquid in the sun observation decreases, while the fall in the shade increases; nay, towards sunset it will fall even in the sun. This phenomenon (which is at first startling, and seeming to impeach the fidelity of the instrument) is, in fact, perfectly in order, and produces absolutely irregularity in the resulting march of the radiation. Only it is necessary in casting up the result (in col. 5) to attend carefully to the algebraic signs of the differences in column 4, as in the following example, (which as well as that above given, is one of actual occurrence).

| 1. Date and times of observation, Wynberg, Nov. 24, 1837. | | 2. Exposure sun or shade. | 3. Readings of the Instrument. | | 4. Change per minute. B−A. | 5. Radiation in parts of scale. | 6. Remarks. |
|---|---|---|---|---|---|---|---|
| Initial. | Terminal. | | A. Initial. | B. Terminal. | | | |
| H. M. S. | M. S. | | | | | | |
| 6 5 15 | ...... | ...... | ...... | ...... | ...... | ...... | |
| 9 0 | 10 0 | ⊙ | + 9.9 | + 9.7 | + 0.7 | ...... | Alt. of ⊙ = 70 19'. |
| 10 30 | 11 30 | + | 23.0 | 10.8 | − 12.2 | 11.25 | |
| 12 0 | 13 0 | ⊙ | 34.0 | 31.4 | − 2.6 | 9.25 | |
| 13 30 | 14 30 | + | 28.5 | 17.0 | − 11.6 | 8.20 | Cirrus haze coming on. |
| 15 0 | 16 0 | ⊙ | 12.0 | 8.0 | − 4.0 | ...... | |
| 6 19 15 | ...... | ...... | ...... | ...... | ...... | ...... | Alt. of ⊙ = 40 37'. |

"Every series of actinometer observations should be accompanied with notices in the column of remarks, of the state of the wind and sky generally, the approach of any cloud (as seen in the coloured glass) near to the sun; the barometer and thermometers, *dry* and *wet*, should especially be read off more than once during the series; if a long one, and if kept up during several hours, hourly. The times should be correct to the nearest minute, at least as serving to calculate the sun's altitude; but if this be taken (to the nearest minute or two) with a pocket sextant, or even by a style and shadow frequently (at intervals of an hour or less) when the sun is rising or setting, it will add much to the immediate interest of the observations. When the sun is near the horizon, its reflection from the sea or any neighbouring water must be prevented from striking on the instrument; and similarly of snow in cold regions, or on great elevations in Alpine countries.

"Every actinometer should be provided with a spare glass, and all the glasses should be marked with a diamond; and it should always be noted at the head of the column of remarks which glass is used, as the co-efficient of reduction from the parts of the scale (which are arbitrary) to parts of the *unit of radiation* varies with the glass used.

"In the case of the actinometers sent out with the Expedition and to the fixed Observatories, it was not practicable to ascertain these co-efficients for each instrument and each glass, owing to the total absence of any favourable opportunity of sunshine. The values of the parts of the respective scales of the instruments, as determined approximatively by careful measurement of the dimensions, were as follows:—

| Marks of the Actinometers. | | Multiplier for reducing parts observed to parts of a standard retained in possession, marked A. 1. | Approximate value of one part of scale in Actines. |
|---|---|---|---|
| Mark's mark. | Private mark. | | |
| 1 | K | 1.4909 | 7.085 |
| 2 | L | 1.3726 | 6.523 |
| 3 | M | 1.4020 | 6.663 |
| A 4 | N | 1.6550 | 7.864 |
| A 5 | O | 1.4403 | 6.844 |
| 6 | P | 1.0608 | 5.041 |

" The dimensions of the instruments which are used in these reductions are,

" 1. The external diameter of the cylinder containing the coloured liquid, *i. e.* its mean diameter, if on measurement with fine callipers its two ends be found to differ.

" 2. The length of that portion of it which receives the sunbeam. The product of these two data gives the area of the section of the sunbeam effective in raising the temperature, and which, though not all *equally* effective, by reason of the cylindrical form of the glass, is yet effective in the *same ratio* in all of them by reason of their general similarity of figure.

" 3. The contents (in water grains) of 100 parts in length of the capillary tube used for the scale. This may best be determined by gauging it with mercury before it is soldered to the cylinder, and ought always to be so determined by the maker; but when fitted this is impracticable, and the measurement of the element in question must be performed as follows:—

" The instrument being placed horizontally, and allowed to attain the precise temperature of the apartment, let the liquid be brought to zero by the motion of the screw; after which let the screw be turned precisely one revolution, or half revolution (as the scale may require) *in* and note the rise of the liquid in parts of the scale. This must be done several times, alternately screwing *in* and *out*. The screw must then be taken out; its thread counted, and the weight of water displaced from a narrow vessel exactly full, by the immersion of the whole length occupied by the thread exactly ascertained by a nice balance; after which a very simple calculation will give the value of the parts of the scale in water grains required; this process was followed in the case of the instruments above mentioned, and if carefully conducted, is susceptible of great precision.

"The glasses as well as the cylinders and capillary stems of the instruments, if accidentally broken, should have their fragments carefully preserved and labelled.

"The unit of solar radiation to be adopted in the ultimate reduction of the actinometric observations is the *actine*, by which is understood that intensity of solar radiation which at a vertical incidence, and supposing it wholly absorbed, would suffice to melt one-millionth part of a metre in thickness, from the surface of a sheet of ice horizontally exposed to its action per minute of mean solar time; but it will be well to reserve the reduction of the radiations as expressed in parts of the scale to their values in terms of their unit, until the final discussion of the observations.

"Meanwhile, no opportunities should be lost of *comparing* together the indications of different actinometers under similar and favourable circumstances, so as to establish a correspondence of scales, which in case of accident happening to one of the instruments, will preserve its registered observations from loss.

"The comparison of two actinometers may be executed by one observer, using alternately each of the two instruments, thus:—

| Instrument. A. | Instrument. B. | A. | &c. |
|---|---|---|---|
| ⊙ .............. | ⊙ .............. | ⊙ ............ | |
| × .............. | × .............. | × ............ | |
| ⊙ .............. | ⊙ .............. | ⊙ ............ | |

beginning and ending with the same, though it would be more conveniently done by two observers observing simultaneously at the same place, and each registering his own instrument. An hour or two thus devoted to comparison in a calm clear day, and under easy circumstances, will in all cases be extremely well bestowed.

"Neither should each observer neglect to determine for himself the heat stopped by each of his glasses. This may be done also by alternating triplets of observation made with the glass on and off: thus,—

| Glass off. | Glass on. | Glass off, | &c. |
|---|---|---|---|
| ⊙............ | ⊙............ | ⊙............ | |
| ×............ | ×............ | ×............ | |
| ⊙............ | ⊙............ | ⊙............ | |

beginning and ending with the glass off, and (as in all cases) beginning and ending each *triplet* with a sun observation. For the purpose now in question, a very *calm* day must be chosen, and a great many triplets must be taken in succession. It will be found that a single thickness of the ordinary bluish or greenish plate glass stops about 0·20 ($=\frac{1}{5}$) of the incident calorific rays; a second glass about 0·16 (or a materially less proportion) of those which have escaped the action of the first. No two glasses, however, are precisely alike in this respect.

"Very interesting observations may be made by two observers furnished with well-compared actinometers, the one stationed at the summit, the other at the foot of some great elevation; especially if the stations can be so selected, that the observers shall be nearly in the line of the incident sunbeam at the time of observation, so as both to lie in the atmospheric column traversed by the rays. Many convenient stations of this kind might be found in mountainous countries; and by repeating the observation two or three times under favourable circumstances, interchanging observers and instruments, &c. and accompanying the observations with all circumstantial and local elements of precision; there is no doubt that the co-efficient of extinction of solar heat in traversing at least the lower strata of our atmosphere might be obtained with much exactness, and thus a highly valuable *datum* secured to science. The observers would, of course, agree to make their observations strictly simultaneous, and should, therefore, compare watches before parting.

"The actinometer is also well calculated for measuring the defalcation of heat during any considerable eclipse of the sun, and the Committee would point out this as an object worthy of attention, as many eclipses, invisible or insignificant in one locality, are great, or even total in others. The observations should commence an hour at least before the eclipse begins, and be continued an hour beyond its termination, and the series should be uninterrupted, leaving to others to watch the phases of the eclipse. The atmospheric circumstances should be most carefully noted during the whole series."

The intention of this instrument is to measure the action of the sun's rays during a given portion of time. After the instrument has been exposed for a short time to the sun, and it is then shaded for one minute, the temperature of the instrument decreases, as is shewn by the descent of the fluid. At the end of the minute, if the instrument was still shaded, the temperature would still further decrease; but if the sun's rays are then allowed to act upon it for one minute, the temperature again increases; therefore the whole action of the sun's rays during the minute is not only measured by the increase of temperature in that time, but also by the decrease of temperature while their action was being arrested, and which would have had effect had the instrument been shaded. Therefore the action of the sun's rays is measured by the mean cooling during the minute, added to the heating power during that time, or by the mean heating power added to the measure of the cooling. It is very necessary to attend to this explanation of the action of the instrument, for I find that some observers have been led into error by mistaking the principle, and among others, a valuable set of observations made by Mr. Dalmahoy at Moulmein, (Madras Journal, vol. iv. page 55,) are of doubtful nature.

In Reid's Chemistry also, (third edition, page 678,) it is erroneously stated, that the "actual influence of the sun's rays is measured for one minute by subtracting the mean of two indications in the shade from the amount induced on direct exposure to the sun;" an error probably caused by persons not accustomed to the use of algebraic symbols mistaking the application of the signs of the quantities.

Dr. Reid also is in error in saying, that the instrument "measures the action of the sun's rays apart from the cooling influence of surrounding objects;" for it obviously only measures the difference between the heating effect of the rays, and the cooling effect of radiation from its surface, and of the contact of the atmosphere.

Leslie's Photometer is another instrument for this purpose; but unfortunately, it is so liable to get out of order, as to be almost useless in this country; because, if inverted during carriage, the thread of the coloured liquor becomes broken. The instrument may, however, be again put in order by holding a piece of hot charcoal near one of the balls, which will drive all the fluid into the other, and thus reunite it.

To adjust the zero point to the scale, the charcoal is then to be applied to the ball containing the fluid, by which it will be driven over into the other ball, and then the bubbles of air may be passed on through it one by one, until, when the instrument is allowed to cool, the top of the thread of fluid will remain near the zero point. During the operation bubbles are apt to form, which cause great trouble; but by getting them into the top of the ball, they can be broken by suddenly bringing the hot piece of charcoal nearly into contact with the glass, by which a sudden expansion of the bubble is produced, which will cause it to burst, while the thinness of the glass will prevent its being injured. I fear the method of operation can be hardly made intelligible except by shewing the experiment, and I merely allude to it, because I have heard it asserted that these instruments are useless when once injured. In my own attempts to repair those in my possession I failed for many days; but half an hour was quite sufficient for the operation after the method was discovered; and what I have done, others can of course hit upon, if they try to acquire manipulation from the above brief hints.

Thermometers with blackened balls seem to be best for use in this country. Dr. Christie has described a very excellent form for one; but common thermometers may be easily made use of.

For this purpose, the best six inch scales should be selected, and the hole round the ball should be enlarged to at least one-fifth inch all round. The ball may then be covered by applying any glutinous varnish and sticking black wool or cotton to it, or, as I prefer, by painting the ball with black sealing wax dissolved in spirits of wine.

It is necessary that the black thermometer should be covered with a close glass case to prevent the wind abstracting heat from it. This is easiest done by enclosing the whole thermometer in a thin glass bottle, or in a glass case.

The case is made of common window glass, framed together with narrow edgings of tin. It is ten inches long, three and a half inches broad, and three inches high, with a door at one end, and was made in the bazar, and cost a rupee only. The thermometer is laid in it, supported on a cube of wood about an inch each way, and the case is laid on a teapoy resting on a book at each end, by which it is kept free from contact with the wood. The time I prefer for the observations is noon, when the sky is cloudless.

The maximum effect of the sun's rays cannot be found by leaving a thermometer exposed in the above case; for I find that the air in it becomes gradually heated by the radiation from the scale of the thermometer. I therefore have found it best to estimate the power of the sun's rays as a function of the time, in the manner directed by Sir John Herschell for the actinometer. In this manner I have found the effect during one minute to vary from 3° of Farhenheit to 7°. But my experiments have not as yet been satisfactory. I find also that sometimes the moisture in the air contained in the case is deposited like dew on the inside, which of course interferes with the passage of the sun's rays; perhaps this may be neutralized, by leaving the door a little open, and the heating of the air in the case may perhaps be prevented in the same way.

The only objection to the use of common thermometers is, that they are not sufficiently delicate in their indications; but perhaps it may be found, that small tubes with balls of an inch in diameter, may answer the purpose in the manner of air thermometers, the end of the tube being immersed in some fluid at the time of observation.

If the naked thermometer is exposed, it may be conveniently done by putting the scale into a small pair of spring forceps, the forked end of which is worked into a conical screw, which may be readily fixed into a tree, a post, or any piece of wood at hand, so as to keep the thermometer at some distance from any thing else. It is known that large blackened masses of metal, exposed to the sun's rays, acquire in India a high degree of heat; but what it may be I have never had an opportunity of observing. It has been a guard room jest to remark, that the guns on the ramparts of Fort St. George were hot enough sometimes to fry a beefsteak upon. I do not suppose that the experiment was ever put to the test; but I remember that they were often much too hot to bear the hand upon. The temperature thus tested could not however be very high, for the boiling point of spirits of wine, or 180° Farhenheit, is a great deal too hot to bear the finger in, and the conducting power of metal would make the *sensible* heat seem much greater than the true temperature.

It is also known, that the soil in some situations between the tropics has a very high degree of temperature when exposed to the full action of the sun's rays, 180° degrees of Farhenheit I think is recorded by Sir John Herschel at the Cape, in a recent work on horticulture by Lindley, if I remember correctly. When it is considered that in this case the cooling contact of the atmosphere can only act upon the same extent of surface as is exposed to the action of the sun's rays, it is not improbable that the temperature resulting may be much greater than that of an insulated mass, which presents to the cooling contact of the air a surface increasing as the cube of its diameter, while the surface exposed to the action of the sun's rays increases only as the square.

Perhaps a closed tin cylinder painted black, and filled with water, or an iron shell, might answer well for observing the effects of solar radiation; but before an unit of comparison can be hit upon, many experiments are required, and the research necessary will be almost out of the power of a single individual. Our information upon the heating and cooling of bodies in the air also is not very extensive; but it would seem that the velocity of cooling is inversely as the cube of the diameter, and that it is not affected by the nature of the surface, (Encyclopedia Metropolitania, article Heat.)

In this imperfect paper I have purposed principally to call the attention of scientific men to the subject, and to notice these points on which information is principally required; and I shall have much pleasure in co-operating with any gentlemen who will give the subject attention, as soon as any fixed plan of observation has been agreed upon.

## *European Notices of Indian Canines, with further illustrations of the new genus "Cuon vel Chrysæus." By* B. H. Hodgson, Esq.

Hamilton Smith has lately (1839-40) produced, in the Naturalist's Library, two volumes upon the Canidæ, which, like all his prior works, are distinguished by bold and skilful efforts to reduce the crude insufficient materials at his disposal into system, and by the graceful illustrations of classical and general scholarship.

It must be confessed, however, that these volumes are upon the whole a failure, signally demonstrative of the impossibility of making a safe and effective use of those descriptions of animals which constituted the Natural History of the last age. I purpose on the present occasion to notice a few palpable errors of fact in this work, and to vindicate my own claim to an earlier and juster definition of the Chrysæan group, than that of our author.

Colonel Smith, then, affirms that the hyæna is found ordinarily in the mountains beyond the Ganges; that wolves, (the race,) are essentially tenants of woody, mountainous regions; that a perfectly wild race of pariar dogs exists in the Sub-Himalayan forests; that jackalls have only six teats; and lastly, (for I will go no further at present,) that the true wild dogs, of which my *Canis primævus* is the type, have not the vulpine odour, or at least, that no author has noticed its presence, and that their mammæ are only eight.

Now the truth upon these several points appears to be, that there are no wild pariars whatever in the Himalayas, Sub-Himalayas, or Saul forests; nor, I believe, in any other part of India: that the regions first and specially particularised, are entirely devoid of the hyæna and of the wolf, which animals, so far from being essentially monticolous foresters, abound chiefly, and almost exclusively, in the barest parts of the plains of India, such as the whole of the Doab; that their avoidance of mountain and forest is most marked, and on this side of the Ghogra or Kali river is, *I know*, absolute; that jackalls have, like the dogs proper and wolves, ten teats or mammæ; and, lastly, that my type of the true wild dogs of India possesses the vulpine odour in all its rankness, and has fourteen mammæ. If Colonel Smith had consulted more carefully the 18th vol. of the Asiatic Transactions, pp. 221—237, where there is a very full account of the animal which he selects as the type of his new group, he would not only have perceived that the vulpine odour had been noticed as characterising it; but he would have avoided the important error in his definition of the group of assigning to it a number of mammæ more *restricted* than that of the ordinary canines. We have seen that Colonel Smith has erroneously assigned six teats to the *Sacalii*, or jackalls, and eight to the *Chrysæi*, or present group. But the facts are, that the jackalls, as well as the wolves and dogs proper, have ten teats, whilst our type of his *Chrysæi* has not a less number, but a greater—has, in short, fourteen mammæ. The restricted maximum number of ten characterising all the dogs proper, or Caninæ, and which number is reduced in the foxes (of India at least) to six, appears to render the material increase of that number in our *Canis primævus* essentially significant, (lycaon, and other aberrant canines not exceeding the typical number.) And as we also find one law of *dentition* likewise prevailing throughout the former, and another characterising the latter, we are reasonably led to regard the latter as a separate type; even though we may be averse to the unnecessary multiplication of genera or sub-genera. Accordingly, and influenced by the above considerations, I in 1837 raised my *Canis primævus* to the rank of a distinct form, giving it the name of *Cuon*, as a convenient appellation, which would serve to point out its intimate affinity with the dogs proper, or genus Canis of authors. This method of appropriating Greek words is sanctioned by the highest authority; and, as my term *Cuon* has the merit of indicating clearly the natural position of this new form, I consider it greatly preferable to Mr. Smith's *Chrysæus*—a vague epithet, and one too, more strictly applicable to the foxes and others, than to the wild dogs. With regard to priority, my name and definition were published in 1838, (in the Linnæan Transactions,) H. Smith's only in 1839-40. H. Smith in defining the group has slurred over the essential mark of a peculiar system of dentition: he has likewise, (as already noticed,) mis-stated utterly the peculiar mammary system. These two, on the contrary, I have, since the period adverted to, always regarded, and stated as the most essential diagnostics of the group; and no one can for a moment doubt their importance as compared with colour of the feet, the relative fullness of the brush, and other characteristics by which H. Smith defines it, and which, by the way, are, *quoad the type*, inaccurate; for the *Canis primævus* has *not* dark feet, and he *has* a very full brush. I have lately procured some more young and mature specimens of the Buansu or primævus, and I find them all characterised by fourteen mammæ. I have lately procured some more specimens of the pariar and jackall; all which, as well as my sporting dogs, I find possessed of ten mammæ; whilst the former have as invariably molars $\frac{6\ 6}{7\ 7}$ as the latter have molars $\frac{6\ 6}{6\ 6}$. Since I called attention to this anomalous dentition, Col. Sykes has confirmed it in regard to the Dukhan species, or *Kolsun*. Our author implies, rather than asserts, that the fact has been determined with regard to two more species, or scylax and ceylonicus. I rely upon it, however, that this able writer has grounds for what he would have us believe in reference to the teeth of all these four species; and it therefore remains only to ascertain, whether in their *mammary* system *as well as their dental*, the three others agree with our type, or primævus.

If so, that type will be established on a firm basis, (whether generic or sub-generic matters not,) although neither the soft viscera nor the osseous frame offer any marked peculiarities;* the dogs proper, jackalls, and foxes being, like the buansus, constructed upon one model in both these last respects. I have already noticed that Colonel Smith's wild pariars appear to be apochryphal. The tame ones have invariably the second tubercular, which is deficient in the cuonian type. Oft his type, I hope, ere long, to procure from Sikim or Chota Nagpoor, a second very marked and greyhound-like species, the existence of which is confidently announced to me by Dr. Campbell and Lieutenant Tickell. Recently I have ascertained beyond a doubt, that the typical species, or primævus, is as common in the mountains west and east of Nepal as in Nepal itself; that it breeds in January and February, and then only per annum; and that it produces at least as many as six whelps at one litter: for that number I have obtained along with their mother. To rear the young is excessively difficult, as my frequent failures of late proves; and I may add, in illustration of the rooted opinion of the country respecting the natural antipathy of these wild dogs to the larger races of the felinæ, that my want of success was *predicted,* because I would obstinately insist on keeping leopards in the vicinity of the buansus.

The accompanying sketches† convey a most lively idea of the aspect of our typical species; the generic character of which may perhaps be stated with sufficient fulness thus:—

CANINÆ.

*Genus Cuon,* (κυων.)

General structure and dentition of Canis; but the molars only $\frac{6.6}{6.6}$, the second tubercular behind the carnassier being

* See the subjoined memoranda, for which I am indebted to the aid of Doctor Campbell.

† Sketches not received.—ED.

deficient. Teats as many as fourteen, or more than in any of the proper dogs; scull by its uniform arcuation along the culmenal line, and by its shorter, stronger jaws, declining from canine models towards feline. Parietes amply swollen with moderate cristæ; or, we may add thereto the following points:—

Odour and aspect of lacalius, but the ears and tail usually larger, the brow and eye bolder, and the muzzle blunter. Shoulders and croup level.

Type—C. primævus. Asiatic Society's Transactions, vol. xviii. Specific character—Wild dog with double coat of wool and hair, which is more or less feathered on the cheeks and hams; large hairy-soled feet; large erect ears, and very bushy straight tail, reaching half way from the hough to the sole: deep rusty above, yellowish below and on insides of ears and of limbs and on lips; chin, bridge of nose, and terminal half of tail, blackish.

Length from snout to rump 36 inches, mean height 20, length of head 8½; of tail with hair 16½.

NEPAL, *March,* 1841. B. H. HODGSON.

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*Note on the Skeletons of the Buansu, the Pariah Dog, and Jackall, taken from several specimens of each in* MR. HODGSON'S *Collection. By* DR. A. CAMPBELL.

SKULL.—The longitudinal and transverse ridges are more prominently marked in the dog and jackall than in the buansu. The cerebral cavity is consequently in the buansu less compressed laterally. It is also of greater capacity, especially in the occipital region. The muzzle of the buansu is shorter than in either of the others, and the general contour of his skull approaches somewhat to the feline cast; shortness of muzzle explicable if not caused by the absence of a second molar behind the great one. The lower jaw is more massive in the buansu, and its rami, at their articulation farther asunder than in the dog or jackall. The articulation of lower jaw is rather more strictly hinge-like in buansu than in the others; at least there is a more marked overlapping of the posterior process forming the joint. The extent of lateral motion in lower jaw does not appear to be less in buansu than in dog or jackall: all the canine animals seem to have the power of lateral motion in the lower jaw, to a limited extent, somewhat more than the cats have.

In the dog and jackall, the frontal sinuses rise gradually (laterally) from the mesial line or depression of the frontal bone, until terminating externally in the margin of the orbit. In the buansu, however, they are arched laterally from the mesial depression, whence the skull derives a good deal of the feline character. The entire superior outline from the nostril to the transverse occipital ridge of the buansu's skull is a gentle curve, or small segment of a large circle; whereas in the dog and jackall this line is nearly straight. Although the longitudinal and transverse ridges are less strongly marked in buansu than in the dog and jackall, there is no comparative diminution in the strength of the zygomatic arch, nor in the size of the zygoma, (space between arch and parietes of the skull). Conformable to the diminished development of the occipital ridges, there is a less development of the alæ of the altas, and of the crest of second vertebræ, in buansu than in the dog or jackall. If the buansu has power of jaw equal to the dog and jackall, the lesser strength of the masticatory muscles indicated by diminished longitudinal occipital* ridge must be compensated by the shorter and more massive lower jaw.

*Spinal Column and Extremities.*—The skeletons of the dog and jackall are identical in all material respects. The vertebræ of the neck, back, and loins are more massive in the dog and jackall than in the buansu, and the greater

* Quære, longitudinal and transverse, *or* occipital ridge ?—B. H. H.

development of the lateral processes of the numbers and of the spinous processes in the dorsals along with a firmer pelvis, would indicate greater strength of trunk in the dog and jackall than in the buansu. On the other hand, the greater size (and development of ridges) of the bones of the extremities (fore and hind denote more power of limb in buansu than in the other two). The number of vertebræ and ribs in all three the same. Cervicals seven, dorsals thirteen, lumbers seven, ribs thirteen.

In general conformation the vertebræ are also alike. In buansu, the spinous processes of the sixth and seventh cervicals are longer than in the other. The following are the only appreciable differences on comparing the extremities of these three animals :—

The scapula is roundest and broadest in the buansu; rounder and broader in jackall than in dog. The crest of the scapula is most largely developed in buansu, and least so in the dog. The fore arm (radius and ulna) is longer in proportion to the humerus in the dog and jackall than in buansu. The carpus and digits united, are longer in proportion to the fore-arm in buansu than in dog or jackall. Thus the humerus and hand are longer in proportion to the fore-arm in buansu than in the dog and jackall.

The relative size of the bones of the pelvis offer no marked differences in these animals. The femur and tibia in all three bear a like proportion to one another. In the buansu the tarsus and toes united bear a greater proportion to the length of tibia than in the dog or jackall. If these slightly marked differences are accurate, and if they affect the physical powers of these animals, in the general mode, the buansu is less fleet of foot than the dog or jackall, also less powerful in the spine; but a more active digger, and more fit to scramble and climb in difficult places.

A. Campbell.

*Classified Catalogue of Mammals of Nepal, corrected to end of* 1840, *first printed in* 1832. *By* B. H. Hodgson, Esq.

BIMANA.

0. *Homo.* Sapiens. The mass of the population belongs to Kalmuc subdivision of the Great Mongolian strips, with some admixture of Indian stock. In the Tarai and low valleys of the Hills, are some traces of aborigines of southern race, like the Bhils, Coles, &c. These latter are denominated Tharú, Demvar, Durré, and Manjhi.

QUADRUMANA.

*Simiadæ.*

1. *Semnopithecus.* 1 Sp. new. Schistaceus, nob. (Nipalensis of former Catalogue, see remark at end.)

2. 3. Macacus? *Pithex*, nob. 2 Sp. new. Oinops and Pelops (πηλος et αχ) nob.

VESPERTILIONIDÆ.

*Rhinolphinæ.*

4. 5. *Rhinolphus.* 2 Sp. new. Armiger et Tragatus nob.

*Pteropinæ.*

6. 7. *Pteropus.* 2 Sp. new. Leneocephalus et Pyrivorus, nob.

*Vespertilioninæ.*

8—11. *Vespertilio.* 4 Sp. new. Formosa, Fuliginosa Muricola et Labiata, nob.

FERÆ VEL CARNIVORA.

*Felidæ—Genus* Felis.

12—16. *Felis.* 6 Sp. Subgenera? Tigris, Pardus, Leopardus et Nipalensis auct. Viverriceps et Murmensis, nob.

17. *Lynchus.* 1 Sp. new. Erythrotus, nob.

*Canidæ—Genus* Canis.

18. 19. *Canis.* Subgenera two varieties of the Mastiff and two of Terrier of Tibet.

20. 21. *Vulpes.* 2 Sp. Indicus nob. et Montanus Pearson.

22. Sacalius Smith / *Oxygoüs, nob.* } Jackall, 1 Sp. Indicus, nob.

23. *Cuon, nob.* General structure of Canis, but molars $\frac{6\ 6}{6\ 6}$ only, odour and aspect of the last, head blunter. Tail and ears larger. Teats 12 to 14. Venatory, gregarious, does not burrow. 1 Sp. Cuon Primævus, nob. type Canis Primævus of Bengal, Asiatic Society's Transactions, (subsequently named (the type) Chrysæus by Smith.)

Mustelidæ.

*Viverrinæ.*

24. 25. *Herpestes.* 2 Sp. new. Griseus auct. et Auropunctala, nob.

26. 27. *Viverra* auct.* Size large, robust habit, never climbs, thumb not remote. Nails obtuse, 2 Sp. new. Melanurus et Civettoïdes, nob.

28. 29. *Viverricula* nob. Size small, scansorial. Habit vermiform, nails more or less raptorial, and thumb remote. Pouch as in Viverra, 2 Sp. Indica et Rasse auct. (Leads through Prionodon to Felis.)

30. *Prionodon.* 1 Sp. new. Pardicolar, nobis.

* These are differential characters merely.

31—33. *Paradoxurus.* 3 Sp. new. Hirsutus, Nipalensis et Laniger, nob.

34. *Ailurus.* 1 Sp. Fulgens, auct. the Wah.

*Mustelinæ.*

35—37. *Mustela.* 3 Sp. M. Erminea auct. and two new. Hemachalanus et Auriventer vel Cáthia, nob.

38. *Martes.* 1 Sp. Flavigula auct.

39—42. *Lutra.* 4 Sp. new. Tarayensis, Monticola, Indigitata, Aurobrunnea, nob.

43. *Gulo.* 1 Sp. new. Nipalensis, nob.

*Mesobema* (*olim Urva*) *nob.* 1 Sp. M. Cancrivora nob. type: the Gulo Urva of *Asiatic Journal* nob. Teeth as in Herpestes, but blunter, structure and aspect precisely mediate between Herpestes and Gulo; on either side the anus a large, hollow, smooth-lined gland, secreting an aqueous fetid humour, which the animal ejects posteally with force. No subsidiary glands, nor any unctuous fragrant secretion. Teats six, remote and ventral. Orbits incomplete; parietes of the skull tumid, with small cristæ.

N. B.—Gray's Helictis is alleged to be identical with our Mesobema, but the dental formula assigns 5-6 molars to Helictis, which is, in fact, a Gulo.

The change of name in our genus is consequent on a general disuse of local generic terms.

*Ursinæ.*

44. *Ursitaxus, nob.* Molars 4-4, of ursine 4-4, flatness almost on the crowns, but the last above transverse, and less than the

carnassial tooth. Aspect and size of taxus. No ears, coarse scant hair, anal glands as in Mydaus, genital organ bony and annulated spirally. Typically plantigrade and fossorial, carnivorous. Teats four in a transverse parallelogram.

1 Sp. Inauritus nob. Indian Badger, of Pennant and Hardwicke type.

N. B.—This form is erroneously sought to be identified with Ratetus Mellivorus.

45. 46. *Ursus.* 2 Sp. Tibetanus et Isabellinus auct.

47. *Prochilus.* 1 Sp. Labiatus auct.

*Sorecidæ.*

48. 49. *Sorex.* 2 Sp. Indicus auct. et Pygmæus nob. ungulata.

*Pachydermes.*

50. *Elephas.* 1 Sp. Indicus auct. two varieties, Isodactylus et Heterodactylus nob.

51. *Rhinoceros.* 1 Sp. Indicus auct.

*Anaplotheres.*

52. *Sub. Wild Hog.* 2 Sp. varieties, Aipomus et Isonotus nob.

53. *Manis.* 1 Sp. new. Auritus, nob.

Ruminantes.

Bovinæ.

*Genus Bos.*

54. *Bos.* 1 Sp. Subgenera ? Nipalese, tame varieties of.

55. *Bibos, nob.* Head exceedingly large. Cranium bovine in its general character, but much more massive and depressed, its breadth between the orbits equal to the height, and half of the

length: frontals large in all their proportions, apparently concave, being surmounted by a huge semi-cylindric crest rising above the bases of the horns. Posteal plane of the skull vertical, equal to the frontal plane, and divided centrally by the temporal fœssæ. Orbits more salient, and rami of the lower jaw more pointed to the front and straighter, with less elevated condyles, than in the Bos or in Bubalus; thirteen pairs of ribs, spinous processes of the whole dorsal vertebræ extremely developed with sudden fall at the croup. Dewlap evanescent. Horns short, very thick, remote, depressed, subtrigonal, and situated below the frontal crest. Gestation of females thirteen months.

1 Sp. new and type. Bibos Cavifrons nob. Gouri Gau of Hindoos. Habital Saul forest.

*Specific character.*

Large wild Indian Bibos with fine short limbs, short tail not reaching to the houghs; broad, fan-shaped, horizontal ears, smooth glossy hair of a brown, red, or black colour, paled upon the forehead and limbs; tufted knees and brows, and spreading green horns with round incurved black tips, and with soft rugous bases furnished posteally with a fragrant secretion. Ten feet long from snout to rump, and five and a half to six feet high at the shoulder: head (to the crown of forehead) twenty-four inches, and tail thirty-three inches. Female rather smaller, but preserving all the characters of the male.

N. B.—To all appearance two other species of Bibos may be found in the Fossil Urus of Europe, and in Aristotle's wild Bull of Persia with depressed horns. These I would call, respectively, Bisbos Classicus, and Bibos Aristotelis.

55. *Bisonus.* Forehead large convex. Fourteen pairs of ribs, dorsal crest confined to the withers. Shaggy coat. 1 Sp. Poephagus auct. tame and wild samples.

N. B.—These differential characters are our own, submitted to the discretion of the skilful.

56. *Bubalus.* 1 Sp. Arna auct. two varieties, nob. Macrocerus et Speirocerus, nob.

*Antelopidæ.*

58. *Antelopa.* 2 Sp. Cervicapra auct. et Bennettii auct? Bharatensis, nob: vulgo, the Chouka, or Ravine Deer.

59. *Pantholops nob.* Molars $\frac{5\ 5}{5\ 5}$. Incisors erect, strong and rectilinearly ranged. Horns with a clear sinus in the cores, long, slender, erect, sublyrate, inserted between the orbits, compressed, nodose, and approximated at their bases. Large inguinal purses. No suborbital sinus.

Nose ovine, bluff, and hairy. Large intermaxillary pouches or subsidiary nostrils, knees simple. Ears pointed, short. Tail short, full. Hoofs low, broad and padded. Size, habits, and general aspect of Antilopa et Gazella.

Female, hornless, with lesser inguinal purses, and two teats.

1 Sp. new and type, Antelope Hodgsonii of Abel, the Chiru of Tibet.

60. *Tetracerus.* — 1 Sp. Chikara necnon, Quadricornis auct. Chousingha of Hindoos.

62. *Nemorhædus vel Kemas.* — 2 Sp. Ghoral (Hardwickii) et Proclivus vel Thâr, nob.

63. *Capra.* — Two varieties of the Shawl Goat.

64. *Hemitragus nob.* General structure, odour, and horns of Capra, but having a small moist muzzle, and 4 teats in the females.

1 Sp. and type. Capra Quadrimammis vel Jharal, nob.

N. B.—Mr. Ogilvy has unwisely confounded this type with his Kemas, the characters of which group were, by the bye, first correctly stated by myself; as were those of Hemitragus. Mr. Ogilvy lays extreme stress on the interdigital pores of the Antilopidæ. But I find them in the tame Sheep and Goats, and they are larger in Tragine than in Cervine forms among the Antelopidæ; for example, in the Thar than in the Chiru. I therefore question their importance, and omit them.

66. *Ovis, wild.* — 2 Sp. new. Ammonoides, nob. et Náhur, nob. three tame varieties, viz. the Hunia, Barwâl, and Câgo.

## CERVIDÆ.

### *Genus Cervus.*

Subgenera ?

| | | |
|---|---|---|
| 67. *Cervus.* | 1 | Sp. Elaphus of the Saul Forest. Possibly a distinct species. Bara Singha of Hindoos. |
| 68. *Pseudocervus nob.* | 1 | Sp. Cervus Wallichii auct. type. Size small. Tail nearly obsolete. Horns branched at the base as in Cervus, above as in Rusa, and quadrifurcate. |
| 69. *Rucervus, nob.* | 1 | Sp. new. Cervus Elaphoides, nob. Type. Aspect and size mediate between Elaphus and Hippelaphus. Muzzle remarkably pointed, horns moderate, smooth, pale, one forward basal process on each beam, no medial. Summit branched as in Elaphus. Canines in males only. |

N. B.—These two sub-genera of ours, rest on no sufficiently solid data, though not more than those which support the other subordinate groups around them. So that the distinctions may remain till the whole family be divided upon sounder principles. Our animals are links between the European and Asiatic Stags.

| | | |
|---|---|---|
| 71. *Rusa.* | | Canines in both sexes. Heavily maned, horns with one basal and one superior process. |
| | 2 | Sp. new. Jaraya† et Nipalensis nob. |
| 74. *Axis.* | 3 | Sp. 1st Cervus Axis auct. or Axis Major, nob. 2nd, Axis Minor nob. Lesser spotted Deer, and 3rd, Axis Procinus, Smith. |

| | |
|---|---|
| 75. *Stylocerus.* | 1. Sp. new. Ratwa, nob. The Kaker and Barking Deer of Europeans. |
| | N. B.—This is probably the Hippelaphus of Du-Vaucel; but the species of the group are too vague to admit of determination. |
| | *Moschidæ.* |
| 78. *Moschus.* | 3 Sp. new. Leucogaster, Chrysogaster, et Saturatus, nob. |
| | N. B. Saturatus is probably the Moschatus of Linnæus. |
| 79. *Tragulus.* | 1 Sp. new. Memennoides, nob. Vulgo Bijay. |
| | *Solipedes.* |
| 80. *Equus.* | 2 Small tame Himalayan and Trans-Himalayan varieties. |
| 84. *Mus. Rats.* | 4 Sp. new. Indicus ? Rattus ? Decumanoides, Nemorivagus et Niviventer, nob. |
| 87. *Musculus, nob.* | Mice, 3 Sp. new Cervicolor, Nipalensis et Dubius, nob. |
| 89. *Arvicola.* | 2 Sp. new. Pyctoris et Mythrix, nob. |
| 90. *Arctomys.* | 1 Sp. new. Himalayanus, nob. |
| 91. *Rhizomys.* | 1 Sp. new. Badius, nob. |
| | *Sciuridæ.* |
| 94. *Sciurus.* | 3 Sp. new. Macruroides, Locria et Locroides, nob. |
| 96. *Sciuropterus.* | 2 Sp. new. Magnificus et Alboniger nob. |
| 97. *Hystrix.* | 1 Sp. new. Nipalensis, nob. |
| | LEUCURUS ? |
| 99. *Lepus.* | 5 Sp. new. Macrotus et Diostolus nob. |
| | N. B.—Indicus et Æmodius of former catalogue, but *several local* names now dropt,—descriptions of the two under publication. Capt. Brown I suspect has described the former under the name of Orientalis, |

*Mustela Calotus Hodgs. $\frac{2}{3}$ nat size*

if so, his name will claim preference. The remaining 4 or 5 yet unpublished are forthcoming shortly. The Catalogue is considerably enlarged and corrected since it was last published in Lin. Trans. A. D. 1838.

Species, of which 65 to 70 are new. Their descriptions will be found, with 4 or 5 exceptions only, in the Journal of the Bengal Asiatic Society, and that of Mr. M'Clelland.

Talpa Micrurus. Short-tailed Mole, velvetty black, with a silvery gloss when rubbed against the grain, and iridescent when wet. Naked snout, and feet, and tail, fleshy white. The tail very small, rudimentary: rest of the structure typical—dimensions as already given.

*Valley of Nepal, March* 1841. B. H. HODGSON.

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## *On a new Species of Mustela? known to the Nipalese commerce as the Chúákhál Mustela? Calotus, nob.* (καλος *et* ους) *By* B. H. HODGSON, ESQ. Plate IX.

Cloaks lined with furs of various kinds are largely imported from the north by the Nipalese merchants, and amongst the less expensive sorts of these furs, so employed, that called Chúákhál is perhaps the best and handsomest. I have frequently endeavoured to procure all or any of the animals, whose skins are thus employed in commerce and in dress, and lately through the kindness of the minister of this place, have obtained a very beautifully cured specimen of the animal called *Chúákhál,* which, however, alas! is stripped of every vestige of bone and of talons or nails. Still the size and figure of the animal may be satisfactorily judged of; and as I am assured by the merchants that it is a weasel or mustela, I purpose to give a summary description and sketch of it. The fineness of the fur, the full spreading tail, and the pointed and splendidly tufted ears, must give the animal in life much the aspect of a squirrel, if indeed it be not one in fact. But, on the other hand, the vermiform figure and well-knit, compact, and purely digitigrade extremities, countenance the assertion of the traders, that the animal is a weasel or congener of our Mustela Kathia vel Auriventer; which latter, they are well acquainted with at home, as they are with our present subject in their travels. It is said to be found both in the snowy region, and beyond it in Tibet and China, where it prefers rocky and waste situations. The animal must be about a foot long from snout to rump, with a tail of eight inches, or ten and a half with the terminal hair. The mean height from four to five inches, the head in length from two to three; and the ears without their tufts, quarter to one inch; with them, two and three quarter inches. The tail is very full, and rather distichous, like a squirrel's. The ear-tufts, which also are sciurine in their character, spring from and conceal the whole helix, which they far exceed in length, and in fact are equal to the length of the head. The fur is thick, abundant, soft, and of two sorts; the longer piles of hair being about three-fourths to one inch long, and rather scantier than the inner or woolly ones, which have about two-thirds of their length. On the tail and ear-tufts the hair alone is found, and it is upon the tail stronger and more glossy than upon the body, though still without hardness. The longest hairs of the tail are from two and half to two and three-quarter inch long—the longest on the ears, (where they are softer,) something less than two inches. The face and limbs are dressed in a close adpressed short vest in which the hairy piles only can be palpably traced. The colour of the animal is a full clear slaty blue, varied or speckled with hoary, an effect resulting from the vague annulation of each hair with dusky and canescent. The limbs, tail, and ears are almost wholly dusky black; and the middle of the belly and of the neck in the same line, together with the insides of the limbs close to the belly, are pure snowy white. The following name of specific character may serve to draw curiosity:—

Mustela? Calotus of a clear slaty blue freckled vaguely with hoary; the amply tufted ears, the spreading tail, and the limbs, blackish; the belly and neck below, pure white; twelve to fourteen inches long, and four to five high; tail with the hair, ten to eleven—without it, eight inches. Habitat, Himalaya and Tibet.

B. H. Hodgson.

*Cathmandoo, April,* 1841.

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*Note on Irish Fresh Water Shells. By* W. H. Benson, Esq.

*Moradabad,* 31*st May,* 1841.

A list of Wexford land and fresh water shells is given in p. 395 of the Annals and Magazine of Natural History, for January 1841, by Mr. Hanley, who seems to have been unaware of the admirable catalogue of Irish land and fresh water species, given in the three preceding numbers by the Vice-President of the Belfast Natural History Society. I am enabled to add to Mr. Hanley's list two other fresh water species found by myself in the county of Wexford in 1834. The Lymnæa is especially interesting, as Mr. W. Thompson, (page 120,) seemed to have but vague information of its occurrence in Ireland; his best fact being, that a tray labelled "Cork" had been received by an English Conchologist, containing undoubted specimens of it, which the Irish collector had not himself identified as belonging to the species, though he vouched for the correctness of the assigned locality. I have now before me two specimens differing only in greater whiteness of the inner lip, and in a blackish coat over the polished epidermis, from English examples of L. octanfracta, given to me by Mr. G. B. Sowerby. The specimen of Planorbis spirorbis is large, and is so strongly marked in form with reference to the type, Pl. vortex, which I took in ditches near the Royal Canal, Dublin, and in Lough Cavrigan, county of Cavan, that I cannot agree with Mr. Thompson in his dereliction of the example of the English and Continental authors, who consider the species to be distinct.

1 Planorbis spirorbis, Müller.

Hab. Ditches by the road side on the lands of Tracy's town near Hillburne, west of Taghmon, county of Wexford.

2 Lymnæa glabra, Müll.

——— octanfracta, Mont.

——— leucostoma, Lam.

——— elongata, Drap.

Hab. with the last. The road in question leads from the gate of Hillburne in the direction of the sea. From the short space of time that I could spare to collect my specimens, I am of opinion, that the species must be abundant in the locality.

At Bannow, in the same county, Helix aspersa was abundant in banks on the cliffs about the sea; and in a clear burn falling down a ravine of the Forth mountain at Newbay, I got specimens of Aneylus flavintilis adhering to stones.

W. H. Benson.

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## *Note on the Self-calculating Sextant, proposed by* Captain Jack.—*By* Captain Campbell, *Assistant Surveyor General, Madras Establishment*

I do not perfectly comprehend the plan of the instrument proposed by Captain Jack, (vol. i. page 521,) and am at a loss to guess at the mode he proposed for laying down on the face of the instrument a scale of co-tangents, the co-tangent of a small arc being of an infinite length, an extent rather inconvenient for a portable instrument. From the general description, it would seem that the instrument much resembles that called the Surveying Square, which is a square with sight fitted to one side, and which has a moveable rule or index also bearing sights, which turns on a pivot at one corner. On two sides a scale of equal parts is laid off, by which the proportional parts of a plane triangle can be roughly estimated, and by a plumbline or level attached to the index, vertical plane triangles can be also estimated in the same manner.

Angles are measured in the most accurate instruments now used by a circular scale of equal parts; because it is easily divided, and being equi-distant from the centre, admits of the application of the verniers, while a tangental scale of equal parts cannot be read off with any degree of accuracy, in consequence of the varying angle between the tangent and the secant.

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## *Observations on the Fossiliferous beds near Pondicherry, and in the district of South Arcot.—By* C. T. Kaye, Esq., *Madras Civil Service.*

The existence of a bed of fossiliferous limestone in the neighbourhood of Pondicherry has long been pretty generally known to those who take an interest in such subjects, and some attention was recently attracted to it by several communications in the *Spectator* Newspaper. An observant person, indeed, can hardly fail of being struck with the nature of the stones which form the paving of some of the streets and the steps of many of the houses in Pondicherry, and which are replete, not only with the fragments of innumerable shells, but with many ostreas and other bivalves almost as entire as if they still reposed in their proper element. The silicified wood at Trivacary is also well known to the public from the beautiful polish which it receives, and from its adaptation to table and other ornaments. To the geologist it is interesting from the vast size of the petrified trees, (one of which is nearly 100 feet long,) from their great number, and from the perfect state in which these organic remains of other worlds are preserved.

It had long been a desideratum to collect data on which the era and nature of the formations which contain the fossils might be decided, and I accordingly took an opportunity of leisure in October last, to proceed to the spot with Mr. Cunliffe, of the Civil Service. The time which we were enabled to devote to the investigation was unfortunately short, and it might certainly have been committed to more scientific and experienced hands. I trust, however, that the facts which we were fortunate enough to collect were not altogether unimportant, and that, imperfect as our researches must necessarily have been, they may pave the way to more interesting discoveries.

Before proceeding further, I may as well mention, that, although the geology of India has generally been considered uninteresting on account of the absence of fossiliferous strata, Pondicherry is not the only locality in the south of the peninsula where fossils are to be met with in abundance. In the inland district of Trichinopoly marine shells are also found imbedded in limestone, and the kindness of Mr. Onslow has put me in possession of several interesting specimens, of which notice will be taken hereafter.

The village of Seedrapett, the site of the shell limestone which is the subject of the present notice, is seven miles west of Pondicherry, and Trivacary is about eight miles to the west of Seedrapett. The form of the country may be characterized as an undulating plain : the limestone formation is flanked both on the east and west by one of the red sandy soils which on the one side forms the low mounds of Trivacary, and on the other the "red hills" of Pondicherry, the latter being perhaps a continuation of the same formation which contains the silicified wood. If this be the case, it is evident that the limestone rests upon a basin or depression of the red sand; but owing to the absence of sections, and the imperfect means we had of ascertaining the position of the strata, this fact is by no means laid down as established, but is merely suggested as a point for future investigation.

The petrifactions of Trivacary have been often described, especially of late; it is only necessary therefore to state, that they consist of numerous silicified trees, some of them of vast dimensions, resting, more or less buried, on low bare hills of a friable red sandstone. The hills are grouped in a circular form, and the petrifactions in many instances retain a perfect resemblance to the trunks of fallen trees. The red hills are bounded by others of a dark granite, the line of demarcation being very distinct. The trees, however, are not found reposing on the hillocks at Trivacary alone, but we observed them at a distance of at least three miles from that place, imbedded in the red sand, on the road to Seedrapett. We were totally unable to discover any other fossil, or any indication of such a thing, in the red soil which so abounds with the silicified wood.

There is a gradual descent from Trivacary towards Seedrapett, and the limestone commences immediately on the boundaries of the red soil: it presents, as has been already stated, an undulating wavy surface, and the stone is found immediately below the turf, and sometimes even appears above it: it is quite hard, and is quarried in large blocks, though to no great depth, for the purpose before mentioned. It is almost every where replete with shells or other organic remains, which are in general so firmly imbedded in the hard stone, that it is impossible to detach them: the geologist, therefore, who would study with accuracy the nature of this deposit, should endeavour to reside for some period on the spot, many of the shells which are most perfect in the stone, not having yet been discovered in a separate state. In one situation, however, there are several small mounds of a whitish limestone, almost resembling chalk, where the surface having been abraded and decomposed by water, the shells which it contained have been separated, and lie scattered on the surface of the soil among the debris of the containing rock: it was in this spot that most of the specimens here noticed were collected. I will now proceed to describe them in the order in which they appear in the Plates.*

Pl. I. Nos. 1 and 2.*—*Ostrea carinata*—The identity of this shell with that figured by Lyell and other authors among the fossils of the European chalk cannot be doubted: they are very numerous at Seedrapett, and are found both in a separate state and imbedded in the rock, sometimes very perfect. No. 1 is slightly fractured at the point; but the linear marking, and even the sharp angles of the ribbing on the sides, are beautifully preserved, and the inner surface retains much of its polished enamel. No. 2 is a perfect specimen of the two valves adhering firmly together.

Nos. 3 and 4 are *Baculites.* The shell is called by Dr. Buckland a straight ammonite, and the same authority states, that it is "found in the cretaceous formation alone." We collected many fragments of this shell on the surface of the soil, varying from three inches to half an inch in length; the most perfect specimen being imbedded in a rolled piece of limestone (No. 3), and owing to a longitudinal fracture displaying four of its chambers. All the specimens display the foliated markings at the junction of the walls of the chamber with the external shell: they are of a yellowish or reddish brown colour, and the interior is generally filled with beautifully crystallized calcareous spar. No. 5 is the transverse section of a baculite.

* These references are made to the Madras Journal of Literature and Science, No. 28, September, 1840, from which this part of the paper is extracted.

No. 6, 7, 8, are bivalve shells, probably referrible to the genus Cardium; they are represented about the natural size; 6 and 7 retain the shell itself, and appear almost recent, but the interior of No. 7 is filled with the limestone and fragments of shells connected together sufficiently hard to take a polish. In No. 8 the shell itself has disappeared, and left merely a cast in whitish limestone.

Plate II. Nos. 1 and 3, are *Echini* of the order *Spatangus*, common in the chalk of England. No. 2 is a small but perfect specimen. No. 1 is a portion of the external shell flattened out on the stone.

No. 3.—This is apparently the apex of a *Turbinolia:* it is not unfrequent in the limestone, and was sometimes found detached, in which case it precisely resembles the drawings of the *Turbinolia* given by Dr. Mantell, in his Geology of the South-east of Sussex; but is apparently of a larger species.

Nos. 4, 5, 6, 7, 8, are fragments of a zoöphyte, or coral, with a pyriform body or termination, which is always found detached (No. 4); other fragments are cylindrical. This zoophyte seems to have consisted of numerous small lamellæ, converging *towards* the centre: but there was probably a cavity *in* the centre, which is now filled up with the chalky substance, as the lamellæ do not unite at the axis. No. 6 shows the radiated appearance presented by the transverse section of a cylindrical joint or fragment, and 7 and 8 display the internal structure where it is laid bare by the decomposition of the external covering. These fragments are probably the joints of the stem or branches of the zoophyte, which may possibly therefore, have been the *Apiocrinites ellipticus;* but until more perfect specimens are found, it cannot be named with any degree of certainty. The component matter of this fossil is carbonate of lime, and it effervesces freely with acid. They are found in great numbers close to the village of Seedrapett. We collected upwards of an hundred in about half an hour, and one of the best specimens I took out of the wall of a mud house.

No. 9 is a small mass of limestone, displaying on both sides beautiful sections of a multilocular shell, which Mr. Burr informs me is a *Turrilite.*

No. 10. A great number of small cylindrical bodies of this description were found, the longest perhaps 1½ inch in length, and about the thickness of a tobacco-pipe: they all have a longitudinal groove or sulcus, whence it may be inferred that they are a species of *Belemnite,* perhaps *B. minimus;* but it must be mentioned that among the hundreds that were collected, and the still more numerous specimens that were thrown aside, not one was found which came to a point. Further research may, perhaps, supply this deficiency.

No. 11. Several casts of a slightly curved chambered shell, with annular markings, probably referrible to the order of *Hamite* were found. The drawing represents the chamber as seen in the section; but the radiated marking is probably owing to crystallization.

No. 12 is a cast in limestone of a bivalve shell.

It is no easy thing to name fossils, even to those who are most accustomed to geological researches, this department forming in general a separate branch of the science. Many of the fossils, however, described in the above lines are of so marked a character, that in those instances where we have ventured to name them with any degree of certainty, we can hardly have been mistaken. I have not neglected either to consult those who were best able to give an opinion on the subject, and have also carefully compared the specimens with the best drawings and authorities I could meet with. To Mr. Frederick Burr, I am particularly indebted for the valuable assistance and information he has afforded me. If we do not err therefore very widely from the mark, we have, even on the information already obtained, very good *prima facie* evidence that the Pondicherry beds are the equivalents of the upper secondary formations of Europe, and the fossils point especially to those of the chalk and green sand.

It is a well known fact, that during the formation of the cretaceous beds in England, a great quantity of silex held in solution by water must have been poured out; which, by the process of chemical affinity having collected around various organic nuclei such as corals, sponges, and other zoophytes, has formed continuous and extensive layers of flint, interstratified with chalk, almost every nodule of which contains and derives its shape from the enclosed remains of some organized body in a state of complete petrifaction. We observed no vestige of flints in the limestone at Seedrapett, and all the fossils collected there consist of carbonate of lime, and effervesce freely with acid; but the vast quantity of silicified wood in the neighbouring formation of red sand, seems to point to some phenomenon similar to what must have existed during the deposition of the cretaceous beds of Europe.*

Lieut. Newbold, in the last number of the Journal, suggested that the fossiliferous beds of Pondicherry probably extended into the Terdaehellum talook of South Arcot. I have made inquiries, but have not yet

* "Flints so commonly enclose the remains of sponges, alcyonia, and other zoophytes, that some geologists are of opinion that the nucleus of every nodule was originally an organic body: that this has been the case in most instances is very evident: and in Sussex there are but few flints that do not possess traces of zoophytical organization."—*Mantell's Geology of Sussex*, 144.

obtained any evidence of this fact. Another interesting question, however, now suggests itself, viz. is the shell limestone at Seedrapett analogous and contemporaneous with that already mentioned as containing fossils in the Trichinopoly district? Sufficient data have not yet been collected to enable one to give a positive reply to this inquiry. The specimens which I have received from Trichinopoly consist of masses of limestone very similar in character to that of Seedrapett, and containing innumerable small shells cemented together in the hard rock. Shells are, however, found detached from the stone, in general I should say in a more perfect state than those at Seedrapett.

Pl. III. No. 1, is a large bivalve from Trichinopoly: of which the shell is entire, with the exception of being chipped at the edges: it is filled with limestone.

Nos. 2 and 3 are intended to shew the nature of the shells contained in two small masses of the stone: the most perfect shells have been chosen for representation; but it was found impossible to figure the innumerable small shells and fragments of which the mass almost entirely consists. The shells in No. 2 are small *turrilites,* evidently of the same species as those represented in Pl. II. No. 9. Several specimens from the same locality, in Dr. Cole's possession, appear to me also to be turrilites, a fact which leads us to infer some analogy between the two formations, which further research will probably tend to demonstrate.

An interesting fossil from Trichinopoly in my possession is a piece of calcareous fossil wood, containing a number of petrified Teredines in crystallized carbonate of lime.

There can be no doubt that our knowledge of these beds is still very imperfect, and it may be supposed that it would have been better to have deferred the present notice until more accurate information should be obtained; but a temporary residence in Madras gave me an opportunity of consulting works to which I might not otherwise have had access, and also afforded facilities for getting up the drawings, &c. connected with the publication, which I was the more unwilling to neglect, as they might not speedily recur.

*Further Observations on the Fossiliferous beds near Pondicherry, in continuation of a paper which appeared in the Madras Journal of Literature and Science, for July* 1840. *By* C. T. KAYE, ESQ. *C. S.*

The above paper was written in November last, after a short and hurried visit to the locality which I attempted to describe, and when the nature of the deposit had been very imperfectly ascertained. The hope, however, which I then ventured to record, that the facts already brought to light would lead to more important discoveries, has since been completely realized.

In December 1840, I was again enabled to take the field at Seedrapett, in company with Mr. Cunliffe. The heavy monsoon of that year had no doubt assisted our geological zeal by abrading the surface of the soil, and thus producing a fresh crop of fossils, even on ground which we had previously considered to be exhausted. We therefore easily collected a great number of shells; but the most interesting discovery which this visit enabled us to make, was that of the Nautilus and Ammonite: the former in great numbers, very perfect, and of unusual size. I have described the country round Seedrapett as an undulating plain: immediately to the west of the village, after passing along the bund of the tank, the limestone rises considerably, and the brow of the eminence which it forms, is covered with angular and rounded masses of the rock. Mingled with these, lay a vast number of Nautili, the limestone of which the fossils consist having, where exposed to the weather, assumed so completely the appearance of large stones which surround them, that there was much risk of their being passed over entirely. When however the first discovery made by Mr. Cunliffe had directed our attention to them, we found them without difficulty; and having pointed them out to the villagers as the objects of our search, these interesting fossils were during the day brought into our tent in such numbers, that our collection was limited only by our means of transport.

The Nautili of Seedrapett are of all sizes, from one not larger than an anna piece, to one thirteen inches in diameter: there are two species, but by far the most common is that of which a section is given.* The shape of the septa between the chambers nearly resembles that of the recent species, being a simple curve; but the siphuncle is situated a good deal nearer the inner than the outer margin of the chamber, while in the recent Nautilus its position appears to be almost, if not, quite centrical. Externally also it differs in shape from the species commonly brought to India, the whorl being much rounder and more dilated. The shell of this fossil has almost entirely disappeared, and the outer chamber, and also such of the air chambers as are situated in the outer whorl, are quite filled with ordinary hard limestone, and those in the inner whorls with a calcareous spar, differing from that in the outer chambers as much as the sparry stalactite does from the limestone roof to which it hangs.† The siphuncle is preserved only in the inner whorls; but the space and collar through which it passed, are visible in the outer air chambers also. Associated with the Nautili we found many Baculites, sometimes imbedded in the stone, sometimes separate, and also a few portions of Ammonite. These fossils were all found on the surface, either quite loose, or partially buried in the rock, and

* Several sheets of drawings of these fossils have been received from Mr. Kaye, and though well executed we have thought it advisable to postpone their publication until they can be accompanied with descriptions of each species.—Ed.

† The fossil species here described differs also in having a larger number of air chambers in proportion to its size. A small specimen, only two inches in diameter, contains forty chambers, while a modern specimen, twice that size, has only twenty-nine. A larger specimen of the fossil has nearly sixty chambers.

a small gully, or water course, which ran along the slope of the hill, was almost full of Nautili.

Tracing the limestone still further to the West, the road leads over it in the direction of the town of Verdoor, where there is a traveller's bungalow. About two and a half miles along this road the formation is lost sight of in a hollow, partly filled up with a dark alluvial soil. Through this bottom the French government have dug an extensive water channel; but I do not think that this cut any where passes through the fossiliferous beds, although in some places they come down almost to its brink; nor is the limestone any where seen on the other side of the water course. Nautili have, however, been thrown out by the workmen, as one or two were found among the loose earth thrown up on either side. In this neighbourhood we collected several Nautili, some Baculites, and portions of Ammonite; also a large number of spiral shells,* and what appeared to us to be the teeth of fish. Here also, we again met with the zoophyte described in the former paper, regarding which, as I have seen reason in some respects to alter the opinion formerly expressed, I beg to offer a few remarks. A very common form taken by this zoophyte is that delineated, Mad. Jour. Lit. Sc. 1840, Pl. II. Fig. 7 and 8: from the small size of the lower termination it would appear that the zoophyte was not provided with a stem, or at least no portions sufficiently small to be joints of that stem have yet been discovered. I am therefore induced to think that it is a species of Turbinolia; the internal structure seems to agree in all respects with that of the Turbinolia described in Pl. II. Fig. 5, which is also very common near the borders of the water channel already alluded to.

* I think that we were wrong in naming any of the multilocular univalves, mentioned in the former paper, as Turrilites. I much doubt whether this shell has been discovered.

The ground in this neighbourhood is naturally strong; in order to clear it for cultivation, the villagers have thrown these stones into heaps, or have arranged them in lines, so as to form the boundary of their fields. The stones so carelessly thrown aside are sometimes petrified Nautili, or they contain in their surface portions of Baculites, of Ostreas, or even of Ammonites, disclosing interesting sections of their chambers. In fact, there is not one of these heaps that does not furnish a perfect study for the geologist; as it has been recently discovered by Mr. Cunliffe, that when fractured the stones composing them *almost all* contain beautiful portions of Baculites, entire Ammonites, and a great variety of shells which I am unable to name. The fracture of course sometimes destroys the shell; but occasionally they are extricated without much damage, in which case they are found to preserve a wonderful degree of freshness. The beautiful Ammonite, figured in drawing * * * was obtained in this manner from a mass of the hard limestone; and it may be as well to observe in this place, that however hard the stone may now be, (and it is sometimes nearly as hard as granite,) it must, when these shells were deposited in it, have been in a perfectly soft and almost fluid state, for it retains the sharpest and most minute impressions of the sculpture on the fossils which it encloses.

A good number of Echini have been found at different times, scattered pretty generally over the surface of the soil; but they are usually too imperfect to delineate correctly. They are I think of only two species, that figured in Plate II. Fig. 2, of the Madras Journal, and that figured in of these drawings.

The large bivalve shell described in Plate III. Fig. 3, Madras Journal, is also a very characteristic fossil, and we collected a great number of stony masses, (I presume wood,) bored by the Teredo, very similar to that noticed in my former paper as having been obtained from Trichinopoly.

Many of these masses indeed bear a great resemblance to pieces of old wood, although the ligneous structure is not visible through a common lens, and I have not been able to prepare a piece for examination under the microscope.

Several portions of Hamites were also found, generally imbedded in the hard stone, and too imperfect to draw.

It is not necessary to enter into a detailed description of the shells figured in these drawings. Drawing I. fig. 4, is the section presented by a spiral shell, which is found in considerable numbers—the septa consisting of calcareous spar, and the interstices being filled up with limestone.

Some of the small shells figured in drawing II. bear much resemblance to fresh-water species; but such can hardly be the case. Fig. 11 of this drawing appears to be an Inoceramus, the hinge of the lower valve protruding considerably beyond the upper. Fig 13 is a singular description of flat bivalve.

Drawing IV. Fig. 2, is evidently a Grypha. Fig. 5 is a very common bivalve at Seedrapett, and is found in a very perfect state. Fig. 4 is a much rarer shell.

It will probably be admitted, that the facts recorded above regarding this formation establish, beyond a doubt—1st. that the deposit is of marine origin; 2ndly, that it is a secondary and not a tertiary formation. The existence of the Baculite, Ammonite, and Hamite appear to me to be conclusive on that point, not to mention that almost all the shells which can most readily be identified, correspond with fossils of the chalk.*

The fossils, of which there are two very large collections now at this place, besides many sets which have been sent to friends taking an interest in the subject, were all found either loose on the surface, or they were extracted from the

* Baculite, Hamite, Ostrea carinata, Gryphœa, Inoceramus, Spatangus, Trochus. (drawing III. Fig. 4.) I am not aware of there being any well authenticated instance of either the Baculite or Ammonite being found in a tertiary deposit.

fragments of the rock which strew the ground. As all these therefore have either been washed out or otherwise detached from nearly the upper part of the formation, it is difficult to form an estimate of the vast reservoir of organic remains which the rock must still contain beneath its surface. We have already seen, that where an occasional stream of water, existing only perhaps during the height of the monsoon, had worn itself a channel down the brow of the hill at Seedrapett, many of the stones which it exposed were petrified Nautili and Ammonites, and this is probably a criterion of what an excavation would bring to light.

In a paper by Dr. Malcolmson, which appeared in the Transactions of the Geological Society, (2d series, vol. v.) and was reprinted in the Madras Journal of Literature and Science for July 1840, there is the following passage: "With regard to the age of the silicified wood of Pondicherry, no facts have yet been ascertained, which can justify any conclusion. It is however to be hoped that a gentleman familiarly acquainted with the tertiary and volcanic rocks of Greece and Italy, will soon communicate positive information regarding the geological, relations of the sandstones containing the silicified wood and the fossil shells, the conical hollows, obsidians, and other indications of volcanic action said to exist in that neighbourhood." I am not aware to whom Dr. Malcolmson alludes; but if the gentleman in question has succeeded in making any discoveries regarding the shells and other fossils at Seedrapett and Trivacary, they have never been divulged. Owing to the absence of sections, and the want of means of penetrating the hard surface of the limestone rock, we can only *guess* that it rests upon the sandstone containing the silicified wood, and thus perhaps the required clue as to the age of the whole formation has been obtained. There is no granite or other igneous rock within the area covered by the limestone, the nearest rock of that description being a dark granite, which breaks through (?) and bounds the sandstones at Trivacary. It is much indeed to be regretted, that no person accustomed to geological research, has been able to visit the spot, and put this question to rest.

With reference to the "conical hollows," mentioned by Dr. Malcolmson, I suppose that he alludes to the singular appearance worn by the low hills at Trivacary,* which take a circular, cateriform shape, and perhaps justify that expression: they, however, entirely consist of friable red sandstone. Although I have now several times explored the whole neighbourhood, with a view to geological inquiry, I have never seen any traces of obsidians, nor do I know of any indications of volcanic action.

The fossils discovered at Seedrapett may be said, on a rough calculation, to consist of between 20 and 30 different species of bivalve, and almost the same number of univalve shells, besides the Ammonite, Nautilus, Hamite, Beculite, Belemnite (?) Echini, and Zoophytes of two or three distinct species.

C. T. K.

*April 2nd,* 1841.

* The appearance of these hills is very singular, and induced us when first we visited them to exclaim, that they must be of volcanic origin. Succeeding visitors took up the same idea; but when a series of the rock in the neighbourhood was forwarded to Madras, it was found that there was no volcanic rock among them. At Trivacary, but on no other part of the sandstone, the surface is seamed with a number of tubes, sometimes proceeding like chimnies, and sometimes taking a horizontal direction, as if the tubes had formed passages for escaping gases. No satisfactory explanation has in my opinion been offered to account for these appearances.

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## *Revised Notes on Fossils, discovered by Messrs.* KAYE *and* CUNLIFFE, Madras Civil Service *at Seedrapett. By* J. M'CLELLAND.

After I had written, and partly printed, a notice of some of these remains with which I was favoured by Mr. Cunliffe, I received an intimation from Mr. Kaye, of his intention of forwarding a more perfect and complete set of specimens. These were soon after received, and shewed clearly, that what I had taken for teeth in Mr. Cunliffe's collection, (owing to the specimens being imperfect and worn,) were really, as described by their discoverers in the Madras Journal of Science, No. 11, 1840, *zoophytes* or *corals*. The specimens further prove, also, to have been correctly referred by their discoverers to that division of zoophytes named *Turbinalia*. Before I became aware of this from an inspection of a specimen in Mr. Kaye's collection, in which the external striæ on the surface are sufficiently perfect, the notes which had been prepared from Mr. Cunliffe's specimens were printed and circulated; and not desiring to see any thing so erroneous in these pages, it appeared better to cancel the portion of my former notes relating to these fossils. Plate vii. is therefore to be regarded as exhibiting fossil *Turbinalia* of Seedrapett. Plate viii. fig. 1, 2, represents sections of the fossil, fig. 1. a longitudinal section magnified, *a.* the base, *b.* the apex ; Fig. 2 is half a transverse section from *c.* to *d.* fig. 1; Fig. 3 is the section of *Turbinalia* —— from Bathgate, for which I am indebted to J. W. Grant, Esq. ; it is here represented to shew the difference between the English and the Indian fossil.

The subject is of so much importance, that I would not have referred to it until better prepared than at present, were it not to correct an error. I trust, however, shortly to have leisure to resume the examination of the very interesting collection which has been entrusted to me for the purpose by Mr. Kaye. In the mean time, the following extract of a letter from Mr. Kaye on this subject, accompanied with four pages of drawings illustrative of these fossils, will be interesting.

"I proceed to comply with your request of forwarding to you as complete a set of the fossils as I can get together. I am not able, however, to send specimens of all those which were in the drawing previously forwarded, many of which do not belong to me.

"As the Nautili already sent you do not appear to have been sufficiently perfect, I have selected three or four, which will I hope, supply the deficiency. The one which is cut, displays the siphuncle in a very central position, which I think you will find not to be the case with others. In most of them the siphuncle is decidedly nearer the inner margin, as shewn in the drawing.

"I send also specimens of five or six different species of Ammonite. They are not very perfect; but this fossil is generally found in the middle of large masses of hard limestone, and is therefore very difficult to extract. Two of them are identical with specimens represented in the drawings, and I think two others are of the same species as the other two figures, but smaller specimens.

"I send you two papers of what we suppose to be Hamites. In general they are got out of the stone only in small detached pieces, as in the paper marked No. 2; but if this fossil is a Hamite, the specimen in No. 2, is of a different shape from any representation I have ever seen of it.

"There are sufficient specimens of Baculite, to shew the different states of fossilization. There are also, I imagine, two species, as one is quite smooth even when the external shell is best preserved, and the other protected by raised tubercles.

"I send also two Echini, which are very good specimens of the only species I have. There is another sort, which is in the drawings, but I have no specimens of it.

"The paper marked 3, contains a piece of calcareous Wood from Seedrapett, bored by some sort of Teredina, and I may mention here, that I have put at the bottom of the box a good specimen of the silicified Wood, from the red sand at Trivacary.*

* This has been cut for the microscope, and proved by Mr. Grant to be fossil fir or pine, confirming the previous examinations of the same fossil by Dr. Wight of Madras, who also found it to be pine, as appears from the concluding paragraph of Mr. Kaye's letter.—Ed.

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" The shell in the paper marked 5, is one of those in the drawings.

" Those marked 6, are also specimens of one of the shells in the same drawings. One of them presents a good view of the hinge.

" No. 7 is also in the drawings, but it is evident that the specimen which I drew was not a perfect one. One of the sides appears to be prolonged into a kind of fringe, as you will perhaps be able to make out from some of the specimens which I send.

" There are a good number of other shells which require no remark ; but I have interested myself a deal to find out what the 'zoophyte' which I have already alluded to, may be. There is in the box a curious mass of limestone almost full of them. This I imagine, as well as those in the paper marked 8, is a species of Turbinalia.

" The small cylindrical bodies supposed by us to be Belemnites, are also still matter of speculation.

" There is also a hollow cylindrical body in a piece of paper marked 9, which does not appear to be a shell. I think it must be a piece of some cane or reed.

" In a piece of paper marked 10, are two of these tubes, which I before mentioned as being abundant in the red sand. They have been matters of much speculation, but I don't think they have been satisfactorily accounted for. Mr. Bruce of Madras informed me, that he had often observed the same thing in the green sand of Europe. At Trivacarry small globular masses of the same substance are very common.

" So much for the fossils of Trivacary and Seedrapett. I have lately received some new specimens of the limestone from Trichinopoly; it is certainly a very curious deposit, every where replete with shells, which lie thicker, and are in general better preserved than at Seedrapett; but the stone is so hard, that it is very difficult to get out the shells. We have not yet succeeded in getting many sorts of shell. I send you by this opportunity, however, fair specimens of those articles we have got. You will see, that in all the specimens the shell itself is preserved. If the shell is broken, this was done in detaching it from the stone, for in the rock they are generally perfect. I think they are very curious, especially the small shell with the *arms*, and the ribbed spiral, which in its external form, very nearly resembles the Turrilite. I can't help thinking that these shells are new. At any rate, I can find nothing like them.

"In the Trichinopoly deposit, there is no sign or trace of a Nautilus, a Baculite, or an Ammonite; nor can I identify any of the shells obtained from that locality with those found at Seedrapett. In their most marked characteristics, they appear totally distinct, even the Teredo in the wood appears different. That in the Trichinopoly specimens being apparently a naked worm, while those in the specimen from Seedrapett, have a shelly covering. We may safely conclude, therefore, that the formations are totally distinct, and belong to different geological epochs.

"In the paper marked 11, is a curious substance common at Seedrapett, which are supposed to be a piece of petrified Sponge or Fungus, but this has been doubted."

Some pieces of the silicified wood, which Dr. Wight at Madras had had cut, and which I examined with a microscope, were undoubtedly coniferous.

*Ostrea* trabeculata,* J. M.—Both valves bent laterally, and covered with folds with toothed edges like *O. serata,* and *O. carinata;* but instead of the folds being rounded as in the first, or presenting narrow sharp ridges as in the second, they present along the ridges hollow grooves; another remarkable difference is, that in the Indian fossil, the folds instead of radiating from the summit of the valves, and diverging with a lateral curve to the margins, descend straight on either side of an elevated ridge to the margins of the valves like rafters. This species is figured in the Madras Journal of Science, No. 28, July 1840, as *Ostrea carinata.*

Although the species is distinct from either of the ostracites which characterise the chalk, yet its form is the same; and this is the more important, as most of the ostrea with folded lunate valves that have been found in Europe, appear to be confined to the chalk formation. This species is generally about three inches long; but from fragments in the same collection there would appear to be individuals of gigantic dimensions in the Pondicherry rock.

*Nautilus.*—Three distinct species of this genus are included in this collection; the orifice of all being broken and filled with a hard calcareous deposit, it will be difficult to deter-

* Figures of these fossils will be given in a future number, provided we can obtain correct lithographic drawings of them.

mine the species until more perfect specimens be found. One of the species is umbilicate, mouth wider than high, and the siphuncle central; the other is not umbilicate, with the whorls compressed, and the height of aperture equal to its width. This species may prove to be identical with Nautilus pompilius, a recent species. A third is without umbilicus, but in other respects like the first. In all, the septa are numerous and straight at their insertion; but concave on their interior surface, and convex posteriorly.

*Cuculla crassatina? Desh.*—A single valve of this or an adjoining species of the Paris basin. The occurrence of this fossil, should it prove to be the same species, is a very interesting fact, particularly as Mr. Deshays mentions having apparently the same fossil from Brazil. The specimen from Pondicherry is however imperfect, so that some doubt as to its identity must still exist.

*Arca Cunliffeii,* J. M.—Length of the hinge equal to the height of the shell, and to half its length. Posterior margin narrow and almost pointed, anterior margin rounded, upper surface transversely striated. There are several specimens of this fossil in the collection.

*Arca crassatina,* J. M.—Length of the hinge equal to about half the height, and one-third of the length of the shell; surface striated transversely. There is but one specimen of this fossil in the collection, and that not very perfect.

*Pileopsis plana,* J. M.—A small depressed smooth species, the height exceeding the length, very thin and generally imperfect, with a pearly lustre, either the same or very nearly allied to a shell in the limestone of the coal formation at Cherra.

*Pileopsis rotunda,* J. M.—A large smooth shell, the length nearly equal to the height, upper surface uniformly arched.

*Paludina,* allied to *Paludina Semicarinata*. Brand. Desh. Coq. Fos. Pl.xv. Fig. 11. Many species of this genus are now living in fresh waters, some in India. It is much to be regretted, that the only specimen in the collection is not sufficiently perfect to allow of the species to which it belonged being accurately determined; but the presence of a fresh-water shell is important, as tending to shew the deposit to have taken place near the mouth of a river; or, as frequently proved to have been the case in Europe, in a basin, alternately subject to salt and fresh water.

*Melania ?*—This is another fresh-water genus; but it is to be regretted, that the only specimen in the collection is imperfect. The spire is short, consisting of four whorls, longitudinally ribbed; there is, however, some uncertainty, the upper portion of the aperture being partially removed, as well as generally injured.

*Scalaria.*—Of this genus there are numerous species, many with transverse ridges on the spire; in some the whorls are rounded, in others flattened. The following species may be distinguished:—

1. *Scalaria annulata,* J. M.—Shell elongated and conical, whorls convex, with three or four narrow transverse grooves and obscure ribs on each; upper part of the aperture slightly raised or expanded. This species is larger than any of the others. There is not a perfect specimen in the collection; but several fragments, consisting of the aperture and the last whorl. The largest of these is three-fourths of an inch in diameter.

2. *Scalaria zonata,* J. M.—Shell elongated and conical, whorls convex, with four ribs on the two last. The ribs on this species are more strongly marked and prominent, and the whorls less convex than in the last. The specimens are all incomplete.

5. *Scalaria Kayeii,* J. M.—Shell conical, spire consisting of four convex smooth whorls. There is but one specimen of this species in the collection, which is named in complement of one of the discoverers of these interesting remains.

3. *Scalaria tricostata,* J.M.—Shell conical, sides of the spire straight, the whorls being merely separated by a groove, and distinguished by three costæ, or spiral ridges.

4. *Scalaria bicostata,* J. M.—Shell conical, sides of the spire straight; the whorls separated by a deep groove from each other, and a small spiral groove on each, dividing them into two costæ.

*Nerita transversaria,* J. M.—Spine transversely striated by lines of growth, internal margin of the aperture toothed. This genus is both fresh water and marine. The marine species (of which this fossil is one) are known by the denticulated margin. There is but a single specimen in the collection, of which the outer portion of the margin is broken and imperfect.

*Natica sulculosa,* J. M.—Shell subglobose, spire equal to the height of the aperture, umbilicus consisting of a small transverse fissure. There is but one specimen of this shell in the collection, and that rather imperfect.

*Bulimus indicus,* J. M.—Shell irregular, ovate, aperture narrow, and length about two-thirds the greatest breadth of the shell; sides of the spire and of the columella nearly straight.

*Bulimus pondicerianus,* J. M.—Shell somewhat elongated, sides of the spire straight, aperture equal in length to about half the greatest breadth of the shell.

The specimens of these Bulimi in the collections are but two, both imperfect; but nevertheless sufficient to prove the existence of two species of this genus of fresh-water shells in these rocks.

*Murex levis,* J. M.—Beak straight and narrow, shell short and smooth, without ribs or undulations; length of the aperture less than the breadth of the spire, the sides of which are straight.

*Baculites* compressed, tapering, and consisting of short joints, margins unequal; both somewhat flattened.

Add. doubtful species.

*Nerita speciosa,* Geol. Trans. vol. v, part 3; and *Serpula recta,* Geol. Trans. ii. both fossils of Cutch.

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## *On the Manufacture of Salt in India. By* J. M'Clelland.

The inquiry detailed in the following remarks, was entered upon according to instructions received from the Medical Board, in a letter, dated 25th February, 1841. The Board's instructions contained an extract of a letter from the Government, dated 10th February, 1841, in which it was suggested, that inquiry should be instituted as to whether magnesia, sulphate of soda, and potash might not be manufactured here, instead of being supplied from Europe.* The

* "His Lordship in Council would suggest that your Board should consult Dr. M'Clelland and Dr. O'Shaughnessy, as to whether magnesia, sulphate of soda, and potash, might not be manufactured and supplied here. It appears, that not less than 18 tons of these articles are asked for from Europe." Dr. O'Shaughnessy's report, which we have not seen, recommended mineral carbonate of magnesia of Madras; while our own attention was directed to bittern of the salt works; and with our reply, were submitted to the Board samples of carbonate of magnesia, sulphate of magnesia, and muriatic acid, prepared in the laboratory of

inquiry was partly connected with the manufacture of common salt, and as the observations to which it led on this branch of the subject could not well be introduced in our report to the Medical Board, it is here proposed to notice the subject generally, in the hope, that the inquiry may lead to the improvement of an article of the greatest importance to all classes.

The excellent paper by Dr. Henry, on the comparison of Foreign and British salt, in the Philosophical Transactions for 1810, suggested the probability of obtaining sulphate of magnesia in the manufacture of salt here, as described to be the case by that author at Lymington. The question involved that of the manufacture of salt, on which very little information appears to exist in India, although no subject can be more important in every point of view. As sea-water in every part of the world contains the same saline matters in very nearly the same proportion, any variety in the quality of salts resulting from its evaporation, must depend on the mode in which that process is conducted.

The Cheshire varieties, as they are made from rock salt, might be omitted; but as they are very pure, they may here be retained for comparison.

the Honorable Company's Dispensary, from bittern supplied from the Calcutta Salt Agency. And as these articles are prepared from the impurities in common salt, their manufacture in conjunction with it, must be attended with a corresponding improvement in the quality of that article itself.

The following Table, from Dr. Henry's valuable paper on Analysis of several varieties of British and Foreign Salt, exhibits how much different kinds differ:—

| Kinds of Salt. | | 1000 parts by weight consist of: Insoluble matter. | Muriate of Lime. | Muriate of Magnesia. | Total earthy Muriates. | Sulphate of Lime. | Sulphate of Magnesia. | Total Sulphates. | Total Impurities. | Muriate of Soda. |
|---|---|---|---|---|---|---|---|---|---|---|
| Foreign Salt .. | St. Ube's, .. .. .. | 9 | a trace | 3 | 3 | 23½ | 4½ | 28 | 40 | 960 |
| | St. Martin's, .. .. .. | 12 | ditto | 3½ | 3½ | 19 | 6 | 25 | 40½ | 955 |
| | Oleron, .. .. .. | 10 | ditto | 2 | 2 | 19½ | 4¼ | 23¾ | 35¾ | 964 |
| British Salt from sea-water. | Scotch (common), .. .. | 4 | ...... | 28 or | 28 or | 15 | 17½ | 32½ | 64½ | 935 |
| | Scotch (Sunday), .. .. | 1 | ...... | 11½ | 11½ | 12 | 4½ | 16½ | 29 | 971 |
| | Lymington (common), .. | 2 | ...... | 11 | 11 or | 15 | 35 | 50 | 63 | 937 |
| | Ditto (cat), .. .. .. | 1 | ...... | 5 | 5 | 1 | 5 | 6 | 12 | 988 |
| Cheshire Salt. .. | Crushed rock, .. .. | 10 | $0.\frac{1}{16}$ | $0.\frac{3}{10}$ | 0¼ | 6½ | ...... | 6½ | 16¾ | 983 |
| | Fishery, .. .. .. | 1 | 0.¼ | 0.¾ | 1 | 11¼ | ...... | 11¼ | 13¼ | 986 |
| | Common, .. .. .. | 1 | 0.¼ | 0.¾ | 1 | 14½ | ...... | 14½ | 16½ | 983 |
| | Stoved, .. .. .. | 1 | 0.¼ | 0.¾ | 1 | 15½ | ...... | 15½ | 17½ | 982 |

In addition to the impurities stated in the table, water either in a free state or in combination with any of the impurities usually contained in common salt, may be considered in itself an impurity, particularly as pure muriate of soda contains very little water of crystallization, and does not attract moisture from the atmosphere. Dr. Henry found the quantity of water to be in the better kinds of salt, only from 3 to ½ per cent.

The insoluble matters in foreign salt imported into England, and which is made by solar evaporation, are chiefly argillaceous earth coloured by oxide of iron, together with a small proportion of muriate of lime, probably derived from the pits from which the evaporation is allowed to take place. In salt prepared by rapid evaporation, muriate of magnesia abounds most, and as this salt remains in solution in the mother liquor after the common salt or muriate of soda has formed, it adheres to the surface of the crystals, and requires afterwards to be drained off. The larger the grain, says Dr. Henry, the less is the quantity of this solution which the salt holds suspended, and hence the salt prepared at a low degree of heat, is less debased by the magnesian muriate than salt formed at a boiling temperature.

Although the quantity of sulphates of magnesia and lime appear to vary from two to five per cent. in some of the varieties of English sea salt, these impurities do not appear to be very conspicuous in Indian salt. Dr. Henry having found the quantity of sulphate of lime in salt bearing the same denomination to differ, he was led to investigate the cause, and found that common salt, formed after two hour's boiling, contained about 1½ per cent., after four hour's boiling only about one per cent. &c. Hence it appeared that the greater part of this impurity falls during the early stage of boiling, and that different specimens of the same kind of salt may therefore differ in chemical purity.

As the chemical constituents of the several kinds of salt (setting aside their impurities) are the same, Dr. Henry is of opinion, that the different properties ascribed to them, depend partly on their mechanical effects. Thus the large-grained salt is peculiarly fitted for the packing of fish and other provisions—a purpose to which the small-grained salts are much less suitable. " That kind of salt which possesses most eminently the combined properties of hardness, compactness, and perfection of crystals, will be best adapted to packing fish and other provisions, because it will remain permanently between the different layers, or will be very gradually dissolved by the fluids that exude from the provisions ; thus furnishing a slow but constant supply of saturated brine. On the other hand, for the purpose of preparing pickle or of striking the meat, which is done by immersion in a saturated solution of salt, the smaller grained varieties answer equally well, or even better, on account of their greater solubility."*

In consequence of the northern situation of the British Islands, the whole of the salt there manufactured is necessarily made by boiling or evaporation by artificial heat, and the rapidity with which the liquor is concentrated by this means, and the low temperature of the climate, the crystals are rapidly formed; hence the salt itself is generally fine grained. In consequence of the latter peculiarity, a preference has been long given to what is called *foreign bay salt*, for the purpose of curing provisions. The *foreign bay salt* is produced from sea-water in the southern parts of Europe, by solar evaporation, or by means of sun and air in small pits to which it is confined, and in consequence of the slowness and uniformity of the process by which it is formed, the crystals are large, and hence great sums of money are annually paid to foreign nations, for the importation of this salt to Great Britain, for the purpose above stated.

The British salt in repute for salting provisions intended for exportation, is the Cheshire large-grained, or *fishery salt.*

* Dr. Henry's Philosophical Transactions for 1810, p. 105.

The brine which is derived from springs, is not heated beyond 100 or 110, and the process of crystallization goes on for eight or ten days.* From the expence of fuel in England, it may be doubtful whether the Cheshire *fishery salt* can ever be made to supersede the *foreign salt* made by solar evaporation, even if it were found to answer equally well for those purposes for which the latter is imported.

At Lymington, in Hampshire, we are told by Dr. Henry, that advantage is taken of the greater heat of the climate to concentrate the sea-water by spontaneous evaporation to about one-sixth its bulk before admitting it into the boilers. The salt is not raked out of the boilers and drained in baskets as in some places; but the water is entirely evaporated, and the whole mass of salt taken out at once every eight hours, and placed in troughs with holes in the bottom, through which the deliquescent parts drip into pits made under ground, which receive the *bittern* or *bitter liquor*. Under the troughs in which the salt is placed to drip, and in a line with the holes through which the liquor passes, stakes are placed, on which a part of the salt that would otherwise have escaped crystallizes, and forms lumps of sixty or eighty pounds weight, called *salt cats*.† This circumstance is particularly to be noticed here, because this *cat salt* is exceedingly pure; and we shall find in the description of the native mode of making salt, that a similar deposit of large-grained salt takes place from the mother liquor immediately after it drips from the baskets.

Dr. Henry is of opinion, that the preference given to salt imported from the southern parts of Europe, to the large-

* Dr. Thomson, who aided Dr. Henry's inquiries on this subject, informed him of a peculiar kind of large-grained salt, known as *Sunday salt*, on the western coast of Scotland. It is so called, in consequence of the fires being slackened from Saturday to Monday, which allows the crystals time to increase in size.

† Henry in Philosophical Transactions, for 1810, p. 94.

grained salts of Britain, for the purpose of packing provisions is a prejudice, which it is to be hoped will one day be abandoned, as injurious to the interest of an important branch of British manufacture. The analysis of Dr. Henry, as the results are exhibited in the Table above given, certainly shew, that on whatever cause the superiority of foreign bay salt depends, for the purpose of packing provisions intended for warm climates, several of the English salts are more exempt from impurities.

Whatever be the natural facilities for the manufacture of *salt* in India, the quality of the article, as vended in the different bazars, is very impure. In the hands of petty dealers it is often seized under the suspicion of being adulterated with nitre; but as this article is five rupees, or five rupees eight annas per maund, while the retail price of salt is from two rupees to three rupees per maund, there can be no fear of such adulteration.* There is, however, no salt to be had in India sufficiently pure and large-grained for packing provisions.

This is owing as much to the practice of mixing all the varieties of *salt* together in the first instance at the salt works, instead of keeping them apart, as to the deterioration which the article undergoes in the hands of the retail dealer.

The following is, according to Mr. James Patton, Assistant to the Salt Agent, the native method of making *salt* in the Calcutta Agency. How far the same plan may prevail generally throughout India, I am unable to say:—

The *sea-water* during spring tides is permitted to flow over a portion of ground levelled for the purpose, to allow the earth to be impregnated with salt; the three highest tides are usually sufficient, and as soon as the ground has

* The dirty and moist appearance of the common bazar salt, is owing to its containing the muriates of lime and magnesia, which give to the whole a deliquescent appearance.

become dry again, the earth and salt are scraped together and placed in heaps. The salt and earth from the heaps are then put into a filter constructed of straw, and washed with *sea-water*, the brine from the filter passes into a hole dug for the purpose, and plastered with clay. From this the liquor is boiled in small earthen vessels placed like a honey-comb, one vessel being attached to the other. This method is followed in *Báhárbung* salt works. In other salt works, called *Tuffaul*, the boilers are flat, and placed in rows. The only difference in the two forms of boiling is, that in the former dry wood is burnt to keep up fires only during the day, and in the other, large logs of green wood are burnt night and day, so that the one makes more salt; but the quality of the salt in both cases is *supposed* to be the same. After the salt is all formed in the pots, it is taken out and with the liquid that remains, is placed in baskets for the purpose of draining.

An improved method of preparing *sea-salt* in India has lately been introduced, and a Company formed to carry it on. After the first difficulties inseparable from a new undertaking have been overcome, much good is likely to result from the manner in which European capital and skill will thus be brought to bear upon an important branch of manufacture, on the success of which, other branches of productive economy, intimately connected with the prosperity of the country, greatly depend.

In the Sunderbuns, where the manufacture of salt is carried on, the lands are so low, that pits could not be conveniently employed, at least without expensive works to guard against inundation. The native method, although perhaps somewhat tedious and expensive, is very simple, and by taking advantage of its variations, as well as of its different stages, important varieties of salt might be produced, which would answer for purposes for which the common salt is unfit. It would be very desirable, for instance, to mark the difference between the *Báhárbung* and the *Tuffaul salts.* The interruption of the fires in the one case, and the continued evaporation in the other, it is natural to suppose might produce some difference in the character of the salt. A large-grained, hard, but impure salt, forms by solar evaporation from the mother liquor, near the place where it drips from the baskets in which the impure salt is placed to dry. This is equivalent in this stage of the process, and the circumstances under which it is formed, with the *cat salt* of Lymington salt works, and might, by allowing the salt to drip over stakes, as at Lymington, be rendered a highly valuable salt for packing provisions. *Cat salt* is obtainable in the proportion of one per cent. of the whole. The *cat salt* in the Bengal manufacture is allowed to deposit in the bittern or mother liquor, and hence, from its impurities, it is returned again to strengthen the brine. It might be very useful to endeavour, by simple application of stakes driven into the ground, to convert this variety into *salt* calculated for packing provisions, and also to know in what quantity it is formed during the season, and how far its quantity and purity might be increased or improved in India.

The following Table exhibits the result of analysis of different salts in general use in Bengal :—

*Several varieties of East India Salt, analysed in the Laboratory of the Honorable Company's Dispensary, May and June* 1841.*

| Kind of Salt. | 1000 parts by weight consist of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Insoluble matter. | Chloride of Calcium. | Chloride of Magnesium. | Total Chlorides. | Sulphate of Lime. | Sulphate of Magnesia. | Total Sulphates. | Total Impurities. | Pure Chloride of sodium. | |
| Khoorda Punga, .. .. .. | 11½ | a trace | 5 | 5 | 24 | 4½ | 28½ | 45 | 955 | Sample received from Mr. Bowring, Superintendent of the Salt Golahs at Howrah. |
| Balasore Punga, .. .. .. | 12 | ditto | 4½ | 4½ | 24½ | 3 | 27½ | 44 | 956 | |
| Madras Coast, .. .. .. | 15 | ditto | 4 | 4 | 24½ | 3½ | 28 | 47 | 953 | |
| Cuttack Punga, .. .. .. | 10 | ditto | 4½ | 4½ | 25½ | 3 | 28½ | 43 | 957 | |
| Salt of the best description procurable in the Bazar, .. | 4 | ...... | 3½ | 3½ | 12½ | 3 | 15½ | 23 | 977 | Purified by the shopkeepers. |
| Salt of the commonest description, Calcutta Bazars, | 25½ | 3¾ | 3¼ | ½ | 30 | 3½ | 33½ | 66 | 934 | Commonly used by the natives of Bengal. |
| Ditto Barrackpore Bazar,† .. | 11 | a trace | 6 | 6 | 26 | 4½ | 30½ | 47 | 953 | |

† Received from Captain Nash, in charge of the Barrackpore Bazar, under the suspicion of its adulteration with nitre.

* The following note by Mr. J. G. Scott, Laboratory Assistant Honorable Company's Dispensary, from whom I received the most willing assistance in this inquiry, may be useful. "The

After providing a large-grained salt for the cure of fish, and other provisions, the next object to which attention might be profitably directed, would be to working up the bittern. At Lymington, in Hampshire, where salt is manufactured from sea-water, partly by boiling and partly by solar heat, pretty much on the plan followed in India, sulphate of magnesia is made from the bittern, which is essentially the same as that which is now lost in our salt works.

method of analysis adopted in examining the several varieties of Chloride of Sodium, is almost similar to that of Dr. Henry's, and is as follows—:

"On 1000 parts by weight of the salt, previously dried and pulverized, three ounces of alcohol Sp. gr. 816, and nearly at boiling temperature were poured. To ensure the access of the alcohol to every part of the salt, they were intimately mixed in a mortar. The alcohol was then separated by filtration, and the chloride of sodium washed as it lay on the filter, with 3 ounces more of alcohol.

"The filtered solutions were evaporated to dryness, and to the dry mass a little fresh alcohol was added. This separated a small portion of the chloride of sodium, which was dissolved with the earthy muriates. The solution was again evaporated, and an aliquot part was dissolved separately for the purpose of putting it to the usual tests. The chloride of magnesium was alone indicated with but one exception, when it was found combined with chloride of calcium.

"To the solution of two earthy chlorides, a fully saturated solution of carbonate of ammonia was added, which precipitated the lime as a carbonate; this was separated by filtration, dried and weighed. To the filtered liquid, a solution of phosphate of soda was added, and the precipitate of ammoniaco-magnesian phosphate was dried at a temperature of 90° and weighed.

"The salt which had resisted the action of alcohol, was dissolved by long boiling in 16 ounces of distilled water, and the solution filtered. A quantity of insoluble matter remained on the filter, which was well washed, dried, and its weight ascertained. To the filtered solution carbonate of soda was added, and boiled briskly for several minutes, in order that none of the earthy carbonates, which were separated, might remain dissolved by excess of carbonic acid.

"The precipitated carbonates after being well washed with boiling distilled water, were allowed to subside, and the washings added to the liquid first decanted from the precipitate. To these united liquids, (after the addition of hydrochloric acid in excess to saturation,) muriate of barytes was added. The sulphate of barytes precipitated was washed sufficiently, dried, ignited, and its amount ascertained.

"To the earthy carbonates excess of sulphuric acid was added in a platina capsule, and evaporated to dryness, calcined in a low red heat and the weight of the earthy sulphates ascertained.

"The dry sulphates then were washed with a small quantity of tepid distilled water, and to the solution filtered, was added a fully saturated solution of carbonate of ammonia and phosphate of soda. The precipitate produced was collected, dried at 90° and weighed.

"It became expedient to examine whether in addition to the sulphates of lime and magnesia, the quantity of which had been determined by the foregoing process, the specimens of salt might not contain also an alkaline sulphate. To decide this point, the amount of the acid deducible from the weight of the sulphate of barytes was compared with that which should exist in the two sulphates actually found. The result of the examination was such as to lead to the conclusion, that no alkaline sulphate was present."

The mother liquor, or bittern of the Lymington salt works, specific gravity 1280, contained, according to the analysis of Dr. Henry,*

| | |
|---|---|
| Muriate of magnesia, ... ... ... | 640 |
| Sulphate of magnesia, ... ... ... | 260 |
| Muriate of soda, ... ... ... | 100 |
| Total, ... ... | 1,000 |

As no muriate of lime was found in the bitterns examined by Dr. Henry, this chemist is of opinion, that the lime in other bitterns is derived from the soil from which the evaporation is conducted; and to shew how the different ingredients vary in proportion, according to the method adopted, the following results of analysis of Scotch bittern supplied to Dr. Henry by Dr. Thomson, may be stated :—

| | |
|---|---|
| Muriate of magnesia, ... ... ... | 874 |
| Sulphate of magnesia, ... ... ... | 70 |
| Muriate of soda, ... ... ... | 56 |
| Total, ... ... ... | 1,000 |

The following are the results of analysis of a specimen of bittern from the Calcutta Salt Agency, of a clear yellow colour, specific gravity 1280:—

| | |
|---|---|
| Muriate of lime, ... ... ... ... | 510 |
| Muriate of soda, ... ... ... ... | 264 |
| Sulphate of soda, ... ... ... ... | 173 |
| Muriate of magnesia, ... ... ... | 48 |
| Vegetable matter, ... ... ... ... | 5 |
| Total, ... ... ... | 1,000 |

* The analysis of sea water, says Dr. Henry, by Bergman, erroneously excludes sulphate of magnesia from its composition, and his results have led to the opinion that to manufacture this salt on a large scale, requires the addition of sulphuric acid, or some sulphate to the bitter liquor.—Philosophical Transactions for 1810.

As the quantity of sulphate in the Calcutta bittern is proportionally small, sulphuric acid, or some sulphate, must be added to form the sulphate of magnesia.

I first thought of sulphate of iron, which ought to be the cheapest substitute for sulphuric acid. And although it has been stated in the Coal Reports, 1838, p. 52, that sulphate of iron may be made at a nominal price from pyritous or refuse coal, such as that of Kyuk Phyu, yet impure sulphate of iron is sold in the bazar at eight rupees per maund, a price which must prohibit its use in chemical manufactures.

To separate the muriate of magnesia from the other salts, let the bittern be boiled down to one-half or two-thirds, according to its specific gravity, and set it aside to crystallize, decant the liquor, and remove the crystals of muriate of magnesia before they deliquesce.

The muriate of magnesia is then to be placed in a vessel to which receivers are attached, and sulphuric acid added gradually till no more muriatic acid vapour is disengaged, then remove the adopting tube, and add carbonate of magnesia to take up the excess of sulphuric acid as long as carbonic acid gas is disengaged, and set the neutralized solution aside to crystallize in flat shallow vessels. The muriatic acid recovered in this process, is equivalent to the sulphuric acid expended in making the sulphate.

For carbonate of magnesia, treat the bittern as for the sulphate, and dissolve the muriate of magnesia in thrice its bulk of water; dissolve the same quantity of carbonate of soda prepared from *sajee muttie* in the same proportion of water, mix the solution, and boil for a quarter of an hour; allow the carbonate of magnesia to fall to the bottom, decant off the water, and dry the magnesia. The carbonate of magnesia thus prepared, is of a lighter and finer quality than that which is imported. Other experiments are in progress, from which it will appear, that the first part of the process, that of boiling the bittern, may be dispensed with. It has been found in a sample of bittern, received from Mr. James Patton, consisting of a small cask that 24 lbs. of a compound salt, consisting of muriate of magnesia and soda had formed in the bottom of the vessel. This salt is transparent and deliquescent if exposed to the air; it requires to be dissolved in water, and decomposed with carbonate of potash, which is to be added as long as magnesia is precipitated, after which, the water is to be decanted off, and the magnesia dried. The magnesia procured in this way, is the heavy carbonate, such as that imported from Europe.

Since the publication by Dr. Henry of the process already referred to, for the manufacture of Epsom salt from bittern, nothing has been made known. Indeed it is impossible that the process employed at Lymington would answer here, since there really appears to be no sulphate of magnesia in the bittern of this place. The existence of that salt in *sea-water,* in the proportion which the results of Dr. Henry's observations on the Lymington brines would suggest, still may perhaps be regarded as doubtful.

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## *Medical Statistics.*

In favouring us with the annexed Tables for insertion in the Calcutta Journal of Natural History, Dr. Murray remarks, that while Medical Journals and Transactions are mostly limited to the history, symptoms, causes, pathology, and treatment of diseases, Medical Statistics may be regarded as a branch sufficiently distinct, to be treated with advantage in works of a more popular character. For ourselves we can judge of the great value of Medical Statistics from one or two points which we have investigated. On these occasions, we found the importance of the subject to depend on, and result from, investigations in themselves not at all intimately connected with medicine.

Medical Statistics, as shewing the *habitats* and comparative prevalence of particular diseases, and leading to the investigation of their causes, and means of prevention, form a subject equally important for the consideration of the statesman, as of the physician.

We shall therefore have much pleasure in devoting a portion of our Journal to this branch of Natural History, as well as to Medical Topography.

Medical Statistics are immediately connected with Topography, and have only been recently recommended to the special attention of medical officers. Topographical sketches of the stations and districts to which the Statistical results relate, often elucidate the cause, and suggest means for the prevention of disease, and the improvement and comfort of Society; particularly when extended to an investigation of the natural productions, which vary no less than salubrity of climate, according to local circumstances.

*20th May*, 1841.

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# Comparative Statistical Tables of Admissions into Hospital, and Mortality from Disease, among the Royal Troops in the three Presidencies of India, for the First Quarter of the Year 1840.

*Abstract of the General Quarterly Return of Sick of Her Majesty's Troops in the* Bengal *Presidency, from* 1*st Jan. to* 31*st March,* 1840.

| Regiments and Stations. | Length of time present in the Command during the Quarter. | Average strength during the period. | No. of Admissions. | No. of Deaths. | Ratio per Cent. per Quarter of Admissions to strength. | Ratio per Cent. per Quarter of Deaths to strength. | Ratio per Cent. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|
| 3rd Light Dragoons—Cawnpore. | The whole period. | 640 | 245 | 1 | 38·28 | 0·15 | 0·40 |
| 16th Lancers—on march from Cabul to Meerut. | Do. | 687 | 228 | 16 | 33·18 | 2·32 | 7·02 |
| 3rd Foot, or Buffs—Meerut. | Do. | 756 | 231 | 3 | 30·55 | 0·39 | 1·29 |
| 9th Foot—on march to, and at, Agra. | Do. | 754 | 328 | 2 | 43·50 | 0·26 | 0·61 |
| 13th Light Infantry—Affghanistan (Cabul). | Do. | 425 | 113 | 16 | 26·58 | 3·76 | 14·16 |
| 16th Foot—Dinapore. | Do. | 421 | 190 | 8 | 45·13 | 1·90 | 4·21 |
| 21st Fusiliers—Chinsurah. | Do. | 579 | 348 | 13 | 60·10 | 2·24 | 3·73 |
| 26th Foot—Fort William. | Do. | 921 | 272 | 10 | 29·53 | 1·08 | 3.67 |
| 31st Foot—Ghazeepore. | Do. | 696 | 157 | 9 | 22·55 | 2·29 | 5·73 |
| 44th Foot—Kurnaul. | Do. | 700 | 186 | 3 | 26·57 | 0·43 | 1·61 |
| 49th Foot—Dinapore and Fort William. | Do. | 679 | 272 | 6 | 40·06 | 0·88 | 2·20 |
| Detachments of Recruits, Invalids, &c. at Fort William, Chinsurah, and on the march, &c. of the above Regiments. | Do. | 727 | 288 | 17 | 39·61 | 0·33 | 5·90 |
| General Quarterly Averages. | | 7,985 | 2,858 | 104 | 35·79 | 1·30 | 3·63 |
| This would give Ratios per Annum equal to | | | | | 143·16 | 5·20 | |

Remarks.

1. The greatest No. of deaths from any one disease was 31—viz. from Cholera.

2. Eighteen deaths from Pneumonia; 15 from Dysentery; 10 from Diarrhœa; 10 from Fever; and 7 from Hepatitis.

3. No death from Gunshot wound.

4. The two Corps on Service viz. 16th Lancers and 13th Light Infantry, sustained the greatest losses by death, each having lost 16 men.

5. The ratio of admissions from Venereal during the Quarter, was 6.28 per cent. to strength.

*Abstract of the General Quarterly Return of Sick of Her Majesty's Troops in the* Madras *Presidency, from* 1*st Jan. to* 31*st March,* 1840.

| Regiments and Stations. | Length of time present in the Command during the Quarter. | Average strength during the period. | No. of Admissions. | No. of Deaths. | Ratio per Cent. per Quarter, of Admissions to strength. | Ratio per Cent. per Quarter, of Deaths to strength. | Ratio per Cent. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|
| 13th Light Dragoons—on march from Bangalore, and embarked for England 24th February. | For 2 months. | Actual strength of 13th L. D. 481. Deduct ⅓ for Quarterly ratios give 321. 321 | 162 | 13 | 50·46 | 4·05 | 8·02 |
| 15th Hussars—at Bombay and route to Bangalore. | The whole period. | 555 | 333 | 13 | 60·00 | 2·34 | 3·93 |
| 4th Foot—Bangalore and Bellary. | Do. | 867 | 580 | 8 | 66·89 | 0·92 | 1·37 |
| 39th Do.—on route to Kamptee. | Do. | 626 | 354 | 0 | 35·11 | 0·0 | 0·0 |
| 41st Do. (Rt. Wing)—Belgaum. | Do. | 482* | 135 | 1 | 28·01 | 0·20 | 0·74 |
| 54th Do.—Fort St. George. | Do. | 522 | 164 | 4 | 31 41 | 0·76 | 2·43 |
| 55th Ditto—Secunderabad, and on route to Madras. | Do. | 789 | 352 | 5 | 44·61 | 0·63 | 1·42 |
| 57th Do.—Trichinopoly and Bangalore | Do. | 803 | 333 | 4 | 41·46 | 0·49 | 1·20 |
| 62nd Do.—at Moulmein. | Do. | 736 | 322 | 0 | 43·75 | 0·0 | 0·0 |
| 63rd Do.—at Moulmein. | Do. | 799 | 198 | 3 | 24·78 | 0·37 | 1·51 |
| 94th Do.—at Cannanore. | Do. | 584 | 230 | 14 | 39·38 | 2·39 | 6·08 |
| Depôt at —Poonamallee — viz. Recruits and Invalids of the above Corps. | Do. | 109 | 273 | 5 | 250·45 | 4·58 | 1·83 |
| General Quarterly Averages. | | 7193 | 3436 | 70 | 47·64 | 0·97 | 2·04 |
| This would give Ratios per Annum equal to | | | | | 189·56 | 3·88 | |

Remarks.

1. The greatest No. of deaths from any one disease was 21, viz. from Dysentery.

2. The next greatest No. of deaths occurred from Hepatitis and Cholera—viz. from each 15. There were only 7 from Fever of all types.

3. No death from Gunshot wound.

4. The ratio of admissions from Venereal is high, being 7.5 per cent. to strength—equal to 30 per cent. per Annum.

* The Left Wing of Her Majesty's 41st Regt., 338 strong, is excluded from this Return, as it was stationed at Poonah, in the Bombay Presidency, and is included in the Quarterly Return of that Command.

*Abstract of the General Quarterly Return of Sick of H. M. Troops in the* Bombay *Presidency, from* 1*st Jan. to* 31*st March,* 1840.

| Regiments and Stations. | Length of time present in the Command during the Quarter. | Average* Strength during the period. | No. of Admissions. | No. of Deaths | Ratio per Cent. per Quarter, to Strength. | Ratio per Cent. per Quarter, of Admissions to strength. | Ratio per Cent. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|
| 4th Light Dragoons. { 448 At Kirkee. 251 On Field Service. } | The whole period. | 699 | 222 | 4 | 31·75 | 1·57 | 1·80 |
| 2nd Foot. { 424 On Field Service. 285 On Route to Deesa. 8 At Colabah & Poonah. } | Do. | 717 | 226 | 7 | 31·52 | 0·97 | 3·08 |
| 6th Foot. Colaba and in Route to Poonah. | Do. | 773 | 431 | 14 | 55·75 | 1·81 | 3·17 |
| 17th Foot. Scinde and Colaba. | Do. | 844 | 342 | 24 | 40·52 | 2·84 | 7·02 |
| 40th Foot. { 700 On Field Service. 100 At Colaba. } | Do. | 800 | 415 | 10 | 51·87 | 1·25 | 2·41 |
| Left Wing 41st Foot, at Poonah. | Do. | 338 | 61 | 0 | 18·04 | 0·0 | 0·0 |
| General Quarterly averages. | | 4171 | 1697 | 59 | 40·68 | 1·41 | 3·47 |
| This would give Ratios per annum equal to | | | | | 162·72 | 5·64 | |

Remarks.

1. The greatest No. of deaths from any one disease was 11, viz. from Hepatitis acuta.

2. Nine deaths occurred from Dysentery, and 6 from Cholera.

3. No death in the return from Gunshot wound.

4. The ratio of admissions from Venereal among the troops on field service was under 2 per cent. while that among those at stations in the Presidency was above 5 per cent. Troops in the field, or on the march, seldom contract much Venereal; yet the late Dr. Burke adduced this as an argument for the abolition of the Lock Hospital system, as he said under such circumstances the troops were not under its influence. The fact is, that it is chiefly in Cantonments that the men are exposed to infection, and where means of prevention are chiefly required to be adopted.

* In place of the *average*, the *highest strength* during the period seems to have been given, which materially affects (reduces) the real ratios of Sickness and Mortality

*Comparative View of the Sickness and Mortality (Health) during the first Quarter of* 1840, *at the respective Stations occupied by H. M. Troops in the* BENGAL *Presidency.*

| Stations. | Corps. | Average Strength. | From Fever. Admissions. | From Fever. Deaths. | Pneumonia. Admissions. | Pneumonia. Deaths. | Hepatitis. Admissions. | Hepatitis. Deaths. | Dysentery. Admissions. | Dysentery. Deaths. | Cholera. Admissions. | Cholera. Deaths. | Rheumatism & Lumbago. Admissions. | Rheumatism & Lumbago. Deaths. | Scorbutus. Admissions. | Scorbutus. Deaths. | Venereal. Admissions. | Venereal. Deaths. | Other Diseases. Admissions. | Other Diseases. Deaths. | Total Admissions. | Total Deaths. | Ratio per cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Cawnpore, ... | 3rd Light Dragoons, | 640 | 28 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 1 | 0 | 6 | 0 | 0 | 0 | 83 | 0 | 112 | 1 | 245 | 1 | 38·28 | 0·15 | 0·40 |
| 2 Meerut, ... | Detcht. 16th Lancers 169<br>3rd Foot, ... ... 756 | 925 | 30 | 0 | 8 | 0 | 23 | 1 | 14 | 0 | 1 | 0 | 19 | 0 | 0 | 0 | 47 | 0 | 108 | 1 | 250 | 3 | 27·02 | 0·32 | 1·20 |
| 3 Agra,* ... | ... ... ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ......... | ...... | ...... |
| 4 Cabul, ... | 13th Do. ... ... ... | 425 | 12 | 2 | 39 | 10 | 7 | 2 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 12 | 0 | 37 | 2 | 113 | 16 | 26·58 | 3·76 | 14·15 |
| 5 Dinapore, ... | 16th Do. for the last 2 months—avr. streng. 421-⅔ for ratios, ... | 280 | 24 | 0 | 6 | 0 | 5 | 2 | 19 | 1 | 3 | 0 | 18 | 0 | 0 | 0 | 18 | 1 | 63 | 1 | 156 | 5 | 55·71 | 1·78 | 3·20 |
| 6 Chinsurah, ... | 21st Do. ... ... ... | 579 | 71 | 2 | 0 | 0 | 6 | 0 | 9 | 2 | 15 | 9 | 11 | 0 | 0 | 0 | 80 | 0 | 156 | 0 | 348 | 13 | 60·10 | 2·24 | 3·73 |
| 7 Fort William, ... | 26th Do. ... ... ... | 921 | 66 | 1 | 3 | 0 | [illegible] | 0 | 23 | 1 | 18 | 7 | 4 | 0 | 0 | 0 | 46 | 0 | 109 | 1 | 272 | 10 | 29·53 | 1·08 | 3·67 |
| 8 Ghazeepore, ... | 31st Do. ... ... ... | 696 | 35 | 0 | 11 | 1 | 11 | 1 | 12 | 1 | 10 | 4 | 14 | 0 | 0 | 0 | 19 | 0 | 45 | 2 | 157 | 9 | 22·55 | 1·29 | 5·73 |
| 9 Kurnaul, ... | 44th Do. ... ... ... | 700 | 30 | 0 | 1 | 0 | 5 | 1 | 12 | 0 | 1 | 0 | 14 | 0 | 0 | 0 | 31 | 0 | 92 | 2 | 186 | 3 | 26·57 | 0·42 | 1·61 |
| 10 Hazareebaug,* ... | ... ... ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ......... | ...... | ...... |
| 11 Berhampore,* ... | ... ... ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ......... | ...... | ...... |

* Corps interchanging during the period. Note.—This does not include Admissions and Deaths of Corps and Detachments on the march in the Presidency.

*Comparative View of the Sickness and Mortality during the first Quarter of* 1840, *at the respective Stations occupied by H. M. Troops in the* MADRAS *Presidency.*

| Stations. | Corps. | Average Strength. | From Fever. Admissions. | From Fever. Deaths. | Pneumonia. Admissions. | Pneumonia. Deaths. | Hepatitis. Admissions. | Hepatitis. Deaths. | Dysentery. Admissions. | Dysentery. Deaths. | Cholera. Admissions. | Cholera. Deaths. | Rheumatism. Admissions. | Rheumatism. Deaths. | Scorbutus. Admissions. | Scorbutus. Deaths. | Venereal. Admissions. | Venereal. Deaths. | Other Diseases. Admissions. | Other Diseases. Deaths. | Total Admissions. | Total Deaths. | Ratio per cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Bangalore,† ... ... | ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ... | ......... | ...... | ...... |
| 2 Fort St. George, ... | 54th Foot, ... ... | 522 | 18 | 0 | 0 | 0 | 9 | 1 | 17 | 1 | 0 | 0 | 8 | 0 | 0 | 0 | 30 | 0 | 82 | 2 | 164 | 4 | 31·41 | 0·76 | 2·43 |
| 3 Trichinopoly, ... ... | Rt. Wg. 57th Do. | 478 | 43 | 0 | 0 | 0 | 10 | 1 | 27 | 2 | 4 | 0 | 11 | 0 | 0 | 0 | 62 | 0 | 56 | 0 | 213 | 3 | 44·56 | 0·62 | 1·40 |
| 4 Belgaum, ... ... | Rt. Wg. 41st Do. | 482 | 1 | 0 | 9 | 0 | 29 | 0 | 14 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 32 | 0 | 38 | 1 | 135 | 1 | 28·01 | 0·20 | 0·73 |
| 5 Cannanore,... ... ... | 94th Do. ... ... | 584 | 25 | 2 | 0 | 0 | 32 | 2 | 53 | 9 | 0 | 0 | 14 | 0 | 0 | 0 | 24 | 0 | 82 | 1 | 230 | 14 | 39·38 | 2·39 | 6·08 |
| 6 Bellary,† ... ... ... | ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ... | ......... | ...... | ...... |
| 7 Secunderabad,† ... | ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ... | ......... | ...... | ...... |
| 8 Kamptee,† ... ... | ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ... | ......... | ...... | ...... |
| 9 Moulmein, ... ... | 62nd Do. ...<br>63rd Do. ... | 1534 | 79 | 0 | 4 | 0 | 59 | 2 | 15 | 0 | 0 | 0 | 56 | 0 | 0 | 0 | 65 | 0 | 242 | 0 | 520 | 3 | 33·87 | 0·19 | 0·57 |
| 10 Depôt Poonamallee,‡ | ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ... | ......... | ...... | ...... |

† Corps interchanging during the period.
‡ Details of Recruits and Invalids constantly varying (a very healthy Station.)

*Comparative View of the Sickness and Mortality during the first Quarter of* 1840, *at the respective Stations occupied by H. M. Troops in the* BOMBAY *Presidency.*

| Stations. | Corps. | Average Strength in the period. | From Fever. Admissions. | From Fever. Deaths. | Pneumonia. Admissions. | Pneumonia. Deaths. | Hepatitis. Admissions. | Hepatitis. Deaths. | Dysentery. Admissions. | Dysentery. Deaths. | Cholera. Admissions. | Cholera. Deaths. | Rheumatism and Lumbago. Admissions. | Rheumatism and Lumbago. Deaths. | Scorbutus. Admissions. | Scorbutus. Deaths. | Venereal. Admissions. | Venereal. Deaths. | Other Diseases. Admissions. | Other Diseases. Deaths. | Total Admissions. | Total Deaths. | Ratio per cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Deesa,* ... | ... ... ... ... ... ... ... | ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ...... | ...... | ...... |
| 2 Kirkee, ... | 4th Light Dragoons, ... ... | 423 | 35 | 0 | 2 | 0 | 1 | 0 | 12 | 1 | 0 | 0 | 6 | 0 | 2 | 0 | 32 | 0 | 104 | 0 | 194 | 1 | 45·86 | 0·23 | 0·51 |
| 3 Poonah, | 2nd Foot, ... ... ... 3<br>17th Do. ... ... ... 230<br>41st Do. ... ... ... 338 | 571 | 17 | 0 | 0 | 0 | 5 | 1 | 8 | 1 | 0 | 0 | 10 | 0 | 0 | 0 | 29 | 0 | 59 | 1 | 128 | 3 | 22·41 | 0·52 | 2·34 |
| Colabah, | 2nd Regiment, ... ... 5<br>6th Regiment, (Average strength during the two months at the Station 711—take ⅔ for Quarterly Ratios), ... ... 474<br>17th Regiment, (800; strong present one month —⅓ for Quarterly Ratios) 281<br>40th Regiment, ... ... 100 | 860 | 178 | 4 | 1 | 0 | 29 | 8 | 61 | 5 | 3 | 1 | 5 | 0 | 4 | 0 | 35 | 1 | 183 | 0 | 499 | 19 | 58·02 | 2·20 | 3·80 |
| 5 Karachee, | 40th Regiment, ... ... ... | 700 | 130 | 3 | 0 | 0 | 5 | 1 | 19 | 1 | 0 | 0 | 13 | 0 | 2 | 0 | 16 | 0 | 100 | 0 | 285 | 5 | 40·71 | 0·71 | 1·75 |
| 6 On Service in other parts of Scinde, ... | 4th Light Dragoons, ... 251<br>2nd Foot, ... ... ... 424<br>17th Do. (476 strong—present two months—⅔ for qrly. Ratios),... ... 318 | 993 | 53 | 1 | 11 | 6 | 2 | 0 | 15 | 4 | 5 | 3 | 19 | 0 | 0 | 0 | 19 | 0 | 106 | 8 | 230 | 24 | 23·16 | 2·46 | 10·42 |

* Not much occupied during the period. NOTE.—This Table does not include Admissions and Deaths of Corps and Detachments *on the march* within the Presidencies.

*Return shewing the comparative Ratios of Admissions and Deaths from the most prevalent and fatal Diseases among H. M. Troops in the three Presidencies, during the Quarter from 1st January to 31st March, 1840.*

| Presidencies. | No. Admitted. | No. Died. | Quarterly ratio per cent. of Admissions to Strength for the Quarter. | Quarterly ratio per cent. of Deaths to Strength for the Quarter. | Ratio per cent. of Deaths to Admissions. | Remarks. |
|---|---|---|---|---|---|---|
| | | | *1st Table—of Fevers.* | | | |
| Bengal, .. .. .. .. | Intermittent, 31 | 0 | 0·39 | 0·0 | 0·0 | 1. From this Table we learn that the Admissions of *Intermittent Fever* were the least numerous of this class of complaints. The admissions were highest at Madras. Only one death occurred from it among the Royal Troops in India during the Quarter, viz. at Madras. |
| | Remittent, ... 68 | 1 | 0·85 | 0·01 | 1·47 | |
| | Continued, .. 375 | 9 | 4·69 | 0·11 | 2·40 | |
| Total. .. | 474 | 10 | 5·93 | 0·12 | 2·10 | |
| Madras, .. .. .. .. | Intermittent, 67 | 1 | 0·93 | 0·01 | 1·49 | 2. *Remittent Fever* was most prevalent in the Bombay Command, where the greatest proportion of "Deaths to Strength" from it occurred; but the greatest proportion of "Deaths to Admissions" was in the Madras command; where, however, only 1 died. |
| | Remittent, .. 11 | 1 | 0·15 | 0·01 | 9·09 | |
| | Continued, .. 509 | 5 | 7·08 | 0·07 | 0·98 | |
| Total. .. | 587 | 7 | 8·16 | 0·09 | 1·29 | |
| Bombay, .. .. .. | Intermittent, 47 | 0 | 1·13 | 0·0 | 0·0 | 3. In *Continued Fever*, the highest proportion of "Admissions to Strength" is found at Madras; but the proportion of Mortality from it, in reference both to "Strength and Admissions," is conspicuously lowest in the Return of that Presidency. |
| | Remittent, .. 201 | 3 | 4·82 | 0·07 | 1·49 | |
| | Continued, .. 254 | 4 | 6·08 | 0·09 | 1·57 | |
| Total... | 502 | 7 | 12·03 | 0·16 | 1·45 | |
| | | | *Summary of Fevers.* | | | |
| Summary of each type of Fever in the three Presidencies, .. ... ... | Intermittents, 145 | 1 | 0·75 | 0·0 | 0·69 | 4. Upon the whole, there were fewest Fevers in the Bengal Command, but the greatest number and proportion of deaths; and these were chiefly from *continued Fever*, which is generally the least dangerous type in India, and the most easy of cure, if early and properly treated. |
| | Remittents, .. 280 | 5 | 1·44 | 0·03 | 1·78 | |
| | Continued, .. 1138 | 18 | 5·88 | 0·09 | 1·58 | |
| General Total and Ratios of Fevers. .. .. .. | 1563 | 24 | 8·07 | 0·12 | 1·53 | |
| | | | *2nd Table—of Pneumonia.* | | | |
| Bengal, .. .. .. .. | 85 | 18 | 1·06 | 0·22 | 21·17 | 5. Unusual mortality from *Inflammation of the Lungs* appears in the Bengal and Bombay returns. Of the 18 deaths in the former, 6 occurred in the 16th Lancers, and 10 in the 13th Foot, both on service beyond the Indus; and the whole of the deaths from it in the Bombay Command occurred in the 17th Foot, which was on field service in Scinde during part of the period. |
| Madras, .. .. .. .. | 17 | 0 | 0·03 | 0·0 | 0·0 | |
| Bombay, .. .. ... .. | 21 | 7 | 0·50 | 0·16 | 33·33 | |
| General Total and Ratios of Pneumonia. .. .. | 123 | 25 | 0·63 | 0·12 | 20·32 | |
| | | | *3rd Table—of Hepatitis.* | | | |
| Bengal, .. .. .. .. | 112 | 7 | 1·40 | 0·08 | 6·25 | 6. *Hepatitis* prevailed to a much greater extent in the Madras than the other Presidencies: but proved most fatal at Bombay in proportion to strength, and conspicuously so in regard to the number admitted. In Bengal too, a greater proportion of those admitted died, than in Madras. |
| Madras, .. .. .. .. | 243 | 15 | 3·37 | 0·20 | 6·17 | |
| Bombay, .. .. .. .. | 60 | 11 | 1·43 | 0·26 | 18·33 | |
| General Total and Ratios of Hepatitis, .. .. .. | 415 | 33 | 2·14 | 0·17 | 7·95 | |
| | | | *4th Table—of Dysentery.* | | | |
| Bengal, . .. .. .. | 205 | 15 | 2·56 | 0·18 | 7·31 | 7. *Dysentery* is always a disease of very great frequency in the Madras Command; but this table shews, that although the proportion of admissions was highest in that Presidency, the ratio of mortality amongst those admitted was conspicuously the least. The ratio of "*deaths to strength*" was lowest in the Bengal, and highest in the Bombay returns. |
| Madras, .. .. .. .. | 372 | 21 | 5·17 | 0·29 | 5·64 | |
| Bombay, .. .. .. .. | 156 | 14 | 3·74 | 0·33 | 8·97 | |
| General Total and ratios of Dysentery. .. .. | 733 | 50 | 3·78 | 0·25 | 6.82 | |
| | | | *5th Table—of Cholera.* | | | |
| Bengal, .. .. .. .. | 74 | 31 | 0.92 | 0·38 | 41·89 | 8. *Cholera* proved most prevalent and most fatal in Bengal during this quarter in proportion to numerical strength, and least so in Bombay. It was most fatal in proportion to the number admitted at Bombay, and least so at Madras. |
| Madras, .. .. .. .. | 43 | 15 | 0·59 | 0·20 | 34·88 | |
| Bombay, .. .. .. .. | 12 | 6 | 0·28 | 0·14 | 50·0 | |
| General Total and ratios of Cholera. .. .. | 129 | 52 | 0·66 | 0·26 | 40·31 | |
| | | | *6th Table—of Rheumatism.* | | | |
| Bengal, .. .. .. .. | 122 | 0 | 1·52 | 0·0 | 0·0 | 9. *Rheumatism* was by far most prevalent in the Madras Presidency, none died from it; but it is a disease by which many are rendered inefficient to the service; and its causes, therefore, ought to be well studied and guarded against. |
| Madras, .. .. .. .. | 258 | 0 | 3·58 | 0·0 | 0·0 | |
| Bombay, .. .. .. .. | 50 | 0 | 1·17 | 0·0 | 0·0 | |
| Genl. Total and ratios of Rheumatism. .. .. | 430 | 0 | 2·22 | 0·0 | 0·0 | |
| | | | *7th Table—of Venereal.* | | | |
| Bengal, .. .. .. .. | 514 | 1 | 6·43 | 0·01 | 0·17 | 10. *Venereal* diseases seem most prevalent at Madras. This Table shews that, according to the average ratio, rather more than one man in every 4 of H. M. Troops in India, [26 per cent.] would be in Hospital with Venereal in the course of the year. It deserves notice, that, excepting from Fevers of all types, the ratio of Admissions from Venereal greatly exceeds that from any other class of disease. |
| Madras, .. .. .. .. | 561 | 0 | 7·79 | 0·0 | 0·0 | |
| Bombay, .. .. .. .. | 183 | 2 | 4·38 | 0·04 | 1·09 | |
| General Total and ratios of Venereal. .. .. | 1258 | 3 | 6·50 | 0·01 | 0·23 | |
| | | | *8th Table—of other (minor) Diseases.* | | | |
| Bengal, .. .. .. .. | 1272 | 22 | 15·93 | 0·27 | 1·72 | 11. The proportion of Admissions from Minor diseases was greatest at Madras; but the proportion of Mortality from them conspicuously smallest in that Command. |
| Madras, .. .. .. .. | 1355 | 12 | 18·83 | 0·16 | 0·88 | |
| Bombay, .. .. .. .. | 713 | 12 | 17·09 | 0·28 | 1·68 | |
| Genl. Total and ratios of other Diseases. .. .. | 3340 | 46 | 16·74 | 0·23 | 1·37 | |

*Note.*—Specific Tables of any other particularly prevalent or fatal Diseases occurring, should be added to these.

*Concluding Summary (Comparative) Table of the Quarterly Returns of Sickness and Mortality among H. M. Troops in the three Presidencies of India, from 1st January to 31st March, 1840.*

| Presidencies. | Average Strength. | No. of Admissions. | No. of Deaths. | Ratio per cent. of Admissions to Strength for the Quarter. | Ratio per cent. of Deaths to Strength for the Quarter. | Ratio of Deaths to Admissions. | Remarks. |
|---|---|---|---|---|---|---|---|
| Bengal. .. | 7985 | 2858 | 104 | 35·79 | 1·30 | 3·63 | 1. It appears by this Table, that although the proportion of "*Admissions to Strength*" among H. M. Troops in India was highest during this Quarter in the Madras Presidency, the proportions of "*Deaths to Strength*" and of "*Deaths to Admissions*" were less *by far* in it, than in either that of Bengal or Bombay. |
| Madras. .. | 7193 | 3436 | 70 | 47·76 | 0·97 | 2·03 | |
| Bombay. .. | 4171 | 1697 | 59 | 40·68 | 1·41 | 3·47 | |
| Summary. | 19349 | 7991 | 233 | 41·29 | 1·20 | 2·91 | 2. The greatest proportion of "*Deaths to Strength*" is found among H. M. Troops in the Bombay Command; and the greatest of "*Deaths to Admissions*" among those in the Bengal Command. |
| This would give average Ratios *per Annum.* | | | | 165·16 | 4·80 | | 3. A sifting investigation into the causes of these differences, could not fail to be highly interesting and instructive to Medical and Military Officers, as well as Government. |

This Table does not include "*Deaths out of Hospital,*" nor "*Men Invalided,*" which will be stated at the end of the last Quarter of each year, to shew the "*entire Annual decrement of Strength*" in each Corps, as well as in each Presidency.

*Note.*—I wished to add two Tables to the foregoing, to ascertain the ratios of Admissions and Deaths *according to "age" and "length of residence;"* but the information for this purpose is at present too defective in the Regimental Returns; it is, however, extremely important, as tending to indicate in the most correct manner, the *age* and *period of residence (acclimatement)* at which Europeans are best adapted for Military Service in India; and I hope to be enabled to give it hereafter in the comparative *Annual Statistical Tables* of the three Presidencies.

JOHN MURRAY, M. D.

*Inspector General H. M. Hospitals.*

# Correspondence.

*From* W. S. Macleay, Esq. *A.M. F.L.S., dated Elizabeth Bay near Sydney, N. S. W.* 12*th September*, 1840.

My dear Sir,—I cannot find terms to express my gratitude for your kind letter of the 12th March last, and for the very valuable present which it accompanied. I assure you, that your excellent work on *Cyprinidæ* has afforded me the greatest delight, and the more so, inasmuch as I am convinced natural arrangement is always best tested by accurate analysis, and also inasmuch as I am not by any means satisfied with Swainson's arrangement of Fishes. As from every thing Swainson writes, there is information to be derived, so I assure you, his little volume on Reptiles and Fishes has not been lost on me; yet the perusal of your Monograph on Indian Cyprinidæ, has made me recur to my old views on a subject, which our common friend, Dr. Cantor, may have told you has long occupied my thought; and although perhaps you will deem these views not sufficiently worked out, and rather crude, I cannot refrain from making you acquainted with them, in order that I may have the benefit of comparing your general arrangement of Fishes with my own.

Fishes form a class of Vertebrata, which has never yet been satisfactorily divided into orders. I do not think that *Acanthopterygii* and *Malacopterygii*, for instance, are natural orders. In order therefore to arrive at the first great and natural division of fishes, I think we must commence by incontestable data, or at least by facts that are generally agreed on. Such facts for instance I hold to be the three following, viz., 1. The near approach of fishes to Batrachian Amphibia, which with Swainson I consider to be made by means of *Lophius* and *Malthe.* 2ndly. The near approach of fishes to Cetaceous Mammalia, which with him also I consider to take place by means of *Selache* and the viviparous sharks. 3rdly. As the grand character of fishes as a class is, their being the most imperfect of Vertebrata, the most typical of fishes ought therefore to be the most imperfect of them, *i. e.* the farthest removed from the type of Vertebrata. Such fishes are evidently the Cyclostomi of Cuvier, such as Myxine, and other genera leading off to *Annulosa.* Though essentially aberrant, as they relate to vertebrated animals, the Cyclostomous fishes are typical as respects the circle of fishes. Now it is this circle of fishes in which we have the three above data, namely the two aberrant orders and one typical order. Consequently I arrange the class as follows, into orders :—

| | | |
|---|---|---|
| Aberrant Group. CTENOBRANCHII. Gills pectinated. | 1. PLAGIOSTOMI, *Cuv.* | Cartilaginous fish, with fixed branchiæ *leading to Mammalia.* |
| | 2. STURIONES, *Cuv.* | Cartilaginous fish with free branchiæ. |
| | 3. OSTINOPTERYGII, *M'Leay.* | Bony fish with free branchiæ *leading to Amphibia.* |
| Normal Group. Fish breathing by gills not pectinated. ACTENOBRANCHII. | 4. LOPHOBRANCHII, *Cuv.* | Bony fish breathing by tufts arranged in pairs along the branchial arches. |
| | 5. CYCLOSTOMI, *Cuv.* | Cartilaginous fish breathing by a series of cells. |

Now this arrangement differs from that of Swainson, in making the vast majority of fishes an aberrant group ; but it is the structure, not the number of species it contains, that determines the plan of a group in nature. The group *Ungulata* is just as important now when containin gcomparatively few genera, as it was in the antediluvian ages, when it contained an immense number of them. Besides, I will venture to say, that the above circular arrangement of fishes, expresses their place among Vertebrata better than that of Swainson. I shall differ from him still further as I go on. But in the mean time I must observe, that the above, and following new names, are merely used, in order that you may the better understand my meaning. I have been obliged to invent a technical name for bony fishes, with pectinated gills, viz.

OSTINOPTERYGII.

Which may thus be divided into tribes :—

| | | |
|---|---|---|
| Aberrant Group. ACANTHOPTERYGII. *Artedi.* Spines in first dorsal hard. | 1. BALISTINA, Plectognathi, *Cuv.* | Maxillary bones soldered to the intermaxillaries, and both to the palatine arch. Opercula and gills concealed under the skin. |
| | 2. PERCINA. | Bones of the jaws free and complete. Operculum distinct. Operculum or preoperculum generally with dentated edges, or with spines. |

| | | |
|---|---|---|
| *Quere.* Are all these Ctenodians of Agassiz? | 3. FISTULARINA. | Bones of the jaws free and complete. Operculum distinct. Operculum, and preoperculum generally with smooth edges. |
| NORMAL GROUP. MALACOPTERYGII. *Artedi.* Spines in dorsals soft. *Quere.* Are all these Cycloidians of Agassiz? | 4. PLEURONECTINA. | Ventral fins, when existing, inserted under the pectorals, and directly suspended to the bones of the shoulder. |
| | 5. CLUPEINA. Abdominales, *Cuv.* | Ventrals suspended behind the pectorals, and not attached to the bones of the shoulders. |

*Observation.*—The Balistina by the confluence of the bones of their jaw, and by the tardy induration of their skeleton, evidently lead off to the Sturgeons, with which they agree in having their free branchiæ opening by a perforation in the skin behind the temple. The Fistularina evidently lead off to the Lophobranchii by Fistularia. Unfortunately, I have not been able to find a near character to separate *Fistularina* from *Percina;* but they are natural groups, because each forms a circle. The following groups appear to be nearly those into which the above tribes may be naturally divided:—

| 1. BALISTINA. | 2. PERCINA. | 3. FISTULARINA. |
|---|---|---|
| 1. Balistidæ? | 1. Chætodontidæ. | 1. Scombridæ. |
| 2. Ostraciontidæ? | 2. Percidæ. | 2. Fistularidæ. |
| 3. Cephalaspis? *Aga.* | 3. Scorpænidæ. | 3. Gobioidæ. |
| 4. Orthogoriscidæ? | 4. Cirrhitidæ. | 4. Lophiadæ. |
| 5. Diodontidæ? | 5. Sparidæ. | 5. Labridæ. |

| 4. PLEURONECTINA. | 5. CLUPEINA. |
|---|---|
| 1. Anguillidæ. | 1. Siluridæ. |
| 2. Echeneidæ. | 2. Cyprinidæ. |
| 3. Cyclopteridæ. | 3. Esocidæ. |
| 4. Pleuronectidæ. | 4. Clupeidæ. |
| 5. Gadidæ. | 5. Salmonidæ. |

*Observation.*—I do not believe the above places of the families of Balistina to be correct. Besides I only know four. I shall say little therefore respecting them, except that I suspect some undiscovered family of BALISTINA leads off to the genus Monocentris, among the Scorpænidæ. I shall begin therefore with the true PERCINA and the family Scorpænidæ. The following are the probable genera of

Scorpænidæ, which family agrees with the group called Buccæ Loricatæ by *Cuvier*. But it is rather a stirps than a family, and the following genera ought to be deemed of the rank of families.

| | | |
|---|---|---|
| ABERRANT GROUP, Head either tuberculous or spinous, | 1. MONOCENTRIS, *Linn.* | Free spines in lieu of first dorsal. |
| | 2. TRIGLA, *Linn.* | Two distinct dorsal fins. |
| | 3. SCORPÆNA, *Linn.* | Two dorsals more or less confluent. |
| NORMAL GROUP. Head neither tuberculous nor spinous. | 4. ORCOSOMA, *Cuv.* | Ventrals complete. Free cones in lieu of first dorsal. |
| | 5. GASTEROSTEUS, *Linn.* | Ventrals reduced to a spine or spines. Free spines in lieu of first dorsal. |

For subgenera, I must always refer to Cuvier and Valenciennes.

From Scorpæna we proceed by means of the subgenera Sebastes among the Percidæ, which is a family that I distinguish by having seven branchiostegal rays, no mailed cheeks, no scales on the fins, and always teeth on the palate.

Probable genera of Percidæ.

| | | |
|---|---|---|
| ABERRANT GROUP. Two dorsals distinct. | 1. PERCA, *Linn.* | Dorsal fins near. Teeth all small, preoperculum not dentated. |
| | 2. OPOGON, *Lacep.* | Dorsals separate, some of the teeth long. |
| | 3. ENOPLOSUS, *Cuv.* | Dorsal fins near. Preoperculum dentated. |
| TYPICAL GROUP. Two dorsals confluent into one. | 4. SERRANUS, *Cuv.* | Teeth hooked. Preoperculum dentated. |
| | 5. OCEVINA, *Cuv.* | Teeth small, not hooked. Preoperculum not dentated. |

From Enoplosus we proceed to Ephippus among the Chætodontidæ, or SQUAMIPENNES of Cuvier, of which the following are probably the genera—

| | | |
|---|---|---|
| ABERRANT GROUP. No teeth on the palatines. | 1. EPHIPPUS, *Cuv.* | Dorsal emarginate, so as to shew it to be composed by the confluence of two. Ventrals distinct. |
| | 2. PSETTUS, *Comm.* | Dorsal not emarginate. Ventrals evanescent. |
| | 3. CHÆTODON, *Linn.* | Dorsal not emarginate. Ventrals conspicuous. |

| | | |
|---|---|---|
| NORMAL GROUP. | 4. TOXOTES, *Cuv.* | Dorsal long, opposite to the anal, and reaching close to the caudal. |
| Teeth on the palatines. | 5. PEMPHERIS, *Cuv.* | Dorsal short, opposite to the ventral, and far separated from the caudal. |

From Chætodon we proceed to Amphiprion among the Sparidæ, which differ from the Chætodontidæ, by having no scales on the fins, and from the Percidæ, by having no teeth on the palatines. The following may be the natural arrangement of Sparidæ into genera:—

| | | |
|---|---|---|
| ABERRANT GROUP. SCIÆNOIDES, *Cuv.* | 1. AMPHIPRION, *Bl.* | One dorsal. Branchial rays less than seven. |
| Operculum with spines. Preoperculum dentated. | 2. PRISTIPOMA, *Cuv.* | One dorsal. Seven branchial rays. |
| | 3. SCIÆNA, *Linn.* | Two dorsals distinct. Seven branchial rays. |
| TYPICAL GROUP. | 4. MÆNA, *Cuv.* Mænides, *Cuv.* | Upper jaw extensile. |
| No spines on the Operculum and the Preoperculum not dentated. | 5. SPARUS, *Linn.* Sparoides, *Cuv.* | Upper jaw not extensile. |

By means of Polynemus we pass from Sciæna to the Cirrhitidæ, which differ from the Percidæ in having in general either more or less than seven branchial rays, and from the Sparidæ in having teeth generally on the palatines. The Cirrhitidæ, however, differ from each other very much in form, as may be seen by the following genera which are clearly of the rank of families:—

| | | |
|---|---|---|
| Two dorsals. | 1. POLYNEMUS, *Linn.* | Two dorsals distinct. Ventrals subabdominal. |
| | 2. MULLUS, *Linn.* | Two dorsals distinct. Ventrals subpectoral. Branchial rays less than seven. |
| | 3. TRACHINUS, *Linn.* | Two dorsals united. Ventrals subjugular. Branchial rays more than seven. |
| One dorsal, ventral fins subpectoral. | 4. BERYX, *Cuv.* | Branchial rays more than seven. |
| | 5. CIRRHITES, *Conem.* | Branchial rays less than seven. |

By means of Trachinus we return among the Scorpænidæ, from which we set out, so that the circle of PERCINA is completed. We now therefore proceed to the next tribe, FISTULARINA, which we enter by reason of the affinity reigning between the Chætodontidæ and Scombridæ, as displayed in such genera, as for instance, Brama and Coryphæna.

Probable genera of the Scombridæ, or family Scomberoides of Cuvier.

| | | |
|---|---|---|
| Body regular and pisciform. | 1. CORYPHÆNA, *Linn.*<br>2. XIPHIAS, *Linn.*<br>3. SCOMBER, *Linn.* | Leading off by Thyrsites to Lepidopus. |
| Body laterally compressed, and vertically elevated. | 4. STROMATEUS, *Linn.* | Ventrals inconspicuous. |
| | 5. ZEUS, *Linn.* | Ventrals conspicuous. |

By Lepidopus we enter among the Fistularidæ, or long eel-shaped Acanthopterygians, which may be arranged as follows, viz :—

| | | |
|---|---|---|
| TÆNOIDES, *Cuv.* One long dorsal. Cranium not produced into a tube. Body tolerably compressed. | 1. LEPIDOPUS, *Gonan.* | Muzzle elongated; mouth considerably cleft, and a caudal fin present. |
| | 2. CEPOLA, *Linn.* | Mouth considerably cleft, no caudal fin. |
| | 3. GYMNETRUS, *Bl.* | Muzzle elongated, mouth small, caudal fin present. |
| FISTULARIDES, *Cuv.* | 4. CENTRISEUS, *Linn.* | Body oval, compressed, scales conspicuous, dorsals two. |
| Cranium produced into a tube. | 5. FISTULARIA, *Linn.* | Body elongated cylindrical, scales small, only one dorsal. |

By Aulostomus we return to Lepidopus, and by means of Gymnetrus and one of its subgenera, Murænoides, we pass to the Gobioidæ, a family easily known by the extreme length and tenacity of their dorsal spines. The following are possibly the genera which generally have a tubercular appendage to the anus.

| | | |
|---|---|---|
| Ventrals not thoracic. | 1. BLENNIUS. *L.* | Ventral subjugular, consisting of only two rays. One dorsal. |
| | 2. ANARRHICAS. *L.* | Ventrals none. One dorsal. |
| | 3. CALLIONYMUS. *L.* | Ventrals subjugular. Two dorsals. |
| Ventrals thoracic, or placed further back than the pectorals. | 4. MUGIL, *Linn.* Mugiloides *Cuv,* | Ventrals separate. Cæcums numerous. Two dorsals. |
| | 5. GOBIUS, *Linn.* | Ventrals united at base. Cæca none. Two dorsals sometimes confluent into one. |

By means of Callionymus, Eleotris, and Chirus, we pass to the Lophiidæ, or Amphibious Acanthopterygians, of which the known genera may probably be as follows; but the truth is, that I have never had an opportunity of accurately examining any of Cuvier's "*Labyrinthiform Pharyngeals.*" The following genera are chiefly to be ranked as families:—

| | | |
|---|---|---|
| LABYRINTHIFORM PHARYNGEALS, *Cuv.* Carpal bones not elongated. | 1. * * * * * | |
| | 2. ANABAS, *Cuv.* | Spines in the fins? |
| | 3. OPHICEPHALUS, *Bl.* | No spines in the fins? |
| PEDICLED PECTORALS, *Cuv.* Carpal bones elongated. | 4. BATRACHUS, *Bl.* | One dorsal. |
| | 5. LOPHIUS, *Linn.* | Two dorsals. |

By means of Ophicephalus we pass to the Labridæ, or fleshy lipped Fistularina that have no spines on their operculum or preoperculum. Their genera are probably as follows:—

| | | |
|---|---|---|
| Teeth concealed by the double lips, which are large and fleshy. | 1. LABRUS, *Linn.* | Muzzle not protractile. Body not laterally compressed. One dorsal. |
| | 2. GOMPHOSUS, *Lac.* | Mouth protractile. One dorsal. |
| | 3. XERICTHYS, *Cuv.* | Mouth not protractile. Body laterally compressed. Two dorsals. |
| Teeth uncovered by the lips, which are single. | 4. ACANTHURUS, *Bl.* Theutyes, *Cuv.* | Spines arming some part of body. |
| | 5. SCARUS, *Linn.* | No spinous armature on the body. |

By means of Xyrichthys we return among the Scombridæ, and so complete the circle of *Fistularina,* which is therefore a natural tribe.

Let us now go back to the family Gobioidæ, and by means of Gobius, we can easily make the transition from the tribe Fistularina to the Malacopterygian family Cyclopteridæ, which forms part of the tribe PLEURONECTINA, *i. e.* Malacopterygian fishes, which have never their ventral fins abdominal.

The families of Pleuronectina are probably as follow; but they are rather *stirpes* than families:

| | | |
|---|---|---|
| ABERRANT GROUP. | 1. CYCLOPTERIDÆ. DISCOBOLI, *Cuv.* | Ventrals united under throat. |
| | 2. ECHENEIDÆ. | Ventrals separate. |
| | 3. ANGUILIDÆ. APODES, *Linn.* | Ventrals none. |
| NORMAL GROUP. | 4. GADIDÆ. GADIDES, *Cuv.* | Symmetrical body with jugular ventrals far apart from anal fin. |
| | 5. PLEURONECTIDÆ. PLATESSA, *Cuv.* | Body not symmetrical, having the ventrals generally a continuation of the anal. |

Many genera of these families of Pleuronectina are wanting, so that I can only guess the above to be the natural series. Brotula and Macrourus certainly shew the affinity of Anguillidæ to Gadidæ. The affinity of Siluridæ to Anguillidæ is well known, so that we next pass thus to the tribe CLUPEINA, which are Malacopterygian fishes, with abdominal ventrals, *i. e.* the same as the group called ABDOMINALES by Cuvier. We are now more truly on the ground of your "Monograph on Indian Cyprinidæ," and I have little doubt of the following being really and truly the families or stirpes of the tribe CLUPEINA, viz:—

| | | |
|---|---|---|
| ATHYLACENTERA. Intestinal canal not furnished with cæca. | 1. SILURIDÆ. SILURIDES, *Cuv.* | No true scales on body; representing PLAGIOSTOMI. |
| | 2. CYPRINIDÆ. CYPRINOIDES, *Cuv.* | Body scaly, mouth slightly cleft; representing CYCLOSTOMI. |
| | 3. ESOCIDÆ. ESOCES, *Cuv.* | Body scaly, mouth widely cleft; representing LOPHOBRANCHII. |
| THYLACENTERA. Intestinal canal furnished with cæca. | 4. CLUPEIDÆ. CLUPEÆ, *Cuv.* | No second dorsal; representing OSTINOPTERYGII. |
| | 5. SALMONIDÆ. SALMONIDES, *Cuv.* | Second dorsal adipose representing STURIONES. |

I am often afraid of trusting myself to Mr. Swainson's method of drawing analogies between things in themselves wide apart. A person may reasonably doubt the legitimacy of any comparison between a fish and an insect, or even between a fish and a bird; because he may attribute all such resemblances to the imagination, the objects being in themselves so very dissimilar in every leading point of view. But no one can doubt that a fish may legitimately be compared with a fish, and every one will I think see that there is no effort of the imagination at work, when a Silurus is compared with a Chiloscyllium, a Cobites with Cyclostomous fishes, or some of the mailed Esocidæ with the Lophobranchæ. The Clupeidæ represent the Ostinopterygii typically in form, so that I have no doubt you will discover the analogy, as yet unknown to me, which exists between the Salmonidæ and Sturiones. I was ignorant of the true arrangement of Cyprinidæ until I read your valuable Monograph. I have now no doubt of its being nearly as follows into genera or rather into families :—

| | | |
|---|---|---|
| VERÆ. *M'Clel.* Body regular. | 1. PÆONOMINE, *J. M.* or GENUS CYPRINUS, *L.* | Intestinal canal long; representing STURIONES. |
| | 2. SARCOBORINÆ, *J. M.* or GENUS LEUCISCUS, *Kl.* | Intestinal canal short; representing OSTINOPTERYGII. |
| APALOPTERINÆ *M'Clel.* Body invested with a slimy mucus. | 3. PÆCELIANÆ, *J. M.* or GENUS PÆCILIA, *Sch.* | Snout prolonged, no cirri, Branchial rays more than three; representing LOPHOBRANCHII. |
| | 4. COBITINÆ, | Mouth provided with cirri. Branchial rays three, CYCLOSTOMI. |
| | 5. PLATYCARINÆ, *J. M.* or GENUS PLATYCARA, *J. M.* | Head flattened, round, and short. No cirri, branchial rays less than three; representing PLAGOISTOMI. |

Thus we see why the Platicaria has the form of a shark? Why Loaches, such as Schistura, J. M. have an analogy to the Lampreys and Myxines? Why Psilorhynchus has so long a snout? And why Gonorhynchus has the muzzle of a Sturgeon. The nearer two groups are in general structure, the more striking their parallel analogies will be; and therefore I think, that by comparing fish with fish, we may obtain more striking analogies than by comparing them, as Swainson does, with mammalia, birds, or insects. At all events, we shall have less reason to distrust the effects of a fertile imagination. Still I am far from denying, that such analogies as he delights in exist in nature. I only say, that they are dangerous things to deal with, and that in his hands, they often become far-fetched and even ludicrous. The cause of the greater part of the resemblances which he discovers between objects the most apart from each other in general structure, seems to be a general law of nature which has ruled that, in every group of animals there should be a minor group more essentially carnivorous, another minor group more essentially herbivorous, another more aquatic or natatorial, and so on. These minor groups may also be characterized by one being more essentially terrestrial, another more essentially aërial, another more aquatic, another more amphibious, and so on. These general principles are the occasion of resemblances between animals the most distinct in their structure, and therefore I understand perfectly what Swainson means when he speaks of a Rasorial type of fish ; yet surely it is an incorrect expression, for so far from fishes having been created on the models of Rasores or Grallatores, for all that we know, birds may have been created on Plagiostomous or Cyclostomous types. The general model was undoubtedly one; but why Swainson should assume this one model to have been taken from birds I cannot divine, except that in Ornithology he is most at home. However, to return to the subject of Cyprinidæ, your arrangement of them shews another set of analogies, which I also think very conspicuous, for instance,

The Pœonominæare the types of the family Cyprinidæ.
The Sarcoborinæ represent ... ... the Esocidæ.
The Pœcilianæ represent ... ... the Clupeidæ,
The Cobitinæ represent ... ... the Salmonidæ.
The Placycarinæ represent ... ... the Siluridæ.

You will perhaps say, that the Cobitinæ ought to represent the Siluridæ; but the relation between the Cobitinæ and Siluridæ is one of direct affinity, in which I perfectly agree with Swainson; and I have accordingly made the Cyprinidæ and Siluridæ contiguous groups in the table of CLUPEINA, given on the opposite page.

When I can secure a safe private hand, I shall beg your acceptance of a copy of the third part of the "Illustrations of the Geology of South Africa." In the mean time I must refer you to a copy which I gave our friend Dr. Cantor. In page 9 of that work, you will see a Table which is in perfect accordance with your views of the value of the word *genus ;* but not perhaps with your view of the word *family ;* nor is what I have written above consistent with the view I have taken in that Table of the value of the words *genus* and *family.* The truth is, what in the foregoing part of this letter are called genera, are families and ought to end in *idæ,* as the peculiar designation of that rank of group; but as these groups agreed wonderfully with the extent of the old genera of Linnæus, I left them that name for your more clear comprehension of my meaning. To be consistent, however, with myself in the above mentioned Table, (page 9 of the Illustrations,) the following ought to be the gradation of groups :—

*Regnum.*—Animalia.
*Subregnum.*—Vertebrata.
*Classis.*—Pisces.
*Ordo.*—Ostinopterygii.
*Tribus.*—Clupeina.
*Stirpes.*—Cyprininæ, above called "Cyprinidæ."
*Family* { Cyprinidæ, above called "Pœonominæ, or the genus Cyprinus."
*Genus.*—Cyprinus.
*Subgenus.*—Tinca.
*Section.*
and so on to the species.

Your Table therefore given, p. 261 of your Monograph, is more in harmony (except indeed the names, which are things of artifice, and have nothing to do with nature) with my Table given in the Illustrations, than is the foregoing letter; and I wish you to understand that were I to publish on Fish, I would make it clearly understood, that I view Linnæus' genera to be groups of the rank of families, so that the groups above called Perca, Scomber, &c. ought to be called Percidæ, Scombridæ, &c.

I have now written enough to shew you how I imagine Fishes may be distributed into something like a natural arrangement. My views must of course be subject to a multitude of corrections; but I think they are more connected, that is, they shew more unity than any Ichthyological synopsis which I have yet seen. I have worked out the Plagiostomi with particular care, as my friendship with Dr. Smith made me pay great attention to his unrivalled collection of Sharks and Skates. If you would wish to see the conclusions to which I have arrived with respect to the Plagiostomi, I shall be happy to send you a sketch in some future letter. In the mean time, you may make what use you please of what I have written in this letter, provided it be clearly understood, that I am asking naturalists whether such be not the facts of the case, instead of dogmatically insisting upon it that they are. I have no idea of publishing on Fishes, at least for the present.

By the way, I observe that my old friend Colonel Sykes has been describing a number of Indian Cyprinidæ in the Proceedings of the Zoological Society. Of course there must be "*double emplois,*" which I hope you will rectify. I am sorry that I have not been able as yet to get any *Cyprinidæ* from our New Holland Rivers; but I attribute it to my own residence so far from any river, not to the absence of them. I am promised by friends, who have better opportunities, the result of their researches; but *I receive nothing,* as they know not how to catch the minute fish of the river. However I intend to try the Nepean River myself when I go down there, which I soon propose to do. In the mean time, my residence on the sea-side enables me to increase my collection of marine genera, and if there be any you wish for, I shall be most happy to send them. A thousand thanks for your kind method of *beating up* for insects to be sent me from India. I shall be happy to pay any fair price for the collector's time and trouble. Tell Dr. Cantor, that I depend on *him* to increase my collection of Annulose Animals, and that I hope he will soon write me. Tell him also, that I have got a marine Serpent of the genus *Pelamys,* caught in the mouth of Port Jackson harbour, the only one our fishermen have ever seen. If he wishes for it, it is at his service; for he knows infinitely more of Serpents than I do, and my grand desire is, to increase my collection of Annulose Animals.

* * * * * *

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But I could go on writing to you on these subjects *ad infinitum,* and therefore I trust you will excuse any tediousness on the score, that my thoughts have been directed into this channel by the perusal of your Monograph. Pray remember me to Dr. Cantor, Dr. Griffith, Mr. Grant, and all who concern themselves with the works of nature, believing me always,

My dear Sir,

Your obliged and truly faithful,

W. S. MACLEAY.

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12*th October,* 1840.

P. S.—As I have had no opportunity of forwarding the enclosed letter, I sit down to make some observations on it that occur to me on now reading it over some weeks after it has been written.

I know not whether you will clearly understand my meaning in making the Cyclostomi the most typical of fishes. Cuvier says that "the *Acanthopterygii* form the type most perfected by nature;" and in this I agree with him, namely, that their structure is most perfected; but the *Acanthopterygii* are not therefore the most typical of fishes, *i. e.* of a class, the general character of which is to be the most imperfectly constructed of *Vertebrata.* Cuvier talks much of the Acanthopterygii being the most homogeneous in their variations; but are not the groups of Sharks and Cyclostomi quite as homogeneous? Nay, are not *Fistularia* and *Vomer* more distinct from each other in form than a Shark from a Skate, or a Lamprey from a Myxine?

There are some relations that require still to be expressed by my foregoing arrangement, such for instance as that of *Platycephalus* to *Eleotris,* as that of Sphyræna to certain Esocidæ, &c. &c. Are all such merely relations of analogy? If so, they are expressed; but I cannot help thinking, that the relation is still stronger than that of mere representation.

All geological forms may I think be referred with ease to the foregoing arrangement, even the most anomalous in appearance, such as *Aphalaspis*; for this fossil form may in my opinion be understood by looking at the head of *Platycephalus.* However the most extraordinary forms of fossil fish belong to the *Ganoids* of Agassiz, or rather to the Sturiones, and those other orders of the class Pisces, that present the fewest existing forms. But on this head I shall at once frankly say, that if any fossil forms can be shewn not to fall into a place in the preceding arrangement, then my general view of Ichthyological affinities is wrong; for I am convinced that there is but *one* system for all animals, whether Antediluvian or not. I shall write you on Echinidæ in my next, and send you some the very first opportunity.

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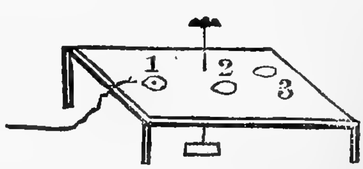
*Description of an Instrument for measuring the hardness of Minerals, extracted from a letter of* Lieut. R. B. Smith, Esq., *Bengal Engineers, dated Allahabad,* 15*th January,* 1841.

"I have long wished to find some easier method of determining the hardness of mineral bodies than that furnished by Professor Moh's scale. I have recently amused myself by constructing a little apparatus, which I fancy will answer the purpose. I give you a rude sketch of it, from which I dare say you will easily see the principle. The frame work is of wood. The centre pin is of hard steel sharpened at the point, working in a screw socket in the wood, so as to admit of ready adjustment. When the instrument is to be used, the substance is placed under the steel pin, and certain weights (1, 2, 3,) are placed on the top of the frame. The loaded frame is then drawn over the mineral, and if the weight is sufficient to cause the pin to scratch its surface, its hard-



ness becomes known, and may be represented by the amount of the weight. For the harder minerals, it would probably be necessary to replace the steel by a diamond properly set; but for the purposes I have in view, in testing the relative hardness of the usual building materials, I think the steel will suffice. The model I made appeared to me to act very well in the trials I made of it. Do you think the instrument might be used with confidence, or do you detect any thing fallacious in it?"

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*Extract of a Letter from Captain* CAMPBELL, *Assistant Surveyor General, Madras.*

In my remarks about fever I should have mentioned, that it is commonly known, and I have had opportunities of seeing that it is a fact, that the people of the hills of the mountainous tracts of Kimedy and Goomsoor, suffer from fever when they descend to the plains and remain there for ten or fourteen days, quite as severely as the people of the plains suffer from the climate of the hills; and I have been informed, that the hill people of the Table lands of the Salem district, dislike descending and remaining in the plains below for the same reason.

I have sent you a paper on Petrefaction, published originally in the *Madras Spectator,* which is very interesting, and I hope you will think it worth republishing. It is I believe, translated by an officer in the Madras 8th Cavalry, from whom I hope we may have more of the same kind. You will observe the bearing the subject has upon speculative Geology, in accounting at once for the association of trap rocks and silicified wood, without " outbursts of thermal waters holding silica in solution," and such other wild speculations, which are particularly unfortunate, as such waters have in no case ever been known to silicify any thing, as in the Geysers of Iceland, where the only effect they produce is incrustation.

The paper was published in reply to some remarks of mine, doubting the organic origin of the " woodstone" of Trivicary, in which, misled by the compact appearance of some specimens I had seen, and not being aware that any trace of the organic structure remained, I denied the sufficiency of the evidence derived from outward form and appearances as a proof of organic origin. In doing so, I roused the ire of some disputants; but fortunately for the interests of science, as Mr. Kaye informs us in the *Madras Journal,* his attention was given in consequence to the search of further evidences in organic associations, from whence has resulted the interesting discovery of the fossiliferous deposit at Seedrapett, to which Mr. Cunliffe alludes in your last number.

The discoveries of Messrs. Kaye and Cunliffe have not been confined to the search for fossils ; but they also discovered detached specimens among the silicified trees of Trivicary, which shew a most perfect exogenous structure, with perfectly distinct medullary rays, annular rings, and detached longitudinal tubular vessels ; and in one, the number of these vessels, and the colour of the whole, give the exact appearance of a piece of cane, except that the medullary rays are distinctly visible. Some have imagined these appearances to indicate a resemblance to the structure of coniferous wood ; but Lindley mentions, that coniferous wood is distinguished by the absence of vessels in the woody fibre, and besides, the shapes of the trunks 100 feet in length without a branch, marks a wide difference from any existing species. The specimens in Mr. Kaye's possession which I have been obligingly favoured with a sight of, are of large size (one nearly four inches square) ; and deserve well to be figured in Lindley and Hutton's Fossil Flora, and I have no doubt they would be highly valued in Europe. The solution of silica, alluded to in the paper on Petrifaction, is probably the common potash silicate, and the petrifying agent is the fluosilicic acid of English chemists. This gas has the property of depositing a portion of its silica on coming into contact with water, and forms in consequence, long tubes on the end of the beak of the retort, from which it is evolved when the end of the retort is played into water ; and it is remarkable, that in the arenaceous matrix of the Trivicary woodstone, fissures sometimes eighteen inches long and an inch in diameter are found composed of water-worn grains of sand, aggregated by a mineral of a bluish lead colour, much resembling in fracture and appearance some of the varieties in the trap dykes of Amboor. I have seen balls with a somewhat similar structure from the same place, and the arenaceous matrix also presents an appearance, which in my opinion plainly shews, that it is not an unaltered sedimentary deposit, for although the quartzose sand is I think undoubtedly water-worn, yet it is mottled with spots of kaolin earth, of a very pure white, which has been by some mistaken for lime, &c. &c. disseminated through the mass.

Regarding your note at page 36, suggesting the use of the term " porcelain clay," instead of kaolin, the terms of course mean the same ; but I much doubt if any more definite idea would be afforded to the generality of readers by the use of either one or the other : but I used the term kaolin, because it is generally made use of as applied more to an earth than a clay. Berthier classes kaolin as clays (argilles); but it would be rather difficult to define the difference between a clay and an earth, for most earths are in a certain degree plastic, as in the shape of mud. I am inclined to consider that a clay, which when worked up with water feels greasy, when squeezed in the hand. This kaolin is plastic to a certain degree, for I have had it "thrown" by the common native potters into thin saucer-like vessels, and I commonly make use of it in chemical analysis for crucibles and muffles, but it does not feel greasy; however, as this mineral it now appears may become of some consequence in manufactories, it will deserve consideration in a separate paper.

With regard to your remarks on the causes of haze, at page 43, I must admit that there can be no limit assigned to which particles of dust can be carried by the winds. While our information is so small upon these subjects, it would be idle to sit down gravely to argue upon a subject of this kind, and it is even difficult to think of a good and plain fact upon which to shew my suggestion, that dust is not the cause of haze in the air, is even probable. The best I can think of at the moment are the following:—A few days ago, with the thermometer about 80°, the wet thermometer depressed about 15°, and the barometer below its mean, the day broke with a sky overcast with hazy cirri; that is, no clear blue sky was to be seen, and though there were no visible clouds, yet the zenith appeared as if streaked with hazy indistinct clouds, like what sailors call "mare's tails" when in a clear blue sky. The wind was steady at N. W. and a light breeze in the morning, which increased in strength as the sun approached the zenith. The weather was unpleasant, and the air with a dry hazy appearance. We have no definite philosophic terms which will express my meaning of the appearance of the air, so that objects ten and twelve miles round were indistinctly seen like the dome of St. Paul's, viewed from Hampstead hill. A high range of hills, about forty miles off, was invisible. In this state matters remained until noon, after which I observed some few cumuli forming in the N. E. a little above the horizon. These gradually increased in size and number, and in altitude, forming an arch about 15° in altitude, and extending from perhaps 20° in Azimuth on each side of N. E. In this state of things, I observed that all under this arch the air was not so hazy as in other directions, and that in the upper part of it some clear blue sky was visible between some of the cumuli, and the range of hills, which lies in a direction about East, was no longer quite invisible, but the outline though still hazy was distinctly to be seen. I noted this at the time as a strong fact opposed to the (what we will call for shortness) "dusty theory," and as shewing the influence of moisture in clearing the air.

Also in Kimedy, which is not more than sixty miles from the sea-shore, the air is generally beautifully clear, the climate being usually very damp and when the air was dry it was generally hazy. Now if I remember correctly, these changes sometimes occurred at intervals of only two or three days, whereas you will observe that had dust been the cause of the haze, it ought also to have produced the same effects in damp weather.

But I don't intend to draw you into a fruitless argument, but only to make good the "possibility" of a cause I have suggested. If we set to work to argue upon first causes upon the imperfect data which have been collected on the subject of Meteorology, we shall be as bad as some geologists, cosmogsists as they ought rather to be termed.

While in Kimedy, I observed a curious phenomenon, which has been remarked upon, I think, by Saussure on Mont Blanc, which was, that at night, during the very damp and cold weather, the sky in the zenith was more like black than blue, and the stars looked like "pantiles of burnished gold set on black velvet." I would quote Poetry, but am nearly as bad as Marryatt's light Prose. The sky about the horizon, or rather near the tops of the surrounding mountains, was more of a decided blue than in the zenith.

While upon this subject, I recollect a curious instance of the extreme clearness of the air, I should perhaps call it tenuity, on the 15th of November 1834, at Ooplauda. Venus was plainly visible to the naked eye at 12 o'clock, two hours from her meridian passage, day clear and sunshine strong; and again on the 18th November at 2 o'clock she was again plainly visible. At this time I think it is stated, that Venus was not at her greatest brilliancy. I am not aware that Venus has ever been seen in the same way, at least I have never seen it mentioned any where, and I have never seen the planet since in the same way.

I do not find any note of why I sought for the planet; but think it was on account of the extreme clearness of the air.

The star could not be seen unless the eye was directed exactly to the place, which I did by a little three inch Kater's circle, with a telescope magnifying seven times, having computed the azimuth and altitude for the time. After having seen the star through the telescope, I observed, to my surprize, that I could still see it on looking over the telescope, and on calling a servant, and pointing carefully and exactly with my finger, he saw it also, and became so excited with delight, that not content with shewing it to all the other servants, the lad ran off to point it out to others; and in a few minutes every one in the place was staring at Venus.

*Extract of a report of Captain* Campbell, *Assistant Surveyor General, Madras, addressed to the Coal and Mineral Committee.*

I have not long ago forwarded, through the head of the survey department, a report upon the mineral carbonate of soda, afforded by lixiviating certain soils in the Barramahal.

I shall here only remark, that there are several uses to which this soda may be put besides becoming an article of export; for instance, in saturating with it the common country vinegar made from sugar, or by manufacturing the vinegar from the destructive distillation of wood. The acetate of soda thus made, might probably pay as an article of import into England, for the purpose of making acetic acid.

Regarding the kaolin earth, which is found in great quantities in Mysore, I have also forwarded a report, which will probably reach the Committee.

A very fine clay of this kind, which burns of a fine white, is found somewhere about Arcot; but I have never had an opportunity of visiting the spot. A manufactory of goglets is established at the place, and are an article of trade to many parts of South India. A mixture of this clay, ground up with the Mysore kaolin, would afford a material for the manufacture of the very finest kinds of pottery.

About five miles north of Salem, carbonate of magnesia occurs in very great profusion as dykes and veins injected into an argillaceous tuffa, which is associated with hornblendic rocks. The magnesia has evidently been injected in a state of pasty fusion, for the dykes and veins shew on their side the most indisputable evidence of having been squeezed through narrow fissures, and is often found in every variety of mineral composition, from pure magnesia through all the varieties of actynolite and amianthus. As magnesian clays have been used with success in the manufacture of porcelain, it is not improbable that this mineral might be valuable in the manufacture of improved kinds of pottery.

Iron is made in very numerous places in the Salem district, by smelting iron sand. The mode of manufacture is exactly the same as has been described by Buchanan, (*Journey in Mysore.*) The iron sand is derived from the disintegration of the softer parts of the granite hills, and not from trap rocks, as has been very generally asserted, and there are several different kinds; but how many, I am not yet able to state. The varieties can be readily distinguished by the colour, which in some is a deep coal black, and in others a lead coloured black. I cannot at present state the chemical composition of all the varieties; but a black kind which I have analyzed yielded titanium and magnetic oxide of iron.

Magnetic oxide of iron occurs in Salem in great quantities, and sometimes in considerable masses, and is occasionally pounded and smelted by the natives.

There are no manufactures of cast steel in the Salem district, but in Mysore and near Chungamah it is made in great quantities. The account given of the manufacture by Buchanan, and repeated by several writers, I have reason to believe to be incorrect, the natives having deceived him; and indeed no chemist can ever believe that the account of the process which has been published, could ever produce steel. Through several natives, who have given me information on the subject, I believe the true process to be conducted by fusing together two parts of wrought iron, and one of a kind of cast iron, which is obtained by smelting an ore which I have not yet been able to procure. But on this subject I shall be able to forward shortly to the Committee more complete information.

Gold is found in small quantities in the Salem district, at the base of a range of hills not far from Salem, on the road to Sankerrydroog, called the Kanjah Mally. At certain seasons of the year, after the rains have fallen, a number of people find employment in washing and separating it from the sand of a nullah. The quantity procured is very inconsiderable, and I believe never at any time affords the workmen a greater profit than eight annas a day. I have been informed, that some years ago an officer, (Lieutenant Nicholson,) was employed by the Government of Madras to investigate this subject, and to ascertain the probable quantity of gold which is procured in several places in South India, particularly in Coimbatore, and that several valuable reports were made upon this subject, which might be procured on application to Government.

Polishing slate is found either in the hills of Cuddapah, or else in the Kurcumbaddy Pass, but I am not certain where, as the locality of some specimens which have been sent me by a gentleman is not well ascertained.

What is generally called corundum, (the native coorunge), is found in many parts of the Salem district, particularly near Indore, and also in the Purmutty talook. It is collected by the natives while ploughing the fields, and is sold at the rate of thirty pounds for six annas. It is of two kinds, of a dirty red colour and of a dark grey, the latter being considered the best. The general crystalline form is a hexagon terminated by six-sided prisms. It has a foliated structure, and frequently imbeds bright shining grains of a metal, which I have not yet been able to identify.

This mineral does not appear to me to be the true corundum, for I find it evidently to be silicious on testing it by the blowpipe. It seems to me to be the grey flint mentioned by Ainslie.

Very fine ribbon agates are found in the Cuddapah hills, and in the district of Congoondy, from which latter place I have a specimen more than five inches in diameter; they occur as rolled pebbles in the river beds.

Very fine specimens of rock crystals are found near Vellum to the west of Tanjore, where there is a mine in which they occur; but the largest I have seen is a hexagon of one and a half inch in diameter. In the bed of the Godavery, west of Rajamundry, very large specimens are found, some of which I have seen being nearly four inches in diameter.

Saltpetre is manufactured in great quantities in the Salem district and in Coimbatore; but this mineral product is so well known, that it hardly requires a particular notice. As the local value of the product is very little, it might, by burning it with charcoal, be converted into carbonate of potash, and that again by incinerating it with fragments of horns and hoofs, be converted into prussiate of potash, which from the cheapness of the materials in India, and the low price of labour, might be a valuable article of import into England.

In association with the magnesia at Salem, chromate of iron is found in detached lumps, and embedded veins in the mass of the dykes of magnesia. It is mined for to some extent by the Company at Porto Novo, who import it for sale in the English markets. The mineral does not occur in any great profusion, and therefore the labour of mining for it is extensive.

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### *Kyuk Phyu Coal.*

We are requested by Dr. Spry, to state that the paragraph relating to the non-payment of the coolies employed in searching for coal at Kyuk Phyu, which appeared in his letter in the last Number of our Journal, was given on authority that appears to be incorrect; and that he has since been assured by the Principal Assistant to the Commissioner at Kyuk Phyu that the authorities of the province have had quite adequate funds placed at their disposal for prosecuting Coal discovery.

Captain Lumsden has also communicated that the excavations (alluded to in the letter of Dr. Spry, as being under execution) have since failed, after sinking to the depth of nineteen and sixteen feet respectively, but that he has reason to believe that when the operations were stopped the stratum through which the workmen were passing had nearly been pierced.

*Mineralogical Report upon a portion of the Districts of Nellore, Cuddapah, and Guntoor.* *By* LIEUT. OUCHTERLONY, F. G. S., *Madras Engineers.*

This is a very full report on the causes of failure that have attended Mr. Ouchterlony's recent attempts to turn the Nellore Copper Mines to good account. We are always sorry to hear of unsuccessful attempts of this nature, although they are often more valuable than more flattering statements of the riches of mines.

The district which was the scene of Mr. Ouchterlony's enterprise, is bounded to the westward by the Ghauts of Cuddapah, the central masses of which consist of granite. Towards the sea, a broad band of laterite forms the general line of coast. Mica slate and clay slate, with occasional protrusions of granite, greenstone, and basalt, form the principal portion of these extensive districts. Transition limestone is, however, found on the flanks of some of the higher granite elevations.

At a place called *Agnigundolah,* the clay slate is traversed by a huge channel of siliceous rocks, running N. E. and S. W., and dipping almost perpendicularly, the clay slate being on either side much indurated and altered, and its beds to a small extent contorted. In the substance of portions of this quartzose dyke green copper is seen disseminated through the stone in small scanty grains in the form of a silicate, and tinging the walls of the channel and sides of its fissures, with a solution of green carbonate.

Further than this, no ore whatever is to be seen, and the cold bare appearance of the rocks, very soon satisfied Lieutenant Ouchterlony, " that the search for ore in this locality was not a legitimate mining enterprize."

In another part of the district, (near Nellore,) composed of mica slate, extensive indications of copper ore occurs, consisting of round pebbles, imbedded in the alluvium, and tinged green with carbonate of copper are seen ; similar green stains are seen on veins of quartz insinuated between layers of greenstone or hornblende slate and mica slate. Trials were made here in various places to a depth of twelve or fourteen fathoms, by Captain Ashton ; but the result invariably proved that the ores were not sufficient to pay the expense of blasting the hard rock, and keeping the mine free from water, which flows with remarkable constancy into the sinkings.

Attempts were made by Lieutenant Ouchterlony at *Sagligherry, Cummuldinna,* and other places, where similar indications were observed, with the same unfavourable results. Lieutenant Ouchterlony justly condemns the reports of Dr. Heyne and others, who held out the most extravagant inducements to speculators in the Nellore mines.

*Extract of a Letter from Lieut.* OUCHTERLONY, *Madras Engineers.*

"The mineral you speak of, the magnesite, is very well known here, and it adds another to the many proofs which could be adduced of the exceedingly bad state in which all such matters of scientific and economic inquiry rest in this part of the world, when an *immediate* channel for the employment of a newly discovered production of the soil is not at once hit upon. The person who first, I believe, drew attention to the importance of the carbonate of magnesia of Salem, was Dr. McLeod, of our medical establishment, who made various reports to Government about its value in the formation of a hydraulic cement. They received much attention at the time, and an honorary reward was, I believe, made to Dr. McLeod; but lately the subject was dropped, until Colonel Paley's experiments at home drew attention to it, and if not now actually under favourable consideration, I imagine it is not quite lost sight of.

"I took several cwt. of it to England in 1836, to try to introduce it into the chemical manufacturing districts, but met with no encouragement; as Tenant's house at Glasgow shewed me, that they could deliver rough magnesia, resulting from the decomposition of the enormous quantities of magnesian limestone used in their chlorine works, at so low a rate, as to throw Indian magnesia in those parts—Liverpool, Manchester, and Glasgow,—quite out of the market. The mineral is exceedingly compact and homogenous, and it is impossible to obtain the "calcined magnesia" of commerce from it in a sufficiently impalpable state of division by a simple process by fire: it must be treated in the usual way with sulphuric acid, and the magnesia produced from the sulphate. For your purpose, viz. that of making the "Epsom salts," and also the calcined magnesia for medicinal purposes, it would of course answer admirably, and as I have a quantity here just now, I will send you up a cwt. or so to experiment upon. The principal locality is Salem; but it is also abundant in the Trichinoply, Coimbatore, and the Mysore districts; its site being in many places near enough to the banks of the Cauvery to allow of its being brought down with the stream of that river to Porto Novo on the coast at a very low rate indeed, not so much as 10 rupees per ton, I am satisfied, and probably a great deal less.

"Its geological position is interesting, and I should much like to have an opportunity of tracing out its peculiarity and its connection with the igneous rocks, with which it is invariably found associated: indeed, its origin is most likely the same, though the hypothesis, that it may be due to deposition from thermal waters under great pressure, or other circumstances favourable to its induration, has some grounds to rest upon. I have only once had an opportunity of seeing the magnesite in situ, which was near Trichinopoly, and about fifteen miles from the S. bank of the Cauvery: it occurred in an extensive "pipe" issuing from the mass of pyrigenous rock, (sienite and hornblende,) which formed the country, and as it reached its upper and partially decomposed surface, it spreads abroad into innumerable veins, clustering here and there into a nucleus, but generally finding their way individually to the clay. As the mine was on a hill side, we had only to scrape among the loose friable rock, until we came to the solid mass or pipe, when the mineral was brought away in prodigious quantities by simple quarrying with the pick: we used it for cement for an anicut or masonry dam, which was under construction across the Cauvery at the time.

"The mineral, however, is found all over the districts which I have named, coming to the surface in patches, and almost every where to be worked in open day without any mining operations, pump work, &c. for a considerable period of time. Steatite is found occurring in the mass of the magnesite, and it is often deeply tinted by manganese. It is also curiously associated with the chromate of iron, which is so abundant and so rich in Salem; but the particulars of this association I am unable to give you, from local ignorance."

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*Report on the Botanic Garden of Seharanpore. By* DR. FALCONER, *Superintendent.*

The report of Dr. Falconer embraces a period of eighteen months, or from July 1839 to January 1841. In the first paragraph we learn, that the expenditure of the garden is about 1,100 rupees per mensem, exclusive of the Superintendent's salary of 100. The entire expense of the establishment throughout the period referred to, being 21,000 rupees.

In the 2nd paragraph we learn, that parties of collectors were started early in the seed season of 1839, into different parts of the Himalaya mountains, and collections made along the wide range formed by the plains up the Aluknunda river to the Niti Pass, on the Thibetian frontier; four detached parties in the hill tract between the heads of the Ganges and Sutluj, with a range of collection extending from the outer ridges to the Snowy Mountains; a large and valuable collection from Cashmere, gathered around the valley and the adjoining portions of Thibet.

In the 3rd paragraph we learn, that in the previous year, 1838, a large mixed collection, consisting of upwards, of 500 species from the Himalayas, were sent to England at different times by the overland route; but although they came up freely, a great majority of them were deemed hardly worthy of cultivation in England, and in consequence in the dispatches of the season 1839-40, attention was directed more to abundant supplies of selected choice species, than to numerical variety. The collection sent was still rich. The seeds reached England in excellent order, and for the estimation in which they were held, and their successful germination, (hardly one failed), the testimony of Dr. Lindley is referred to.

The 4th paragraph we cannot abridge; it is as follows:—"The arrangements for the current season have been on a similar scale, and a still richer collection formed. An abundant supply has been sent of the Neoza, or edible pine, and other species of which but sparing quantities went last year. The amount of the dispatches is only limited by the capabilities of the overland mail to transmit them."

The 5th and 6th paragraphs relate to the introduction of valuable species into India; viz. the varieties of wheat cultivated in Upper Egypt, and grain seeds from Switzerland; it being an axiom in scientific agriculture in Europe, that grains gradually wear out, if the same sort is continually grown on the same spots, and that an importation from distant localities is required to keep up the produce at the highest standard of quality. On comparing the Switzerland grains with the best Indian grains of the same sort, the superiority of the former was very apparent. The body of the seed of European wheat was formed of a farinaceous powdery albumen, which flew off into a fine dust on crushing; while the Indian grains were seen to consist of a hard long-looking albumen, which was broken with difficulty, shewing what English agriculturists call a "sleety body," and indicating a comparatively very inferior grain. According to my observation, this is the general character of the wheats cultivated in the plains of India; and it is worthy of consideration, whether the grains of the country might not be improved by the Government encouraging the importation of seed from other countries.

We pass over 7th and 8th paragraphs, relating to the introduction and cultivation of Rhubarb, Atropa belladonna, Hyosyamus pallidus (Nov. spec. ?) Aconitum, fruit trees, and ornamental plants, which evince an honest interest on the part of Dr. Falconer in the success and utility of the establishment under his superintendence.

The following extract of a letter from Professor Lindley, in reference to plants and seeds sent to the Court of Directors from this garden, shews the important objects the Seharanpore garden is likely to accomplish :—" I have great pleasure in informing you, that the result of the seeds, for which we have so repeatedly been indebted to the liberality of the Honorable Court of Directors, has been most satisfactory. A very considerable number of fruit trees, shrubs, and handsome herbaceous plants, have already been secured to the country. Among the former, are the Deodar in abundance, as well as other Himalayan Coniferi and Betula Bhojputtra, which would alone render the exertions of the Company in the introduction of new plants, of national importance, especially since the large quantity of such things which is imported, renders it practicable at once to disperse them through the country."*

In the 11th paragraph, Dr. Falconer states, that besides the extension of the Agricultural and Horticultural departments of the Garden, plans are in progress for the natural arrangement of the plants now contained in it.

In the 12th paragraph, Dr. Falconer states, that in conformity with instructions from home, an extensive experiment is instituted for the cultivation of hemp.

The 13th and 14th paragraphs relate to a branch of the Seharanpore Garden at Mussoorie, in which pines introduced from England, and gum-bearing plants and fruit trees from the colder parts of Central Asia, are reared with success, as well as the hop ; although Dr. Falconer conceives little prospect of a good hop crop being produced, in consequence of the periodical rains, which are unfavourable to the plant. Dr. Falconer recommends situations in Affganisthan, beyond the influence of periodical rains, as holding out the best prospect of success, as for instance the steppe between Ghuzni and Mukoo, Pugwan and the vallies of Kohistan, for the same object.

We learn from Mr. Griffith, who has recently seen the Seharanpore Garden, that it is a highly useful and interesting establishment, doing much credit to the liberality of the Government, and the talents of the Superintendent.

* In a report by Professor Lindley, on the effects of a recent severe winter in England on the plants raised from seeds sent home by Dr. Falconer, hardly any of the hardier kinds from the Himalaya, were injured in the slightest degree by the severity of the weather; but bore it as well as the hardiest English plants; and amongst those species which seem to thrive best in England, and promise most, is the Deodar, the introduction of which into England is a result entirely due to Dr. Falconer.—Ed.

*Report on the Botanic Garden of Calcutta. By* Dr. Wallich, *Superintendent.*

This document, like the report of Dr. Falconer, consists exactly of *nineteen paragraphs*; but here the resemblance ceases. As to the expense of his establishment, Dr. W. is silent, conscious perhaps, that the least said is soonest mended. In doing himself the honour of submitting his report, he asks permission to make earnest apologies for not having furnished it earlier. The report embraces a period of five years, from January 1836 to 31st December 1840, during which period the garden cost probable about 2,50,000 rupees.

In the 2nd paragraph, Dr. Wallich ventures respectfully to rest his hopes of approbation on his anxious efforts to promote the Agriculture and Horticulture of India, on the list of plants (list A.) distributed from the Garden during the last five years, and on the list of persons to whom they were given, and the boxes in which they were sent. This is referred to as list B.

We have been at some trouble to analyse both these lists, and the following is the result abstract of plants dispatched from the Botanic Garden for the last five years, to the following places:—

| Names of places where the Plants were sent to. | No. of sorts of Plants. | Total Number. | Cases. |
|---|---|---|---|
| Plants sent to England, ... ... ... | 4,251 | 5,645 | 261 |
| Ditto ditto to France, ... ... ... | 1,392 | 1,612 | 58 |
| Ditto ditto to British Colonies, ... ... | 414 | 602 | 25 |
| Ditto ditto to Africa, ... ... ... | 427 | 1,787 | 39 |
| Ditto ditto to Stations in India beyond Calcutta, ... ... ... ... | 1,609 | 8,177 | 128 |
| To residents in Calcutta and its vicinity, ... | ... | 1,72,109 | 145 |

The total number of plants distributed in and around Calcutta in five years, thus amounts to 1,72,109; to all other parts of India and the rest of the world during the same period, the total number of plants distributed is 17,823, or rather less than one-tenth of the number of plants given out to persons residing in the vicinity of the Garden. Dr. Wallich carefully inserts in list A, the scientific names of no less than 1,431 species distributed as above in five years; but he omits to distinguish in this list the useful from the useless, and the merely ornamental plants, or even the Indian, from introduced species. Such serious omissions of details in the lists submitted by Dr. Wallich, render this portion of his report of little value; as it is impossible, without a tedious and fruitless analysis, to ascertain whether the plants referred to as distributed are such as are in any way likely to become objects of cultivation, or whether they are not such as might be obtained and distributed, as well, if the Calcutta Garden had never existed.

The correctness of this last allusion is rendered highly probably, from the mere circumstance of 768 species out of 1431 having been named by Indian botanists; and we cannot be far out in referring one-half of the remaining 663 species to European botanists, to whom collections have been sent from India; thus reducing the operation of the Garden during the last five years to the distribution of 331 introduced species. Then taking the ratio of ten-elevenths as the proportion in which the distribution is confined to Calcutta, the Botanic Garden would thus have distributed to the inland provinces of India during five years no more than 33 species of imported plants. The next object is to ascertain by analysis of Dr. Wallich's lists, what these 33 species were, or at least, how many of them were useful plants. We find, for instance, in the 1431 species we have gone over, only 32 useful plants; all the others are more or less ornamental, without possessing any useful property that has yet been discovered, as far as we can ascertain. Having thus noticed the general results afforded by the lists contained in the report, we shall now endeavour to afford a cursory view of the document itself.

In the 3rd paragraph, the Doctor says, " he has excluded annuals from the list with one notable exception—Henbane, which forms a sort of cultivation, important, extensive, and somewhat precarious, besides requiring much labour; of this plant he supplied to the Honorable Company's Dispensary, in January last, 15,000 full-grown individuals." Now the consumption of henbane throughout the Bengal Presidency amounts annually to about 100lbs. weight, and two-thirds of this comes from Neemuch.

In the 4th paragraph he has excluded nutmeg, clove, and mangosteen from the list, because these plants have never thriven under the Doctor's care. The mangosteen never blossomed in the Garden; the clove will not live in it; and the nutmeg cannot be reared in it from seedlings. The Doctor does not appear to have resorted to any expedients, with a view to overcome these difficulties; nor does he refer to localities better suited, in certain cases, to such important operations as we are disposed to think, should be a part of the Superintendent's duty to do. Dr. Wallich seems unfortunately to be impressed with the idea, that the introduction of plants into the Botanic Garden, or neighbourhood of Calcutta, is the great object of the institution.

The nutmeg, mangosteen, and clove, might, *a priori* be pronounced unfit for introduction into Bengal to any useful extent. One of the great points of utility in a Botanic Garden is, to procure plants for introduction into localities that appear best suited to them, and one of the uses of a scientific Superintendent is, to point out those localities. There are places in the South of the Peninsula, which appear to be well adapted to the three above-mentioned plants; but the Doctor does not refer to them.

Again, the Doctor states, "that he has been frequently requested to furnish such common species as the Papaya, Guilandina, Moringa, &c. to N. S. Wales; but he has thought it unnecessary," he says, "to burden the list with such common names." Why, the introduction of such useful plants as the Papaya, Guilandina, and Moringa to New Holland, is of far more importance than the thousand useless names that burden the list.

In the 5th paragraph, the Doctor enumerates 22 plants included in the list A, which are more particularly useful than any of the others.

It is not stated by whom these useful plants were originally introduced. Were the Leechee, Loquat, Alligator Pear, Wampee, Sapota, introduced by the Gardens, and thence supplied to individuals, or by individuals supplied to the Garden? We want information as to priority, to which merit is generally attached. We have no information regarding the extent to which they have been introduced, and none with regard to places in which they have succeeded best, although both these items are very important.

The Doctor cultivates two sorts of oranges from Sylhet and Bencoolen. "Vines do not succeed, although Dr. Wallich had himself a vine at Serampore 30 years ago, which he received from his benefactor and friend Dr. Carey; this bore fruit as well as several vines which that venerable and great man had trained against his house before Dr. Wallich's time; but the cultivation of grapes requires more attention, labour, and expence than Dr. Wallich can bestow on it in the Botanic Garden, the soil of which, somehow or other, is particularly unfavourable to the plant." If attention, labour, and expense, cannot be bestowed in the Garden, where else can it be bestowed? A Government institution has greater internal resources than a private one. Why has not the soil been ameliorated? We happen to know that it is capable of being improved, and that Mr. Masters did improve it very much.

In paragraph 6, Doctor Wallich states, he has had no success in the introduction and extensive cultivation of foreign grasses, and this is unfortunately but too true with regard to every other useful plant; not a single one that we are aware of, has ever been introduced by means of the Botanic Garden of Calcutta since 1814, that could not, and would not, have been introduced without it. We have no wish to undervalue the institution, but if Dr. W. will mention a single useful plant for which India is indebted to the Garden under his management, we shall gladly notify the circumstance to our readers.

We cannot conceive that it was ever intended to introduce foreign grasses into Bengal. The question has been mooted, we believe, chiefly with reference to Hindostan and our N. W. Provinces, not to a verdant country like Bengal. But the whole question appears to be, whether foreign grass can excel Doob grass—this is abundant throughout India during the rains and cold weather, failing partially during the season of drought; during which, it or any other grass requires irrigation, which the natives are inclined in preference to apply to other objects of cultivation promising a better return.

In the 7th paragraph, Dr. Wallich states, in respect to plants "yielding wood applicable *to all purposes of life, large and small*, as well as *those* that are strictly ornamental and horticultural," that he believes the list will be considered rich and varied. It is to be regretted that Dr. Wallich did not, like Doctor Falconer, distinguish timber trees and other useful plants by allusion to their properties in his list. We can only discover five species, each of them indigenous plants. With regard to the introduction of useful plants, Dr Wallich confesses in this paragraph, that he feels much hesitation whenever the question is the introduction of any new article of very momentous and extensive cultivation, as he has not lived long enough to witness any such grand improvement. This is a discouraging view of the case, which may be recommended to the consideration of Dr. Royle, whose views are in many respects just, and considerably opposed to those of Dr. Wallich.

In the 8th paragraph, Dr. Wallich refers particularly to the riches of the ornamental plants,—to the Passion flowers, *Thumbergias, Euphorbia splendens, Amherstia nobilis*, and *Poinciana regia*, "the latter second only to the former" in splendour, and which, from its exquisite beauty, Doctor Wallich predicts will soon become a plant of common cultivation. Many plants which have been imported over and over again, have resisted all the Doctor's endeavours to keep them alive. "The beautiful, but so far rebellious species of Fuchsia are most particularly of this description; nor will it excite surprise," says Doctor Wallich, "that the whole class of Orchideæ, which justly excites the pride of gardeners at home, should be with us in the plains of India of such difficult management."

Loddige's list of Orchideæ embraces 1,000 species; Dr. Wallich's 72. There is no reason why these plants should be of difficult management, if properly selected. The *proper* scope of the garden is the cultivation of tropical products, and there is no reason why it should not be as rich in tropical plants, as European gardens are in those of temperate climates. Why therefore, are so few distributed? We believe that upwards of 250 species may be found within such a circuit of Calcutta, as will admit of their arriving in excellent order. But we know that Dr. Wallich, instead of despatching them immediately, keeps them at the Gardens, until obliged to send them home on sick certificate.

In paragraph 9, Dr. Wallich states, that the list of applicants for plants amounts to 2,107 parties, to whom 190,000 plants have been sent, including 64,000 plants of Hyoscyamus, and with regard both to this plant and the Mudar, alluded to in the same paragraph, both may be had equally well and cheap without the aid of the Botanic Garden. Dr. Wallich suddenly diverges from the subject of medicinal plants to that of his correspondence with Egypt, Africa, Island of Mauritius, the Cape, New Holland, America, France, and England; and, in short, to every part of the world with which India is in communication; and he assures us, that most happy would he be if this intercourse were more widely extended by means of steam.

In paragraph 10th, Dr. Wallich remarks, that "it will be easy to form an estimate of the incessant and laborious correspondence which this part of his duties entails upon him, and which would be far less extensive in other parts of the world, where the business of a man's life, official or not, is less burthened with writing;"—nor is this the only demand upon Dr. Wallich's time; for he assures the Government, that unless, the Superintendent assumed the function of Ship Agent, he would never be able to keep up the exportation of plants by sea. Our analysis of the list of places to which plants are distributed by Dr. Wallich will shew, that a sircar on a salary of 20 rupees per mensem, would be sufficient to relieve Dr. Wallich from this portion of his duty, and leave his valuable time, now so much absorbed in writing, available for more congenial and philosophical purposes.

In the 11th paragraph Dr. Wallich is confident, that satisfaction will be afforded from observing native names on the list of applicants for plants, as a gratifying instance of their botanical zeal, particularly as they must pay Dr. Wallich for the pots on delivery.

The 12th paragraph affords additional proof of the success of transmitting plants by sea in closed boxes, and of the kindness of commanders of ships, in conveying boxes gratuitously to and from India, for the Garden, which makes us regret that it is not richer in objects worthy of such liberality.

The 13th paragraph refers to the number of boxes of plants imported, from Europe, of which there have been in five years 115; deduct from this 13 boxes in which the plants were found dead—leaving 102 boxes of living plants. A list of donors is given, but nothing stated as to the number of plants received alive, or how many of them are likely to turn out an advantage to the country. Ten or a dozen plants are mentioned, but so vaguely, as with one or two exceptions, to leave the reader at a loss to know when they were introduced. Dr. Wallich here compliments Dr. O'Shaughnessy, whose most important researches connected with the medicinal drugs of the country are well known to the Government, and who has found *Crinum Asiaticum taxicorium* to be a valuable substitute for squill. "The *Palo de vacca,*" Dr. Wallich says, "does not like this climate at all," and "he should long since have attempted its removal to a more congenial one, if he had not feared that the transport would have endangered its safety."

In the 15th paragraph Dr. Wallich observes, that there must be many medicinal and otherwise useful plants in existence, which it would be desirable to introduce into India, and he is only waiting for the establishment of steam communication with the tropical parts of America, and other countries, which are to a certain extent closed to us. "It is not so much by means of seeds," says Dr. Wallich, "as by an interchange of living plants, that the introduction of the woody species can be expected to be accomplished." We do not quite agree with him in preferring the introduction of woody species by plants to that of seeds, which may be so well and easily packed, and in general are possessed of greater powers of vitality; but the success of extensive interchange now going on between Dr. Royle and Dr. Falconer, proves the importance of the transmission of seeds overland, and has altogether superseded Dr. Wallich's Ship Agency viâ the Cape, both in the success and the convenience of their arrangements.

In paragraphs 18 and 19, Doctor Wallich regrets the reduction of the establishment of collectors formerly placed under him; but why were former collectors discontinued? We are not aware of any reduction of the establishment on ill-judged grounds. In all large establishments it is easy to modify the employment of a few of the servants, and without incurring any increase of an expenditure, already much too great.

One object of considerable importance connected with the difficulty experienced by Dr. Wallich of cultivating in Bengal, seems to be entirely omitted in his report. Were such plants of temperate climates as appear on the list of distribution freshly imported, or had they in any measure overcome the difficulties which doubtless exist in lower Bengal, Cerasus puddum, Viola odorata, Camelia Kissi and caudata, Fragaria vesca, Spiræa Roxburghiana, Achillæ nobilis, Fraxinus floribunda, &c. would have given valuable statistics on this question. The localities of all the plants in the list should have been enumerated, and the useful properties of such as possessed any, should also have been stated.

The labour expended in lists of mere names, might have been made to afford a valuable contribution to Botanical Geography. Of the ornamental plants, the richest portion of the list consists of Indian species, and yet it does not embrace above a third of our list of Melostomaceæ. Of Compositæ, containing some thousand species, many ornamental, the list only presents 18.

Another point of great importance is omitted; no details of the extent to which any useful plants have been introduced. Is Melanorrhæa still one of the Plantæ Asiaticæ Rariores; or are cabinet-makers likely to be able to avail themselves of its beautiful varnish?

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## Mr. J. B. Tassin.

This gentleman, whose Maps are so well known to the Indian Public, being about to return to Europe, we cannot allow the opportunity to pass without offering our tribute to the liberality with which his time and acquirements, as a Lithographic artist, were always held available for works of a scientific or literary character. On our return from Assam, Mr. Tassin offered to lithograph the whole of the Drawings of the Animals collected on that occasion, free of expense beyond the actual cost of paper and printing. The Plates of the Journal and Researches of the Asiatic Society were lithographed by Mr. Tassin, on the same liberal terms up to the departure of Mr. James Prinsep, who was so sensible of the obligation, that had he lived, Mr. Tassin would not have been allowed to quit Calcutta without a vote of thanks, or some higher mark of the Society's respect.

## *Proposal to form a Zoological Garden in Calcutta.*

It is universally acknowledged that nothing has been created in vain; and as this is true with regard to all objects that live, whether on the land or in the waters, it should be of itself enough to recommend the study of nature as a profitable pursuit. Of the myriads of creatures that compose the creation, man is only familiar with the few which have attached themselves to him; scarcely forming a thousandth part of the equally curious and interesting creatures which have evinced a less tractable disposition for domestication, and still hide themselves in the recesses of the forest.

It has therefore become necessary, in order to acquire a knowledge of animals, to assemble them together in collections. Small collections of wild beasts are maintained as objects of curiosity or amusement at native courts; but such collections are small, and confined to the more ferocious and common description of beasts, generally such as afford entertainment by their encounters with each other.

It has recently become an object of much interest in civilized nations, to devote collections of living animals to purposes of instruction as well as entertainment, and to form for their reception, what are called Zoological Gardens, in which they are arranged with the utmost convenience for observing their habits, and acquiring a knowledge of their names and peculiarities. About 15 years ago, a Zoological Garden was established in London, for the exhibition of animals from all parts of the world. That garden has now become one of the most interesting places of general resort in the metropolis, and yields an income from admission tickets, of upwards of ten thousand pounds a-year.

The expence of collecting wild animals in England is very great, as they must all be introduced from foreign parts; and such as are brought from warm climates require expensive buildings, stoves &c. for keeping up the temperature to that which the animals were accustomed to in their native climates.

In Calcutta the expense of a Zoological Garden would be comparatively small, as trees would afford nearly the whole of the requisite shelter.

India abounds in wild animals, which from the nature of their haunts in the depths of the forests, as well as from that of the climate, few persons can ever hope to become acquainted with, unless they are collected into a Zoological Garden. So numerous are the native animals of India, that it would be unnecessary to resort to foreign countries for materials to form a most attractive collection. Thus another great source of expense and difficulty attending such collections in other countries would be avoided here; while the interest and value of the Garden would be enhanced by the exhibition it would afford, of the unknown animals of the country.

The Zoological Society of London, and similar Societies in other places throughout Europe and America, would no doubt be more or less interested in the success of the proposed establishment, and do their utmost to contribute towards its success.

But whatever the interest and importance of such an establishment might be likely to prove in a scientific point of view, its success would mainly depend on its being made a place of recreation, and general amusement to the people of Calcutta.

Mr. Raleigh, who has the merit of being the first to propose this excellent establishment, suggests, that 150,000 rupees should be raised in 500 shares of 250 rupees each, leaving it open to persons who do not wish to become shareholders, to subscribe such sums as they may think proper.

This, however, would be open to the objection of placing what would no doubt soon become a popular institution, in the hands of a Company, whose income, as Mr. Raleigh's prospectus suggests, should be derived from the sale of duplicates to scientific institutions in Europe, and on the sale of tickets of admission to persons not shareholders nor subscribers.

It is a matter of no consequence how the money be raised, whether as an advance for shares, or as donations, or compositions for annual subscriptions. A proposal so well calculated to open a place of rational recreation, and promote the interest of the city of Calcutta, is not likely to be allowed to fall to the ground for want of funds, and from the nature of the object, it would be necessary to have a sufficient amount in hand to begin with, as the principal outlay would be at the commencement for the preparation of the grounds, as well as for the purchase and collection of animals of interest.

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## *Collections.*

We have received an intimation from Major Davidson of Goalpara, of the existence of four species of Feræ, between the size of the smaller leopard and that of the wild cat; namely, two sorts of grey cats, about the size of *Felis ornatus*, and distinguished from each other by the length of the tail; 3d, a small spotted cat, with yellow tail; 4th, a small striped cat like a tiger.

From Captain Bogle and Lieutenant Phayre, we have received for Barrackpore since the publication of the last number, two consignments of animals; the first consisting of *Papio Rhesus* and a Hoolook, which died on the way; several specimens of *Lemur tardigradus;* several *Rhizomys,* or bamboo rats, and *Monitors;* which were sent on their arrival to Barrackpore. The second dispatch, which arrived in June, consisted of a young Hoolook, three Lemurs, a Martin, two young Swine, a Rhizomys, a Porcupine, a small Felis, and two spotted deer. These animals were generally in a sickly state on their arrival, and as some of them were not considered fit to bear the additional journey to Barrackpore, were retained. The Hoolook, the Felis, and the Lemurs have since died; the others have now recovered, and are to be sent to Barrackpore. Captain Bogle remarks, and we fully agree with him, that the cold season is the most favourable time for sending animals to Calcutta. He is therefore desirous of having all the cages returned to Arrakan, that he may, during the ensuing cold weather, renew the collection. We have been favoured by Lieut. Hopkinson of Arrakan, (where we rejoice to see so many animated with a spirit of inquiry,) with a collection of skins of various small mammalia and birds, a list of which we hope to give in our next number. Dr. Cantor has forwarded a series of the Entomological portion of his Chinese collections, together with seeds, to the India House, both in excellent order. We have been favoured with the following list of objects, which the Earl of Derby is desirous of introducing into England from this country:—

Lemurs, Squirrels, Antelopes, Cattle, the Yak, Kiang, or wild horse of Thibet, and Deer; the Green Pea-fowl, Mynaul Pheasant, Tragopas, Chakur, *P. Hepburnia*, and other partridges, black and other Francolins, Polyplectrons, Bared-headed, Black-backed and other Geese, Cotton and other Teal, Mandarin and Java Ducks, Purple and other Gallinules, Pigeons of all sorts, Sonnerats and other jungle Fowls, Hornbills, Jays, Starlings, Thrushes, and Oriols or Mangoe birds, Grosbeaks and Finches, Plovers, Quails, Vultures, Eagles, Owls, Herons, and other Waders, Cyrus and Cranes. There are many, no doubt in India, who will be happy to respond to Lord Derby's patriotic wishes. His Lordship has already, with the aid of the Zoological Society, succeeded in naturalizing the Nylghy, the Saumber Deer, the Spotted Axis, and Hog Deer in England. These animals now breed freely in Knowlsy Park, and in the course of a few years, will become identified with the common stock of English animals.

From the Reverend Mr. White of Singapore, we received a small collection of fresh-water fishes, consisting of the following:—*Systomus immaculatus*, *Systomus chrysopterus*, *Anabas scandens*, *Ophicephalus wral*, and a *Plotosus*, which all appear to be common to Bengal and the Straits, together with a species which will require to be examined more particularly. We have also received parcels of Echinidæ, and a fish, *Gobius rubicunda*, from Lieutenant Phayre ; and from Lieutenant F. Hayes, outline sketches of two fishes of the Nerbudda, *Pimelodus tengara* and another of the same genus, called *Gegra* by the natives, probably *Pimelodus rita*, Buch.; also sketch and two specimens of birds, an Edolius, Merops, and Psitticus, with several skulls, of interest. We have also received a serpent from Dr. Allen, of the ship Amherst; and *Sciurus maximus* from Major Davidson, of the Engineers, obtained at Poree.

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*The following corrections and additions are requested to be made in Capt. Hutton's paper in the 4th Number.*

Page 463, line 18, from top, for *insured*, read *inspired*.
,, 465, ,, 12, ,, ,, for *lives*, read *livers*.
,, 472, ,, 8, ,, ,, for *naturally*, read *namely*.
,, 474, ,, 11, ,, ,, after *that*, and before *climates*, insert *the*
,, ,, ,, 19, ,, for *Death's-hawk Moth*, read *Death's-head Moth*.
,, 481, ,, 17, after *which*, insert, *went out of the ark as well as those which, &c.*
,, 484, ,, 7, ,, ,, for *our* read *one*.
,, ,, ,, 24, ,, ,, before *conditions*, insert *varying*.

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*Errata in the 5th Number.*

P. 4, line 14, from top, for 1706 feet, read 6071, the height of the lake on Mont Cenis.
P. 15, ,, 10, ,, ,, for 10.40, read 100.40 the greatest known temperature of Madrid.
,, ,, 12, ,, ,, for 69, read 91, the greatest known temperature of Lisbon.
P. 99, line 11, from top, for *agathinus*, read *achatina;* for *Maurice* read *the Mauritius*.
,, ,, 13, after *remarkable*, add *fact*.
,, ,, 14, For *Helices unidens*, read *the single-toothed Helilices*.
,, ,, 15, For *Partul*, read *Portula*.

THE

# CALCUTTA JOURNAL

OF

# NATURAL HISTORY.

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## *On the Schistose formations of the Table Lands of South India, with the characters of Hornblendic rocks. By Captain J. Campbell, Assistant Surveyor General, Madras Establishment.*

The whole of the South India with which I am acquainted, is characterized by flat plains of an apparently general undeviating level, sometimes extending for many miles without an eminence of any kind, and presenting therefore the most monotonous aspect which can be imagined. From these in some parts rise abruptly conical hills and ridges of granite, as mentioned in the descriptions of the granite of the Barramahal. The plains of the Cranatic, of the northern Circars, of Trichinopoly, and of Salem, and also the Barramahal, all present precisely the same appearances, changed only in some parts by the greater frequency, or more close approximation of the granite hills.

It is the surface of these plains which affords the arable soils, and even in the smallest arable tracts which are found in confined valleys on the summits of many of the table lands of Salem, of Kimedy, and of Goomsoor, the formation is precisely the same.

The apparently perfect level of the surfaces of these plains is a deception, as may be seen by examining the beds of the principal rivers, which have so great a declivity as to run nearly dry in a few days after having been filled; but the change of level is so gradual, as to escape observation by the eye. In proceeding west from Madras, by the valley of the Palar, the plain of the Barramahal is gained at Vaniambady, (which is elevated more than 2000 feet above the sea,) by a gradual ascent the whole way, equal to about 10 feet in a mile, or $\frac{1}{528}$th part of the whole.

On examining the formation of these plains, by seeking sections in nullahs, and by wells, it will be found that they are composed of a series of thin contorted beds of crystalline schists, porphyries, pegmatite, and trap, and generally the absence of argillaceous slate and limestone, (as a rock,) is deserving of remark.

The rocks which compose this formation are the following:— pegmatite, red or white felspar, porphyry, (as proposed in the Madras Journal); I make use of the term porphyry in the generic sense as defined by MacCulloch, and the rock to which the above expression is applied, is formed of angular crystals of red felspar embedded in a continuous mass of white felspar, and in the following the preposition, "in," is dropped.

Also, quartz; claystone; quartz felspar; porphyry; trap; blacks chorl; granular quartz and black mica in loose aggregation, (the mica schist of some writers); mica slate; hornblende slate, (rare); quartz rock, (very common); greenstone sienite; augitic sienite; kunkur in beds, or embedded in and sometimes graduating into a rock resembling loosely aggregated micaceous granite; hornstone, (rare); friable gneiss; gneiss; iron schist; crystalline black hornblende.

Some of the beds closely resemble granite, both micaceous and hornblendic, in structure, composition, and general appearance; but differ from the granitic formations in being generally much softer, and frequently quite friable, and in never shewing any signs of cleavage.

The Petralogical characters of the above rocks cannot be entered upon here; but hereafter will be given under their respective heads; for although I consider the identification of particular rocks to be of the greatest consequence to perspicuity in local descriptions, yet as the subject of this paper is more Geological than Petralogical, I shall postpone the minutiæ for the present.

The beds in which these rocks are arranged are very irregular, and are very seldom continuous for any distance. They seldom exceed a few feet in thickness, and almost always fine out at both ends when both can be seen; sometimes one bed is found embedded in another; sometimes parallel beds, in violent contortions, may be traced for some little distance, and soft masses in concentric layers are common in the friable gneiss and hornblendic rocks.

The beds of the various hornblendic rocks form a very large proportion of this formation, and are constantly divided by rhomboidal partings, both vertical and horizontal, the separations of which are filled with kunkur. In a soft rock which may be called friable trap or wacke, seams of kunkur dividing it into rhomboidal masses three or four feet square are common.

Massive beds of milk quartz are common, but they never take the appearance of veins, while small tortuous veins of quartz, both compact and sometimes friable, frequently only an inch or two thick, occur very commonly between, or crossing and cutting through several beds, and these veins, as in the Mysore red marle, fine out perfectly, and are *never* connected with the larger beds.

In the friable gneiss and pegmatite, contorted streaks or veins similar to those described in granite are very common; and also similar nests of sienite, which are not harder than the embedding rock occur, apparently half melted and drawn out into streaks which mingle in the mass.

Generally the rocks nearest the granite are the hardest, and the softest are nearest to the surface. The position of the beds is in the utmost confusion, sometimes vertical and sometimes horizontal. The dip is in all directions, and I have never been able to observe with certainty any general direction. At Salem and at Seringapatam, I have observed the beds to dip generally to the South East, by which the edges at the surface appear to have a N. E. and S. W. direction; but it is seldom good sections of the strata can be found. The beds may perhaps have been deposited in their present form, and disturbed by disruptive forces; yet the contorted strata and tortuous veins of quartz, as also the various beds of quartz could scarcely have been so produced, and it will also be seen, that many of the alternating beds are formed of rocks generally allowed to be of igneous origin.

In describing the granitic formation, I have remarked that the schistose series shew no signs of disturbance, by which was intended that they shew no signs of a general disturbance or elevation, such as would have resulted from a forcible elevation of the granite beneath them. The contortions and intersecting veins I do not consider as the effects of disturbing agencies, but as original in the formation itself.

Dykes of trap are common in this formation; they are always vertical, and never branch off into veins. The trap agrees exactly in character with that in the dykes described by Lieut. Baird Smith, (Madras Journal, vol. ix. page 287,) in what he has called, in common with Dr. Benza, the sienite of Amboor, *i. e.* the Euritic granite, the characters of which I have before defined.

The direction of these dykes is generally North and South, although they sometimes take other directions. They are seldom more than 12 feet wide, and the character of the rock changes in the same dyke sometimes through all the varieties of trap to hornblende rock, and to basaltic hornblende; but never to basalt unless near granite.

The dykes are always divided into prismatic forms at right angles to their length, and what is very remarkable, on the sides these prisms are *always* displaced and canted slightly upwards, so that the lower angle of the upper prism extends beyond the upper angle of the lower one. Besides this, the faces of the prisms on the sides of the dykes shew a vertically channelled appearance, as if they have, when in a semi-pasty state, been squeezed into a fissure; and also the trap on the sides of the dyke *never* adheres to the adjacent rock, as I have remarked, it always does in dykes of basalt in granite. I am not able to state whether the displacement and canting of the prisms has place on both sides of the dyke, or only on one, nor on which side I have generally observed it. Sections by which the side of a dyke is laid bare being generally formed by the course of a nullah, it very seldom happens that both sides are accessible at one place.

In Salem and the Barramahal, the greatest portion of the minerals found occur in the beds of this series: of these the principal is Corundum. Magnetic iron ore also is found in great profusion, both as a crystalline schist, composed of granular quartz, felspar, and magnetic iron ore, and in lumps or crystals of two or three pounds weight. I am informed also, that masses of two feet in diameter are found near Attoor in Salem.

Over the whole of the plain of the Barramahal and in Salem, the surface of the granite is found at no greater depth than 20 or 30 feet. In the stony and gravelly plain of Trichinopoly, granite is seen every where close to the surface, appearing above it in numerous places. In the eastern part of the table land of Mysore, I have shewn that the granite is to be found close below surface. Dr. Benza, (Madras Journal, vol iv. page 1,) informs us, that granite occurs at a short depth below the surface of the plain of the Carnatic, and I believe the same will be found to be the case as far north as Berhampore.

It is from the occurrence of this bed of granite, close below the surface, that water occurs in most parts of South India, at a depth of a few feet only.

Few wells are more than 50 feet in depth, and in general water is found in plenty at half that depth. About Hydrabad, I have been informed the wells exceed the depth here mentioned, being sometimes 300 feet before water is obtained. The geological peculiarity which may be the cause of this, we have, I believe, no published descriptions of.

It appears therefore probable, that the part of the Peninsula of India, to which these observations are confined, is formed of a mass of granite, the general surface of which rises gradually from the level of the sea, up to an altitude of 3,000 feet.

Upon the surface of this mass, in some parts, there are a number of conical points and ridges, sometimes of considerable altitude, (near Allambaddy on the Cauvery river, the summits are fully 3,000 feet above the vallies at the bases of the hills,) where it is channelled out towards the bed of the Cauvery river.

A belt of these hills in close approximation runs nearly parallel with the sea-shore along the whole coast of the Peninsula, and forms what are generally called the Eastern Ghauts. This belt is not a connected ridge in any part, and is generally about twenty miles in width, and in no case ever resembles what some writers have endeavoured to compare it to—a sudden break in levels, produced by a disruption of the rocks of the mass.

There are of course many points of resemblance between the "schistose series" of rocks, and the primary schists of English authors, but we cannot consider them identical; in the first place, because tracts formed of the latter always form broken and rugged tracts, and are elevated and stratified at high angles conformable with the subjacent rocks: while the schists of South India never lie conformably upon the bases of the hills, nor rise in that situation in any degree above the general level; and also, the primary schists have always been referred to aqueous origin. Phillips, in his gneiss and mica slate system, insists upon the visible water-worn appearance of the debris of which they are formed, while in the Indian rocks nothing of the kind can be found, and on the contrary, all the crystalline portions are formed of particularly sharp and well-defined angular parts.

With the porphyritic series of primary schists of Dr. Boase in Cornwall, we cannot identify this formation; because the Cornish formation is characterized by argillaceous schists and similar allied rocks.

The general level surface of this formation, and its situation in the bottoms of the hollows between the ranges of granite hills, naturally suggests the idea of its having originated in the depositions, as a sediment from the detritus of older rocks; but it is impossible that the contorted and convoluted beds and intersecting veins can have been so formed.

That the formation may be a series of sedimentary deposits, subsequently altered or metamorphised by the action of heat is certainly possible, and the insulated beds of trap and diminishing tortuous veins may be accounted for in the same manner; but to this theory objections may be found in the rhomboidal forms which are assumed by some of the trap rocks, with the seams between them both horizontal and vertical filled with kunkur, and in other points also; but besides, if a graduation between this formation and the granite is proved to exist, the same origin must be allowed for both.

That the graduation between the schistose and the granitic formation does exist, I think is probable for several reasons: because in some localities a perfect graduation between portions of gneiss and the granite can be distinctly seen: because in the granite under the Mysore red marle formation, it may be distinctly seen that the direction of the stripes in it, wherever it can be seen above the surface, is always nearly North and South, or about 15° N.E. generally, and in the same formation; the few schistose rocks which occur in it, have their lamination always vertical and exactly corresponding with the direction of the stripes of the granite. It can also be observed, that these schists are only modifications in the structure of the granites, from possessing a fissility parallel with the stripes.

In Mysore the granite is exposed in flat surfaces, sometimes of considerable extent; but in the Barramahal the masses of granite are either so conical, or else in round globular masses, that it is not easy to see any particular direction in the stripes if such exists, and the schists also are much contorted; but generally, where they are found with a regular lamillar structure and vertical, the direction is North and South; and as in Mysore the schists are certainly mere modifications of the granite, I do not see any good reason why they should not be so considered also in the Barramahal.

The beds of gneiss generally occur below all the other rocks of the schistose series, and nearest the granite; and the graduation between them and the other rocks is certain; but to prove with certainty the graduation between the gneiss as a formation and the granite, would be a very difficult point, and much laborious examination must be necessary before we can assume as certain a point of so much consequence.

The arable soils which lie upon the surface of this formation are of very inconsiderable depth, seldom more than a foot or so. They are produced by the disintegration of the soft rocks of the surface, which generally yield easily to the native plough, and in consequence, we always find the colour and composition of these soils to answer perfectly to that of the rocks below them.

Of these soils there are four varieties:—

1. A poor gravelly soil intermixed with angular pieces of quartz lying upon pegmatite and porphyries.
2. Light red soil, with few pieces of quartz lying upon sienite.
3. Red soil lying upon greenstone, with associated kunkur.
4. Dark brown red soil, very ferruginous, intermixed with angular pieces of ferruginous claystone, lying upon trap.

In none of these soils are pebbles ever found, the fragments of rocks being always sharply angular. Near the beds of rivers and water-courses, water-worn pebbles are frequently found in the fields, but I have never in any part of India, seen pebbles in any other situation.

Superposed upon the surface of the "schistose series" deep beds of earth are sometimes found of several miles in extent, and sometimes 20 feet in depth. They are characterized by seldom containing fragments of rocks, and never any pebbles. That they are not alluvial is proved by blocks of granite being sometimes found in them, which are traversed by veins of quartz, which also run into the earth, as mentioned in describing the granite formation. As similar beds of earth never occur *below* schistose rocks, I am inclined to consider them as a separate formation, which may be generalized under the term terraceous series.

Layers of sand, as found in alluvium, never occur in these beds.

The soil is generally red, or sometimes an arenaceous calcareous loam, and generally portions of ramose kunkur traverse them in all directions, both vertically and horizontally, and the pieces are all in connection from the surface down to the depth of even 10 feet. A remarkable formation of this kind is found in the valley which runs north and south-west of Balcondydroog in the Barramahal, which is 10 miles in length by 4 in width.

The beds of the Regur soil, or cotton ground of the Salem and Barramahal, I consider as belonging to this series. The most remarkable bed of this kind occurs on the west side of the town of Darampoory. It covers a surface of about 16 square miles, and is as well as I have been able to ascertain about 25 feet in depth. It lies upon a sienite in loose aggregation of grains of quartz and felspar, with a little hornblende, but I have seen no graduation between the two. The cotton soil as usual is mixed with small pieces of kunkur, sometimes so completely cellular, as to be quite like a honeycomb; but which shew no signs of having been rolled or waterworn, and on the contrary have frequently delicate protruding points, and the quantity of kunkur is greatest at the bottom of the bed, to the exclusion almost of the cotton soil entirely, so as to form nearly a bed of kunkur. Cotton soil has been frequently described as having originated from the decomposition of the trap rocks; a fallacy which was first, I believe, pointed out by Lieut. Newbold, and in which I entirely coincide with him. Trap rocks always in decomposition form a *red* ferruginous earth, which is found commonly on hills of globular greenstone.

Beds of soil similar to these have been often called "untransported soils," and their origin has been referred to the decomposition of granitic formations, without remembering that decomposed granite would give little besides a quartzose sand.

Between many of the beds of the terraceous formation and the schistose series, a perfect gradation and connection may be observed in the change of some of the softer hornblendic trap into a soft wacke, mingling with the beds of the terraceous formations; while long diminishing veins from the beds of the schists run also into them; and very frequently schists and earth connected with the terraceous formation may be seen alternating.

In the Barramahal, beds of soil do occur which may be alluvial or sedimentary, or at least seem most probably to be so; for no facts appear upon which they can be supposed with any degree of certainty to be any thing else. Such occur about the flanks of mountain ranges, and in the valley of the Pallar river at Vaniambaddy, and in these districts strata of sandy deposits are to be seen, and also rolled pebbles and a few rolled blocks.

The table lands of South India appear to be a peculiar feature of this part of the continent, for among all the imperfect information to which I have access, I find no descriptions of any similar ranges of mountains. The hills of the Goomsoor country, and of Kimedy in the Northern Circars, are tracts of this kind, and in the Salem and the Barramahal there are several. Of these the best known are the Shaivary hills, 10 miles N. E. of Salem, the table land of which in extent is about 8 miles long by 2 in width. The Kolly Mally, about 10 miles East of Namcul is a more extensive tract, containing about 60 square miles. The Culry Mally, north of Attoor, contains about 130 square miles. In the Barramahal, there is a small range, the Gailgherry hills, between Tripatore and Vaniambaddy, which contains about 12 square miles, and the Jewaudy hills, SW. of Vellore, which contains about 130 square miles. There are besides, a number of smaller tracts about 30 miles south of Oossor. The elevation of the flat surface on all these hills is much about the same, being between 3,500 and 4,500 feet above the sea.

Of all these ranges, the slopes rise abruptly from the plains of the flat country, and are formed of globular masses and crags of granite, generally euritic; the ascent is so rough and steep that loaded cattle can neither ascend nor descend them on any side. The flat summits are formed of a number of intersecting low ridges of granite, of nearly the same altitude. The hollows between which are filled with schistose rocks and soil, so as to form vallies of not more than $\frac{1}{4}$ of a mile in width, above the surface of the plains of which, the ridges of granite project about 100 or 200 feet.

On the Shairvaroy hills and on the south end of the Jawaudy hills, conical summits are found, elevated nearly 6,000 feet above the sea; they are peculiar for being round and smooth in outline, and are covered with a cellular ferruginous claystone, which appears to be allied to what Dr. Benza has called "hœmatitic iron ore" upon the Nielgherry hills. These high summits are formed of hornblendic granite, which is more solid and compact than the euritic granite of the other parts, and the claystone lies upon this. The claystone when pounded yields a deep red powder, in colour exactly like colcathar of vitriol (peroxide of iron) and might perhaps be used as a pigment. In some of the cellular cavities, there is a sort of botryoidal dark coloured calcedony; but the whole has much the appearance of a volcanic product. About their most elevated parts lithomargic earth occurs; but I do not agree with Dr. Benza in believing, that it results from the decomposition of the ferruginous claystone.

A very singular peculiarity of these table lands is the occurrence of the springs of water, which run copiously all the year round, I believe, without any diminution at any season.

On the Shairvaroy hills, a spring of this kind is found about 100 feet only below the highest summit, and is of great advantage in watering the plantations of coffee there. In this case of course all the European theories for causes of springs fail, there being no higher level from which to bring the water, and although there are hydraulic principles by which waters could be imagined to be so raised, such as the transmission of the pressure of one column of water by interposed air to the top of another column, and thus multiplying the pressure; yet if these ranges of hills are formed of a mass of granite, how can the fluid be transmitted unless through the softer portions between the blocks, or through a vertical stratification.

It is remarkable, that the soils on these table lands are always much richer, and more ferruginous than those of the plains below.

The form of some of these ranges of hills has sometimes suggested the idea, that they might have been "craters of eruption," and the red ferruginous soils disintegrated lavas, which filled the hollows upon the summit; but I have never been able to find any satisfactory trace of lavas about their flanks.

As the hornblendic rocks form a large proportion of the schistose series of rocks in South India, it may be useful to add a list of them with their characters, for the purpose of identifying those which have been enumerated.

The mineral, which forms the characteristic ingredient in the following rocks, I have not been able to identify with any European species. It answers in outward characters to Jameson's definition; but in chemical composition, it differs widely from the proportions given by Thomson; he makes it a magnesian mineral, but most of the specimens which I have analyzed are very ferruginous, and contain little magnesia, and approach more to the composition given by Thomson of "Arfredsonite."

Hornblende in the Salem district is rare as a pure mineral, occurring almost always in conjunction with others, and the crystals being generally small and often amorphous, the crystalline form gives but little help.

I have specimens of compound rocks formed of this mineral, which shew a perfect graduation from the black varieties of perfect black granite up to a rock which has a grey-coloured fracture, and which to the bruise of the hammer shews a considerable quantity of magnesia in its composition. I have found it to approach closely to Dr. Thomson's composition of hornblende.

I may here remark, that the appearance of the bruise by a heavy hammer is a very correct indication of the quantity of magnesia contained in a compound rock; the whiteness of the appearance of the bruise shewing the most magnesia.

*Crystalline hornblende.*—Formed entirely of crystals, or grains of various sizes of pure hornblende, without any admixture of other minerals.

*Colour.*—Shining deep coal black; sometimes a brownish black.

*Crystals.*—Imperfectly foliated; longitudinally deeply marked or lined, sometimes striated.

*Fracture.*—Uneven; smell none.

*Streak.*—Whitish.

*Bruise.*—Black, very little whitish.

*Weathered surface.*—Brownish; sometimes very little decomposed, sometimes decomposed* into a yellowish substance of an ochrish appearance, but with the striated surface of the crystals still visible.

Melts before the blowpipe into a black frit, or dull glass, with strong intumescence; sometimes with difficulty into a deep black perfect glass without intumescence.

Called hornblende rock by MacCulloch, common hornblende by Jameson, found embedded in granite rock; also in beds in the schistose series; also embedded in situ in kunkur; sometimes contains crystals of green Augite.

Is found four miles east of Oossor, intersected with thick veins of crystalline white quartz and white felspar, giving to the mass which it forms, (a small hill,) a curious pyebald appearance.

*Black Granite.*

*Colour.*—Greyish black, nearly quite black when polished; composition of black hornblende in the largest proportion, with grains of quartz and felspar.

*Fracture.*—Irregular, sometimes imperfectly conchoidal, perfectly granular, but generally like fine-grained granite.

*Structure.*—Of perfect crystalline grains of hornblende, which to a lens shew the characters of hornblende imperfect-

* It is doubtful if it is decomposed, for I have lately got crystals containing the yellow ochre inside of them.

ly conglomerated together with grains of felspar and quartz perfectly visible by a lens.

*Streak and Bruise.*—White or whitish.

Is very tough, heavy, and breaks with difficulty under the hammer.

Sometimes so very tough, that a piece of the size of a man's fist will resist completely the attempt to break it by a three-pound circular hammer.

Melts imperfectly before the blowpipe into a black frit.

Is the hornblende rock of Bakewell, and the primary trap and primary greenstone of some authors.

Is known to Europeans by the name of black granite, which term is also used by Pinkerton (Petrology.)

The masses often give a ringing sound when struck by the hammer, like clinkstone, without shewing any difference in the mineral composition.

Graduates into hornblendic granite and into greenstone.

Occurs in great profusion associated with granite, forming hills of piled globular masses, exactly similar to the hills of granite.

Occurs in the schistose series, as varieties in the structure of dykes of trap, but never in beds.

Has a perfect rhomboidal cleavage, and is used as building material sometimes.

### *Hornblende Slate.*

To prevent mistakes, it might by some be thought best to reject this term altogether; but if that was done, it would then be necessary for us to use or invent new terms, and I think we should find greater inconvenience from increasing the already too extensive terminology of rocks, than from using old terms in a new sense. I therefore propose to retain this old name, and to confine its use as now defined.

By common use, the term has been applied to a rock of homogenous composition to the eye, and which splits up into thin lamina, as commonly used for roofing and for writing on. In using the term, therefore, the above argillaceous schist is naturally presented to the mind, and although it does require a little stretch of the imagination to apply this term to the crystalline schists, such as gneiss, &c. yet there is no absurdity involved; but when we come, like Dr. MacCulloch, to apply the term in a generic sense to a fanciful class of rocks, which are not associated together in nature, and to include under this term the most incongruous rocks, which have not the slightest resemblance to one another, the term then becomes meaningless and absurd; and accordingly most absurdly has it been applied unto every rock, for which careless and hasty writers could not readily hit upon a name.

Dr. MacCulloch in Iona, (Western Isles,) describes a rock composed of black mica, in compact aggregation with quartz and felspar, which splits into large slabs, *i. e.* has a schistose structure. This rock he remarks, polishes nearly black, and therefore most likely the colour of its fracture will be dark coloured, and the rock therefore will much resemble those slabs of slate worked up in London into square cisterns for water.

There can be no doubt, that the above is a proper application of the term mica schist; but, we err greatly when we come, like some authors, to apply the term to any aggregation of quartz or felspar with mica, in which the mica is in very minute quantity. The rock has no longer a schistose structure even though the parallelism of the mica can be observed; none but the most determined systematist will assert, in such case that the term can be properly applied. On the above grounds I propose, therefore, that we should confine the term hornblende slate as follows, to what is indeed only a schistose variety of black granite :—

*Colour.*—Black, sometimes a little speckled in appearance.

*Lustre.*—Glistering like minute mica, from which it is distinguished by the grains not coming off in minute lamina by the point of a pen-knife.

*Fracture.*—Irregular and granular.

*Cleavage.*—Into lamina generally, not extensive, nor very thin.

*Structure.*—Minute, requires a lens to see it, exactly like that of black granite, the crystals of hornblende being plainly visible.

Fresh fracture, like black granite.

Weathered surface more like schistose sienite, by the grains of felspar becoming more easily visible.

Differs from schistose sienite, only in containing more hornblende.

Is found embedded in granite, and also in beds in the schistose series.

### *Greenstone.*

This absurd term for a rock almost always black or brown, appears to have been borrowed by Werner from the Swedes, by whom it was applied to a rock really green, formed of hornblende and mica, with some particles of quartz, (Pinkerton's Petrology.) The name has been very loosely applied by writers on geology; but the correct definition may be, a confused aggregation of crystals of hornblende intermixed with a few crystals of dark-coloured felspar: the latter being in small proportion. It has a general dark hue or blackish appearance, in which it differs from sienite, which is speckled.

*Fracture.*—Imperfectly granular and irregular, cleavage none. The weathered surface has a rusty brown appearance. Occurs as beds among the schistose series.

### *Globular Greenstone.*

The characters the same as greenstone, except that the blocks even of 12 feet in diameter, have a perfect concentric lamillar structure, by which it exfoliates into pieces about an inch or two in thickness, having exactly the appearance of a piece of rusty shell. When the softest of such blocks are exposed to the air, the upper surface often breaks up, and becomes disintegrated, exposing the spheroidal structure in a series of diminishing rings or steps, shaped like a Roman amphitheatre in miniature; whence many persons have imagined, that the action of the air has produced the peculiar structure. This, however, is totally incorrect, and I have seen blocks in which two centres of spheroidal structure are plainly to be seen, and besides, the concentric lamina of both are traversed by the same fissure cutting through the whole of the block: which is a complete proof, that the structure is original. I have a specimen of about nine inches in diameter, being the centre of a block which was soft and friable, and in which the concentric lamina of about $\frac{1}{4}$ inch in thickness are divided from each other by a perfect thin film of white carbonate of lime.

On the road between Royacottah and Kellamungalum, about three miles east of Anchitty, may be seen a mass of greenstone rock, which in parts is friable, and several yards wide. It shews the concentric lamillar structure perfectly plain, with several centres; the concentric rings being marked by dark rings, which coincide with the scales into which the rocks divide. The concentric divisions are not circular, but bent into irregular curves, which do not interfere with each other. In two places, irregular-shaped smooth masses of black granite are embedded, the upper half being denuded and exposed; around these, the concentric lamination of the greenstone coincides with the irregularities of the surface, and in one part where the central mass is split into two pieces, and the part slightly separated, the lamination of the greenstone bends in a curve into the hollow of the fissure. Near the mass of black granite, the lamination is very thin and fine; but is rendered perfectly apparent by the same thin leaves of carbonate of lime alternating with it. In the large mass of greenstone layers of carbonate of lime, $\frac{1}{10}$th inch in thickness occur also in the lamination, and irregular veins also run through the mass.

It occurs frequently in hills formed of piled globular masses, associated with granite, and forming indeed a part of the same granite hill, the interstices between the round masses being filled with a sort of imperfectly granular and friable wacke. It must be considered, therefore, as one of the rocks of the granite series or formation.

*Sienite.*

Dr. MacCulloch first pointed out the impropriety of applying this term to hornblendic granite; but as even by those who have admitted the correctness of his remarks, the term has still been fancifully applied to a rock of the same mineral composition as the granite, and considered as associated with trap and porphyries, no definite idea can be attached to the term, and it is impossible to discover from the published descriptions of authors, with any certainty, whether the sienite of Malvern, &c. is a granite or not. Without altering the application of the term, we may, however, be able to use it with perspicuity as applied to Indian rocks, by strictly defining the characters usually given of this rock.

It is composed of granular or crystalline hornblende, in aggregation with felspar.

It differs from greenstone in containing less hornblende, and in having *always* a speckled appearance, which greenstone *never* has.

In the greenstone, the felspar and hornblende are partially mingled together; but in sienite, the crystals of both are entirely distinct, and in no way confused together. In greenstone the felspar has a rusty red colour; in sienite the felspar is quite white and resplendent, or sometimes is slightly red: but never dull in lustre. In small hand specimens, it does very closely resemble hornblendic granite; but in mass, it can easily be seen that it has no cleavage, and that it has not the solidity and firmness or aggregation of granite.

It occurs in beds in the schistose series; but seldom in association with granite.

MacCulloch remarks, "that it is only when the base is composed of *common* (resplendent) felspar, that it resembles granite." This is a matter of course, for as compact felspar is dull and earthy in fracture, it could not be like granite which is crystalline. Dr. Boase makes the difference between greenstone and sienite to consist in the latter containing quartz. This may be, but I cannot define it as a character of the Indian sienite, for it is almost impossible to distinguish between resplendent felspar and grains of quartz, when crystallized together in fine grains. It is sometimes distinctly striped or veined in structure by alternating stripes, or layers of granular hornblende and white felspar; of this kind a beautiful variety occurs at Hoonsoor, west of Seringapatam, where the veined structure is contorted into zigzag waves, not more than two or three inches in length, bent completely back upon the direction like the letter *Z*.

*Porphyritic Sienite*

differs from the last only in the crystalline grains of hornblende being perfectly insulated and separated in a continuous base of felspar, with a dull earthy appearance (probably compact felspar). This has also a perfect speckled appearance, and can therefore be readily distinguished from greenstone.

*Schistose Sienite—Schistose Porphyritic Sienite*

are only schistose varieties of the two last, the rock having a tabular structure, or is finely laminated into thin plates, sometimes not a quarter of an inch thick, or rather it has a tabular cleavage; for in its mode of aggregation the composing minerals do not alternate, so as to cause a striped appearance. These rocks in petrological characters differ in no way from the above rocks, except in being schistose. They have generally been included under the varieties of hornblende slate; but I propose that we should, in India at least, use the above more accurate terms, which are quite as convenient as the old term, and have the advantage of perspicuity, as well as of conveying definite ideas.

*Rhomboidal Trap.*

Trap is another term in Petrology, which has been most abominably misused. As it is now made use of by English geologists, in a generic sense, for all submarine lavas, or rocks of undoubted igneous origin, modified by unknown agencies, without any respect to the mineral composition; perhaps therefore it would be best to reject the term altogether from a petrological definition, and leave it for the use of geological theorists.

In India, however, the term has been very universally used as applied to rocks generally characterized by the presence of hornblende; and as in describing these protean rocks, a general term for such as we cannot arrange with any particular species of rock, will be very convenient as a sort of lumber room; I propose therefore we should limit its use to such rocks as have been described by Lieut. Baird Smith, as forming dykes in hills of Palicondah and Amboor (Madras Journal, vol. ix. page 287.)

The colour is generally a sort of reddish brown, a little speckled in appearance when viewed closely. The fracture surface is dull and earthy, never in any degree granitic. To a lens, the structure is to be seen composed of amorphous grains of hornblende, without glistering faces, mixed up with felspar in the greatest proportion, which partly isolates the grains and causes the approach to a speckled appearance. In structure, the masses are composed of a number of small rhomboids, not generally larger than three or four inches in the face.

The cleavage is generally in faces parallel to the faces of the rhomboidal prisms, and it breaks with difficulty in any other directions. It is very tough, and is broken with difficulty.

It never occurs in extensive beds, but as veins and dykes in the schistose series, and in euritic (Pallicondah) granite.

It is never found associated with, or embedded in the solid true hornblendic granite, and as remarked by Lieut. Smith, the rock enclosing the dykes never shews any altered appearance, nor is any change whatever, or sign of disruption to be seen in the adjacent rocks.

It occurs sometimes associated with globular greenstone.

*Basaltic Hornblende—Basalt.*

I have already sufficiently defined these, while describing the granitic formation of the Barramahal.

*Augite.*

As augite is considered by some mineralogists as a variety of hornblende, produced by being cooled in a different manner from a state of fusion, it may be as well to mention it here, although it does not form in South India any extensive class of rocks. Augitic sienites occur, answering to the rock mentioned by MacCulloch in the beds of the schistose series, and crystals of augite occur in hornblende sienite forming to gether a compound rock, which is not common, but deserves notice, as it is plainly shewn that the difference between the two minerals is not produced as has been supposed.

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*Topographical Remarks regarding Affghanistan, made during the advance and residence of H. M. 13th Light Infantry, between 1st of April 1839, to 31st March, 1840. By* J. Robertson, M. D. *Assistant Surgeon. Communicated by Dr. Murray Insp. Genl. of Hospitals.*

Affghanistan is bounded on the north by the Hindoo-Koosh, traversing the country from east to west; on the east by the Indus; on the west the Desert separates it from Persia. Beloochistan on the south separates it from the Indian ocean. At one time Balk, beyond the Caucasus, was added to the

Affghanistan dominions, as well as Cashmere, Herat, and Beloochistan.

Within these boundaries are comprehended a great variety of soil and scenery; but generally speaking, Affghanistan may be described as a vast aggregate of mountains, with intervening valleys of greater or less extent, varying in fertility and size; sometimes stretching out into barren and arid plains almost entirely destitute of water, and with a scanty vegetation of camel thorn and prickly shrubs, only affording for a short time a little pasturage for the camels of the wandering tribes: in other places is to be found the well-defined fertile valley, highly cultivated, with a plentiful supply of water, producing abundance of fruit, grain, vegetables, &c.

Affghanistan may contain from 420 to 460,000 square miles, a great proportion of which space is but imperfectly known, and has never been visited or surveyed, and consists in a great measure of a maze of mountains, for the most part bare and barren; but some are covered with deep forests of pine and wild olive trees. The principal ranges are the Himalayah or Hindoo-Koosh, Parapamisan, and the Solyman range, from which spurs and off-shoots branch in every direction.

The portion of country traversed by H. M. 13th Regiment was from Quetta to Cabul, by Candahar and Guznee.

The general aspect of the country between Quetta and Candahar is barren and cheerless: consisting chiefly of arid plains, (almost a desert,) scantily supplied with saline brackish water, surrounded by rugged rocky mountains, with hardly any signs of vegetation. The regiment was exposed to severe and fatiguing duty, extreme heat, and great vicissitudes of temperature. The bazar was without supplies, and the country furnished almost nothing, for the crops had not yet ripened; and even the Pisheen valley, which had been described as a paradise or oasis in the desert, was but partially cultivated. From this valley the road to Candahar leads over the Kojuk Amran mountains by the Kojuk pass, where the troops suffered greatly from hard labour and exposure.

The crest of the Kojuk pass attains to an elevation of about 7,500 feet, the base being 6,800. The rocks are of ferruginous clay slate of a soft friable structure, the strata nearly vertical, with a slight dip to the East, and running North and South; the acclivity is gradual from the Pisheen valley, and the descent abrupt and precipitous towards Candahar.

The Ferula asafœtida and rhubarb were very luxuriant, and abound in the hills; there was also a tree which I believe to be the Pistacia terebinthus, from which there exuded a viscid gum, having a strong terebinthinate odour: the Amygdalus nana, with many forms of European vegetation, such as Stellaria, Boragineæ, Ranunculaceæ, Sedum, several of the natural family of the Piperitæ, Leontodon Taraxacum, Gentiana viscosa, Allium montanum, &c.

From the Kojuk to Candahar, the regiment moved over arid plains, covered with the usual stunted and prickly herbage, surrounded by bare rugged hills; it suffered greatly from the want of water, which when procured, was often brackish. After being exposed to great fatigues and extremes of temperature, (the thermometer ranging from 54° to 103°,) we arrived at Candahar on the 27th April, and encamped on a plain to the S. E., and distant about two miles from the city.

Candahar, in lat. 31° 30′ North, and long. 55° 30′ East, is a walled town, containing about 60,000 inhabitants, situated in a fertile and well watered valley, about 3,500 feet in elevation: the surrounding hills are chiefly of limestone formation, rising above the plain from 300 to 3000 feet. The Urghundab river, which flows to the west of the town, supplies the country with water, and around Candahar the water is close to the surface. In the warm season the heat is great and the climate variable: at times the wind is not only hot by day, but sultry and oppressive at nights, and loaded with dust.

Fortunately, accommodation was found for the sick in a village about 600 yards in the rear of the camp, in a well ventilated building, which secured the sick from the extreme heat to which they would have been exposed in tents; the thermometer rose as high as 112° in the subalterns' regulation tent, and even to 120° in the soldiers' tents.

A party of the regiment, 100 strong, was sent with the force that was detached to occupy Ghirisk, a fort situated on the left bank of the Helmund river, 70 miles to the west of Candahar, and noted for its insalubrity.

After leaving Candahar, the route to Guznee was up the valley of the Turnuck; and, with the exception of the narrow strip of alluvial soil on the banks of the river, from a quarter to half a mile in breath, which was fertile and well cultivated, the general aspect of the country was barren. From the banks of the river the ground rises by gentle undulations, is clayey and stony, covered by a stunted herbage of wormwood and prickly shrubs, and bounded on each side by bare rugged mountains.

From Killati Giljee, and about Guznee, the country is more fertile and better cultivated. From Candahar to Guznee there is a gradual rise in the elevation; Guznee being estimated at 7,726 feet above the level of the sea, and at Shashgou, 13 miles from Guznee on the road to Cabul, the top of the pass is 9,000 feet. From thence there is a gradual descent to Cabul, and the route followed is a succession of defiles and small valleys well watered and cultivated, and bounded on all sides by bare *primitive* rocks.

*Cabul.*—The city of Cabul in lat. 34° 38′ 3″ north, and long. 68° 31′ east, is situated at the foot of a range of hills that cross the Cabul valley. The Cabul river passes through a gorge in the range: on the banks of this river, along the base of the mountain, and a spur off-shoot from it, the city of Cabul is built. At the extremity of the spur is the Bala Hissar, from which, up the crest of the spur and top of the mountain, a wall has been built, which extends along the mountain top, and has been continued by means of a bridge (now in decay) across the Cabul river, and over the crest of the hill on the northern side of the gorge, terminating on a spur of the hill at the extremity of which Deh-Affghana, a considerable suburb forming a part of Cabul, is situated. Deh-Affghana and the Bala Hissar are the extreme points where the hills terminate, and thus form a sort of semi-circle enclosing the city of Cabul. On the south-west and south-east between those points, and without the city, is an open plain well watered and cultivated, and studded with mud forts, villages, and gardens. The gorge on the mountain range opens towards the west, and leads to the fine valley of Chardeh. On the right bank of the river, and partly occupying the gorge, is the Kuzzilbash, or Persian quarter of the town; on the left bank are gardens and cultivated fields; and lower down is Deh-Affghana, and the Morad-khana quarter of the town: the latter also inhabited by Persians. On the right bank, between the Bala Hissar and the river, is the principal mass of the buildings of the city of Cabul. With the exception of the great bazar, *choukh*, the town has a mean, dirty, tumble-down appearance; the houses are mostly two storied, built of wood and sun-dried bricks; the streets narrow dirty lanes, where no attention is paid to cleanliness, drainage, or ventilation.

The Bala Hissar is built on a detached spur of the hill, and is situated to the east of Cabul. It is surrounded by a loop-holed stone wall about 30 feet in height, and consists of the Upper and Lower Hissar. It is 800 yards across in any direction, and is surrounded by a wet ditch 40 yards in width, and 1½ mile in circumference outside of the ditch.

The highest part of the Upper Hissar is about 150 feet above the surrounding meadow, and the lower is 30 feet. In the Lower Hissar there is the palace in the northern corner; the barracks were built for the temporary accommodation of the troops during the winter, it contains 6,000 inhabitants.

The wet ditch is filthy and muddy, filled with impurities, and 6 feet in depth, covered with vegetation. On the melting of the snow, and during the spring rains, the stench and effluvia that arises from it renders its neighbourhood very disagreeable, and cannot but prove injurious. From the top of the citadel there is a good view of Cabul and the surrounding country; on the north-west, the Pughman hills; to the north, the snow-clad Hindoo-Koosh, and the plain shut in on all sides by ranges of mountains. The plain itself is crossed here and there by low hills, the intervening spaces being the meadows of Cabul, with cultivated fields, gardens, walled villages, and forts plentifully scattered around. The plain is watered by the Cabul and Logar streams, from whence numerous canals and water-cuts are led all over the valley for the purpose of irrigation. About one-third of the valley is either covered with water, or is marshy ground. North from Cabul, five miles, is the lake of Vizeerabad, about 7 miles in length, and 1½ in breadth; but varying considerably according to the season of the year. It is very shallow, and the drying up of its borders leaves the ground white with saline efflorescence. Along the foot of the hills, from the south-east of the Bala Hissar, is a very extensive marshy surface, and the other part of the meadows is merely what in England is termed a bottom, the water being close to the surface. On the melting of the snow and the spring rains all around the Bala Hissar, the surrounding meadows appear almost covered with water, the resort of wild fowl in winter, and in summer and spring the source of intermittent fevers.

*Mountain Soil.*—The hills around Cabul are chiefly primitive, composed of gneiss in places assuming a granitic appearance, with dykes of dark porphyrytic trap and veins of quartz; the height of the hill above Cabul is 1,200 feet. Cabul itself being 6,000. The Pughman situated to the N.W. have snow in their ravines and hollows the whole year round, and must be upwards of 13,000. The lower hills in the centre of the valley or meadows, consist chiefly of limestone and indurated clay, in some places perforated by caves, the occasional residence of wandering people. In the extreme north, towering above the neighbouring mountains, are the snowy peaks of the Hindoo-Koosh; the valley is also shut in to the east by ranges of hills, which may be considered as off-shoots from the Suf-feid-Ko. On the top of one of them, and distant about 10 miles from Cabul, a minar or Bactrian pillar is distinctly seen. The valley is shut in on all sides by bare primitive rocks, which by reflecting and radiating heat, must tend to increase the glare and temperature, but the air cooled by the snowy mountain tops rushes into the valley, moderates the heat, and produces vicissitudes of temperature. The soil of the valley is a light clayey alluvial deposit, from three to five feet in depth, to this succeeds gravel and sand, on reaching which, water is found in great quantity: many parts of the surface are incrusted with saline efflorescence, rendering the water more or less brackish.

*Climate.*—In so extensive a country, there is a great variety of climate depending on elevation and position of the valleys. That of Cabul is considered extremely salubrious; it is warmer than England in summer, and colder in winter. The thermometrical range is very extensive, from below zero to 102°. There has been no opportunity of calculating the mean temperature of the year in the Cabul valley, from the Regiment having been under canvas till the approach of winter; the difference between night and day, the diurnal variation, is considerable, amounting to 40°; the nights and mornings are cool, the noon-day sun hot.

June, July, and August are the warmest months; December, January, and February, are the coldest. The greatest cold was experienced in February, the thermometer falling several degrees below zero, but this winter was considered a severe one; altogether about 5½ feet of snow fell during the winter. The sun at noon-day possessed sufficient power to melt the surface of the snow, rendering it disagreeable and wet, and the instant the sun went down, the surface became hard and frozen.

The seasons are very regular; from May till November the air is dry and clear, a bright blue unclouded sky, with scarcely even any rain, except only a few drops, not sufficient to wet the ground and lay the dust. In November a few showers of rain are soon followed by snow; in December, January, and February, there is snow and frost; from the middle of March till the 1st May, there is almost incessant rain, the snow melts with the greatest rapidity, and the transition is sudden from winter to summer, there being little spring. Thunder and hail storms occur at this period; earthquakes are by no means unfrequent during winter. It is said, that they are never experienced at Candahar. If I remember rightly, Humboldt remarks, that in South America earthquakes are most severely felt in towns situated at the foot of gneiss mountains, which is the case with Cabul.

The prevailing winds are from the North, N. W. and West, easterly winds occur but seldom. The mornings are generally calm and still, towards the forenoon a breeze springs up, and often blows fresh from the Hindoo-Koosh. The winter is generally calm and still, with little wind: at the breaking up of the winter, the winds are variable.

*Vegetable and Animal Productions.*—As my knowledge of the subject is very limited, I shall merely observe, that in the comparatively cold climate of Cabul, the vegetation consists chiefly of the European forms.

There are few indigenous trees, as during the marching in this country, with the exception of the wild almond and

Pistachia Terebinthus and tamarisk, those that have been met with occurred in orchards or cultivated places; these are the vine, peach, apricot, mulberry, walnut, cherry, plum, pear, apple, quince, pomegranate, the poplar, (Populus alba,) the willow, the singed, white-thorn, and plane tree, (Platanus orientalis.)

In the hills, or Kohistan of Cabul, various species of pines and cedars are found, along with the oak, elm, ash, and juniper. One of the species of pine yields an edible seed termed the *chilgoza*, and to be had in the bazars in abundance; a shrub resembling the laburnum, a species of Cytisus, is very common in the hills about Istalif and Chareekar.

A species of wormwood, or Absinthium, abounds over the whole of the arid plains in Affghanistan; it diffuses a strong aromatic odour, and furnishes food for camels, and in many places is the only sort of firewood amongst the thorny shrubs with which the sterile plains are covered. The camel-thorn is scarcely ever absent, the Hedysarum alhagi belonging to the natural family Leguminosæ, as also prickly bushes resembling the furze and broom, many species of Astragalus, and the wild liquorice.

Amongst herbaceous plants are found very generally distributed the natural families of the Boragineæ and Cruciferæ; of the former, are Anchusa, Myosotis, Onosma, Echium, Lithospermum; and of the latter an order eminently European, Hesperis, Cheiranthus, Sinapis, Arabis, Raphanus, and Nasturtium.

Bulbous plants are also numerous of the lily tribe, Hypoxis, Irideæ, Tulipa, Anthericum, Asphodelus, Allium, Ornithogalum Sedum, Sempervivum tectorum, (or house leek,) and many species of Euphorbia, of the Compositæ Scorzonera, (or viper's grass,) Leontodon, Taraxacum, many species of thistles, as also the Camomile or Anthemis, with several of the Labiatæ.

Amongst the most valuable of the plants, is the Ferula persica, which produces the Asafœtida. It is one of the

Umbelliferæ, and sometimes grows to the height of four feet. The milky juice extracted from the stem near the root concretes into gum, which is exported in great quantities to India.

The Fennel (Anethum graveolens,) and a plant resembling in its characters the Bubon Galbanum are also found.

The Rhubarb appears to me to be the Rheum ribes, the leaves and stem being warty. The early shoots are protected from the light and sunshine, and in this blanched state are held in great estimation as an article of food by the natives of Cabul; the root does not appear to be used by the Affghans.

Of medicinal plants, Hyoscyamus niger, Datura strammonium, Papaver somniferum, are to be found in the vicinity of Cabul; the seeds of the Datura are often mixed with the raisins, and a very stupifying and deleterious spirit obtained by their distillation.

The hemp plant, from which *bang* and *churrus* are prepared, also abounds.

The common plants which accompany the cultivation of the Cerealea in the valleys, are those that are found in cultivated fields in Europe.

In the ditches and water courses, Ranunculus aquatilis, Hippuris vulgaris, Butomus umbellatus; on the banks of the streams, are the white clover, ranunculus, and many other familiar forms of European vegetation.

Amongst the culinary vegetables may be mentioned, turnips, carrots, cabbages, lettuce, beet-root, radishes, onions, garlic, egg fruit, cucumbers, and melons.

Wheat, barley, maize, tobacco, madder, rice, cotton, beans and vetches, are to be seen in cultivation with lucerne, trefoil, or clover.

The potatoe has only lately been introduced, and will no doubt soon spread over the country.

With the exception of the camel, the domestic animals are

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almost the same as in Europe—the horse, ass, mule, cow, buffalo, sheep, goat, dog, and cat. The sheep are all of the fat-tailed breed, and the goats have often the soft wool at the roots of the long hair, from which *pushmina,* or the coarser sort of shawl is formed.

The bear and leopard are said at times to be seen in the neighbouring mountains. The wild goat and wild sheep browse on the aromatic herbs amongst the craggy steeps, and the ibex in the most inaccessible places. The wild goats and sheep found in Affghanistan differ from those of the Hymalayah. Amongst the mammalia may be enumerated the wolf, jackal, fox, and hare, two or three species of jerboa, the marmot, several of the pole cat and mongoose kind, as also the badger, rats, mice, &c.

As birds of prey, may be mentioned the bearded vulture, vultures, kites, falcons, hawks, with ravens, crows, jackdaws, and magpies. The owl is also found. Of game birds, a species of otis or bustard, red-legged partridge or chicore, and a large sized partridge, termed the *couk-a-durrah,* black partridge, quails, woodcock, and snipe.

Pelicans, storks, herons, spoonbills, wild-geese, and wild-ducks, divers, and coots, lapwings and plovers. In winter the bazar of Cabul is well supplied with water fowl.

The birds of the order Passeres, as larks, starlings, blackbirds, and thrushes, &c. are numerous.

The land tortoise, and many species of Lacertæ, or lizards, are very common.

Leeches are found in great abundance in the numerous water-courses and ditches of the cultivated valleys.

In the mountain streams around Cabul, I believe there is only one sort of fish found.

In a country so extensive as Affghanistan, there can be little doubt but that it will eventually be found to produce many minerals; rock-salt, iron, copper, antimony, lead, coal, exist, as also sulphur and lapis lazuli.

*Agriculture.*—The want of water, and the vast extent of rugged rocky mountains, have doomed a great portion of the country to irremediable barrenness. In the valleys that are interspersed amongst these mountains where water can be obtained, the cultivation is of the highest order, and as the productiveness in this dry climate almost entirely depends on irrigation, great labour and skill are expended by a semi-barbarous people in the construction of water-courses, often leading from a very great distance along the sides of precipitous mountains, and by canals, embankments, and levelling, distributed through the fields with the utmost care. In some places a series of wells are dug, and the water allowed to flow from one to the other by under-ground communication, gradually diminishing in depth until the level of the cultivation is attained, when the collected water can be directed over the fields; these are termed *khareises*, and made at great expense. The implements of husbandry are primitive and rude; their fields are neat, and around the water-courses willows are generally planted; the crops appear particularly rich. Lucerne and trefoil are very extensively cultivated, as when dried they are the principal food of the cattle in the winter, which in some parts of the country lasts for many months. The lucerne is of a very fine kind, and is cut seven times, and even as often as eight times in the season: the clover four times.

From the quantity of water used in cultivation, and the necessity of keeping the fields in a constant state of moisture, every valley in Affghanistan is more or less under the influence of aqueous exhalation, more especially where rice is cultivated; to these sources may partly be attributed the intermittent fevers which are endemic in the valleys.

There is some of the land incapable of irrigation, and on which seed is sown on the chance of rain; this is termed *lulmee*, as they say the grain is left to the mercy of God.

*On the Population and its Character.*—The population is supposed to amount to about eight millions. The various tribes, and the character of the many races that compose this number, would occupy too much space were I even capable of writing on the subject, although it must be confessed, that the physical characters of the different tribes, and their peculiarities in reference to their habits and mode of living, would be an interesting inquiry; for here is to be found the wandering tribes distinct, and yet inhabiting the same country as the fixed population; and I suspect it will be found, after accurate examination, that the beautiful simplicity, which has been described as existing amongst the pastoral people, is a creation of the imagination, and that when moral and mental cultivation do not exist, the savage virtues are too often imaginary and the only law, is that of the strong.

Their vices are numerous, and their virtues few; they pretend to regulate their conduct by the precepts of the Koran, and the customs of their ancestors as handed down from father to son,—an eye for an eye and a tooth for a tooth,—the quarrels of the individual become the quarrels of the tribe which they are bound to revenge, hence blood feuds innumerable, and want of union. The exercise of the right of hospitality is too often followed by crime. It is doubtful if their ancestors ever paid taxes, and their descendants seem inclined to follow this prescriptive right of freedom from taxation, so that the only revenue collectors were large cannon; they will first fight, and if it cannot be helped pay; but it never enters into their heads to pay again if it can be avoided. Truth is not to be found, deceit is every where practised, intrigue is the breath of their nostrils; God is eternally in their mouths, but never in the heart; envious of each other, cruel and vindictive, human life is not valued, and the unfortunate that trusts them is sure to be deceived. From such elements the Affghan monarchy is to be constructed under the restored king Shah Sujah, with the assistance of the British.

The aspect of the country would seem adverse to kingly state; it is poor and rocky, and not well adapted for the pageantry of royalty which was formerly kept up by the possession of Cashmere, the fertile valley of Peshawur, and fruitful Scinde, and the wild tribes fought and gained plunder, but never paid.

*Cabul, its houses, &c.*—Cabul from the time of the emperor Baber has been described in glowing colours, praised for the fineness of its climate, the beauty of its scenery, its gardens, their fruits and their flowers have been the theme of the poet and the traveller. "The climate is extremely delightful, and there is no such place in the known world, for there is at once mountains and streams, town and desert."

The mountains are bare rocks; the streams insignificant; the town has a mean appearance; and the desert adds but little to its beauty, for it is so common all through the country, as not even to have that charm which variety affords.

The royal garden, said to be the finest in Cabul, is a quadrangular space about 1000 yards in length and 800 in breadth, enclosed by a dilapidated mud-wall; muddy canals run through it, and straight rows of Lombardy poplars planted along the eight walks which branch off from the quadrangular space in the centre; fruit trees planted in even rows, rosebushes, beds of iris, narcissus, stock, gillyflower, and sweet william, and I believe the graves of some saints, constitute the garden.

The atmosphere is so dry that after the spring rains irrigation is constantly required; even the ground on which the fruit trees are planted is saturated with moisture at least five times in the season, rendering this smiling garden little better than a marsh, and yet the water is only a few feet from the surface of the ground.

The streets of Cabul are narrow and badly paved, with imperfect hollows or gutters in the centre, generally leading into some stagnant hole, mostly the neighbourhood of the *Hummaum*, or vapour baths.

The houses are formed of a frame-work of wood and sun-dried brick and mud, generally of two stories, and in the form of a quadrangle; the apartments are open towards the court, being merely closed by sliding panels of wood; the roofs are flat and carefully surrounded by parapets to prevent the females from being seen; for the same reason there are seldom if ever openings in the outer wall of the buildings, and the doorway or entrance is never straight, a covered dark passage leading either to the right or left; in such buildings there can be no ventilation; every sort of filth is thrown into the streets. The apartments are of no great size, from 12 feet in width to 14 or 20 in length, with little or no furniture, chiefly consisting of a mat with a *numud* or sort of felt covering for the floor, and for the better classes, a Persian or Herat carpet; and around the room there are numerous small recesses in which are placed tea cups, China basons, and tea pots, generally of Russian manufacture; the rooms are plastered with a fine clay rendered adhesive by being mixed with the down of seeds of a sort of rush; sometimes the plastered wall is stamped, and whitewash and talc and the whites of eggs give the surface a light shining appearance; it looks well, and one wonders at the taste displayed. Occasionally the roofs are formed of small carved pieces of wood well joined and tastefully arranged, so as to give the appearance of Mosaic to the ceiling, but most frequently small sticks are laid across the beams, over which are mats, and then the mud of the roof. There is generally an inner and outer room only separated by sliding moveable panels. A very few of the better classes have small gardens round their houses, and the court is planted with flowers and fruit trees, with a stream of water running through it.

All the poorer classes leave Cabul on the approach of winter, and proceed to the milder climate of Jellalabad on account of the expence of firewood and charcoal, and their not being able to lay in provisions for the winter. There are no fire-places in the houses; the apartments are warmed by charcoal burnt in a small earthenware or iron vessel, this is covered with a frame work of wood over which is fastened coarse cloth stuffed with cotton, and over all is a large quilt suited to the size of the room; the heat is thereby retained, and the members of the family sleep under it at night and sit on cushions with the feet and lower part of the body covered with it by day, with the upper part of the body and arms encased in tanned sheep skins or cloth lined with furs. The apartments are all so open there appears to be no danger from the vapour of charcoal, which moreover is shut in, the heat only escaping. I never heard of any injurious consequences, nor do the natives appear to be aware of the effects of carbonic acid gas, or even of its existence.

This mode of imparting warmth at small expense is well suited to the Affghans, and is termed a *sandali*, and is used in the open shops in the bazar as well as in their houses.

The bazars are for the most part a row of cells on each side of a narrow street, before which is a raised platform or booth, in which the vender of the various commodities sits with his goods or wares displayed beside him; in the hot weather the heat of the sun is moderated by the bazar being covered with the branches of trees. The Chow-chut, or principal bazar, is a very fine one, and is at all times a bustling, stirring, crowded place. Each class of merchants and tradesmen have their respective quarters, but bakers, cooks, confectioners, apothecaries, butchers, fruiterers, and green-sellers are dispersed in various places.

There are also several large caravansaries for the reception and accommodation of the travelling merchants and traders and their goods.

The population of Cabul in summer may be reckoned 100,000, of these 12,000 are Kazilbashes or Persians, 10,000 Hazaras, and a few families of Armenians and Jews, the remainder being Affghans, Hindoos, Cashmeres and Punjabees.

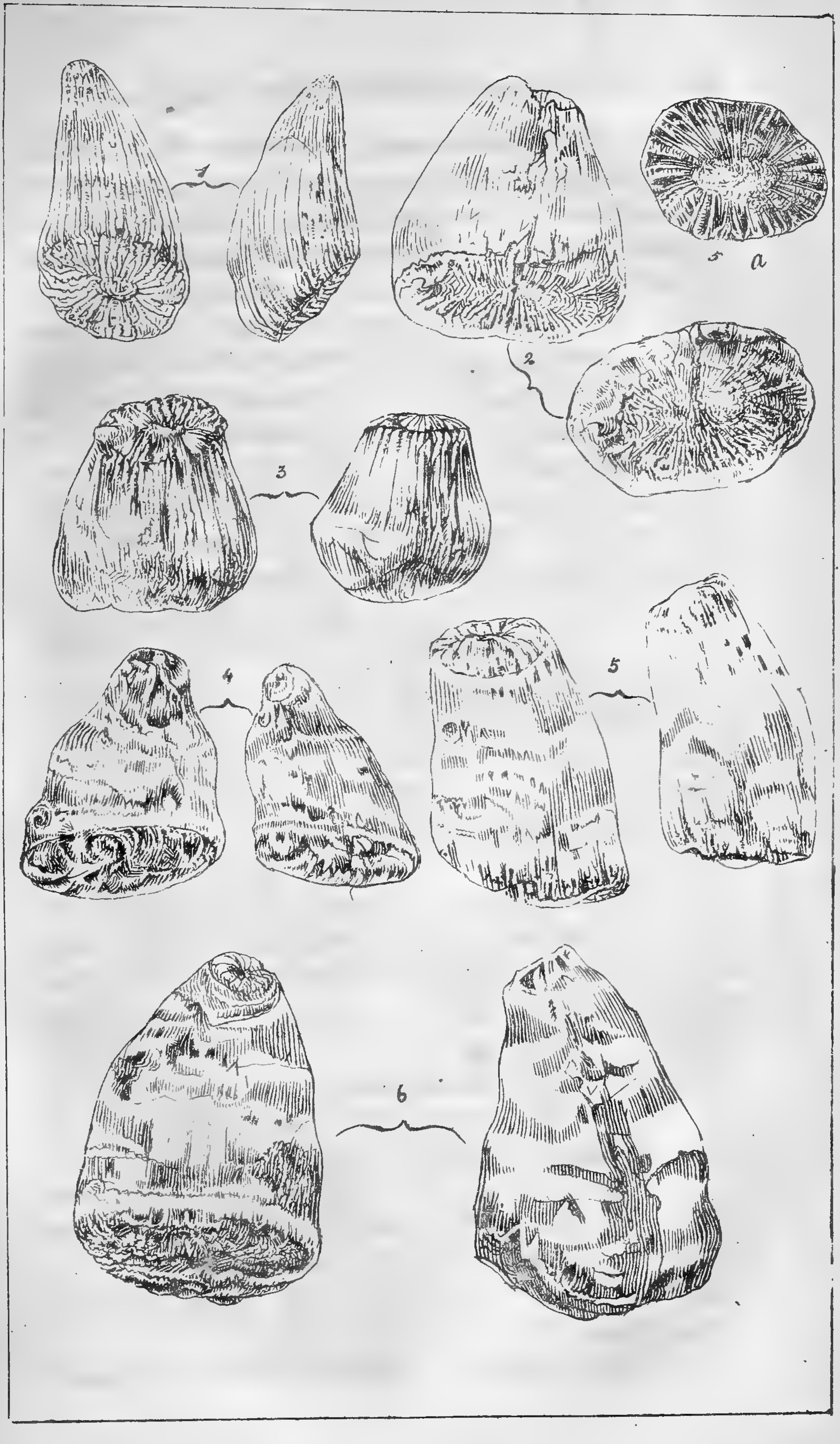
The Affghans are a strong powerful athletic race, many possess handsome features, some as fair as Europeans, but the generality are of a brown sunburnt hue, with healthy ruddy colour in their cheeks, dark hair, dark irides, occasionally reddish-brown hair, with blue eyes, long oval faces, high cheek bones, high noses, copious unshaven beards. They belong to the Caucasian variety of man, and present a strong contrast to the Hazaras, who are a decided Mongolian tribe, with their round heads, and flattened face, straight hair, scanty beard, small and oblique eyes, thin and scarcely curved eyebrows, small flat nose, low forehead, thick lips, and short chin. They are a thickset, square built, strong race, and generally employed as porters and labourers; the female domestics or slaves, for they are purchased by money or procured by barter, are of this race.

The Affghans in general are a social sort of people, fond of entertainments, and spend the greater part of their time in the open air, for their shops and houses, as I have before stated, are open; they are fond of sight-seeing, and pay frequent visits to the gardens in the vicinity of Cabul; it may safely be stated that once a week at least, generally on their Sunday, they enjoy a holyday in the gardens.

They are fond of gambling, fighting quail and game cocks, and those that can afford it are addicted to hawking, and such field sports as the country affords, but game is very scarce.

Although contrary to the precepts of the Koran they are rather fond of indulging in strong drinks; in almost every house they prepare spirit from fermented raisins, and winter is the season for their drinking parties; they sit round the *sandali* and sleep off the effects of the debauch at their friends' houses; they are never seen drunk in the streets, many indulge in opium eating, and also in the use of churries and bang.

Their moral character is bad, being addicted to unnatural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crimes; and the females are said to possess a considerable share of beauty, but little chastity; even the females contrive to enjoy a considerable degree of freedom, and like the men frequent the gardens, and form parties to the tombs of saints and places of prayer. At least once a week they visit the *Hammaum* or vapour baths, which are the great places for gossip and scandal. The nature of their dress, which conceals their form and features is highly favourable for intrigues.

*Of the Diseases.*—The information under this head is very vague and uncertain, and only obtained from the casual applicants for advice, often when the medicines of the native Hakeems have failed.

Fevers prevail in spring and autumn, and I believe that intermittent fevers may be considered as endemic in every valley in Affghanistan, and in the lower valleys assuming the bilious remittent form; I have also seen cases of severe fever in the common continued form, with high vascular action.

Affections of the chest and air-passage are very common, especially during the winter season in the young, in the form of pneumonia and bronchitis with sore throat, and croup amongst the children, and chronic bronchitis amongst the aged.

Pneumonia is well known and much dreaded by the natives, it is termed *sinai-pala;* on being seized with it, they immediately resort to bleeding; it is a very fatal complaint. After some little trouble I ascertained that in the winter in the Bala Hissar, containing a population of 5,000—100 deaths took place from disease of the chest; some died on the third day, but most frequently on the 7th. One of the children of a *Moolah* was seized with croup and recovered; as is the custom with Mahomedans, he said prayers over the dead, and made inquiries from me as to the cause of the deaths.

Jaundice I have met with occasionally, in this complaint a holy *Syud's* prayers were said to be very efficacious; he placed a vessel containing sweet oil before the patient, then prayed at intervals, and in three days the cure was generally effected, and my informant assured me, that the oil acquired a deep yellow colour.

Liver complaint I have seldom seen; occasionally enlarged spleen with dropsy, the sequela of fever.

Cardialgia, termed by the natives "*Dird-i-dil*," is a very common affection, and one for which they frequently apply for medicine, and appears to have arisen from the use of cheese, with the almond and other stone fruits as articles of food. A native *Hakeem* had recommended the use of pounded almonds as a remedy to one unfortunate man, which added greatly to his sufferings.

But of all diseases, ophthalmia, acute and chronic, and its sequela in the shape of blindness, closed pupil, granular eyelids, ulcerous specks of the cornea, are by far the most frequent, and I believe is to be ascribed to neglect of cleanliness and inattention, assisted by the vicissitudes of temperature, sleeping in open rooms, or on the tops of their houses exposed to the night air. I was asked to attend the wife of Hyder Khan, who was labouring under a most severe attack of purulent ophthalmia; the disease had made considerable progress, she was however fortunate enough to recover perfect vision of one eye, and escaped with slight opacity of the other; it was during my attendance on this native lady, that a great many females applied for advice, and it was sad to find what a great number were irremediably blind from neglect and ignorance. In illustration I may mention, that one of the daughters of one of the principal men in Chandoul was one of the applicants, and by the advice of a *fakeer*, the neck and head of a blue pigeon had been chopped off, burnt, and reduced to ashes, a portion of which had been daily crammed into the eye.

Hœmorrhoids is a common affection, and rheumatism not unfrequent; scrofula also exists, many had well marked cases of disease of the joints and enlargement of glands of the neck, particularly in children of the poorer classes, who lived in confined, ill ventilated houses, on the ground floor, ill clothed and ill fed.

I have only seen one case that appeared to be tubercular phthisis, so if it does exist, it must be very rare.

An aphthous state of the mouth and throat appears to be a very common complaint, occurring during the melting of the snow and spring rains.

In a mountainous region so extensive, embracing every sort of formation, with inhabited valleys of different sizes and elevation, where the streams are often supplied by the melting snows, and where many of the agents to which the production of goitre has been attributed exist, it is curious that bronchocele does not appear to be known, as it is well known to prevail through the whole of the Himalayah,* and at Karabaugh on the Indus, which is within the influence of the periodical rains, bronchocele is very common, and where the periodical rains do not extend the disease appears to be unknown.†

Venereal affections were said to be very uncommon, and were hardly known except in the form of gonorrhæa in the town of Cabul, until the Seik troops seized Peshawur, and from thence it was introduced into Cabul, where it is known by the name of *band-i-ferung*—or the French disorder; the native *Hakeems* cure it by using preparations of mercury.

* Not throughout the whole of the Himalaya, since many places are exempt from it, as Dorjeeling and Cherra Ponji. The circumstances attending that disease in Kemaon have been investigated with striking results, and we have no doubt the most complete success would attend an investigation of the subject in any other quarter.—Ed.

† This cannot apply to Switzerland or to Yorkshire.—Ed.

The practice of inoculation is common, especially amongst the Hazaras, but vaccination has not as yet been introduced.

Cholera prevailed to a great and fatal extent in 1826, and small-pox now and again commits its ravages amongst the inhabitants.

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## *On the Construction and Management of delicate Balances, and a new method of Weighing. By Captain* J. CAMPBELL, *Assistant Surveyor-General, Madras Establishment.*

To the analytical chemist a delicate balance is an instrument of the utmost importance, the whole of the results obtained in his researches being estimated by its mechanical action, and even the operative manufacturing chemist depends upon its indications for the correct knowledge of the values of metallic ores, and the purity of the precious metals.

In India these instruments are not made for sale, and any person requiring one, must either submit to the delay of ordering it from England, or else make it up himself; while the price charged in London for them is very high; if a fine one, never under 20*l* or 30*l*.

If the mode of adjusting a balance is not perfectly understood, it becomes nearly useless; but to make the necessary adjustments, a considerable degree of mechanical skill and knowledge is required, and therefore in England chemists seldom trouble themselves with it, but leave it to the makers; few authors in consequence are acquainted with this practical operation, and the directions generally given in works are often based upon false principles.

In India any one who has picked up a knowledge of mechanical arts may, with the assistance of a good native workman, make up an excellent instrument at a trifling expence; and Lieutenant Braddock has shewn in the Madras Journal,* that instruments so made are not at all inferior to those which

* Madras Journal, vol. ii. page 86.

are considered good ones by the first rate chemists of England.

To explain the principles of the following remarks upon the construction and modes of adjustment of a balance, it will be first necessary to take a general view of the principles of the instrument.

The balance is a lever, having two arms nearly in the same straight line, at the extremities of which the weights and load are hung at nearly equal distances from a central axis, or centre of motion between them.

The force acting upon the ends of the arms or points of suspension, is the force of gravity due to weights and load. The force at each end of the lever acts in parallel and vertical lines, and the effect to put the system in motion will be the moments of these forces, or the force itself multiplied into the perpendicular upon the direction of its action from the centre of motion.

The perpendicular from the centre of motion upon the direction of each force, will be equal to the line of the angle which the arm of the balance makes with the vertical multiplied by the length of the arm.

The moment of the force acting upon each end of the balance will be equal to the product of the weight, the length of the arm, and line of the angle which it makes with the vertical line from the centre of motion.

Let A and B be the weights at each end of the arms.

$\alpha$ and $\beta$ the length of the arms.

$\varepsilon$ = angle included between the arms. If the arms do not form equal angles with the vertical, but the angle with the arm A is the greatest, then the moments of the forces acting upon each arm will be

$$A.\alpha.\ \text{Sin}\ (\tfrac{1}{2}\varepsilon + \text{Inclin.})$$
$$B\cdot\beta.\ \text{Sin}\ (\tfrac{1}{2}\varepsilon - \text{Inclin.})$$

As the forces act upon opposite sides of the centre of motion, the effect to put the system in motion will be equal to the difference of the moments.

In the case of an equilibrium the moments will be equal, and no motion will ensue.

When the angle $\varepsilon$ is equal to 180°, the above formula will become

$$A.\alpha.\ \text{cosin Inclin.}$$
$$B.\beta.\ \text{cosin Inclin.}$$

and if the moments are equal in one position, they will also be equal in all, because the differences of the moments will be the same in all positions.

If the angle $\varepsilon$ is greater than 180°, that is when a line joining the two points of suspension would pass *below* the centre of motion; if the moments are equal in one position, and the system is displaced by an extraneous force which increases the angle of inclination of the arm A with the vertical, then the moment of the force A will be decreased, and the moment of B increased, therefore the system when again at liberty will regain the position of equilibrium.

If the angle $\varepsilon$ is less than 180°, an increase of the inclination will increase the moment of A, and decrease that of B, and therefore when the system is again at liberty, the action of the forces will continue the displacement, which will not be regained until the system is overturned.

In the foregoing the beam of the balance has been considered for the sake of simplicity as being devoid of weight, but to take this into account, a third force may be considered as acting upon the centre of gravity of the mass.

If D = the weight of the beam.

8 = its distance from the centre of motion.

Then if $\varepsilon$ is greater than 180° and D is below the centre of motion—then in the case of an equilibrium, $A.\ \alpha.\ (\frac{1}{2}\ \varepsilon +$ Inclin$) = B.\ \beta.$ Sin $(\frac{1}{2}\ \varepsilon -$ Inclin.$)+$

$+ D.\ 8.$ Sin Inclin.

as in the case of the balance generally. But if ε is less than 180°, an equilibrium can only take place when the moment of D is greater than the difference of the moments of A and B, and when by the increase of A and B the moment of D becomes the least, the system will overturn or upset as in a balance adjusted so as to 'set,' as it is technically called.

The sensibility of a balance depends upon the moment of D being as nearly as possible equal to the difference of the moments of A and B, as the system is then easiest put in motion.

To adjust a balance, the points of suspension, and the centre knife edge must first be brought as nearly in a straight line as possible. The arms of the beam must then be nearly equalized in weight by filing. The beam must be made to vibrate slowly and steadily, and if the vibrations are too rapid, the centre of gravity is too low, and it must be raised by screwing up the adjusting ball on the top. If the beam upsets, the centre of gravity is above the centre of motion, and the ball must then be screwed down. When the beam settles horizontally, or to the zero-point of the scale, it must be reversed to see if it will again settle at zero, by which any error in the position of the scale, or the index, is at once detected.

The beam having been made to vibrate slowly and steadily, the scale pans are then to be hung on, and a weight as heavy as the beam will bear is to be placed in each. Additional small weights are to be placed in the pan which is lightest, to bring the beam to the horizontal position. If the beam upsets and will not settle horizontally, the screw point supports are to be turned so as to bring the points lower; but if the beam vibrates too quickly, the points are to be screwed up a little.

By this the points of suspension are brought nearly into a straight line with the centre of motion, but if it is found that the beam vibrates quicker when loaded, than it does when unloaded, it shews that the points of suspension are still a little below the centre, and they must be raised slightly until the vibrations of the beam do not change in rapidity on loading.

The next thing is to equalize the length of the arms of the beam. To do this, the scale pans with the weights in them and stirrups to which they are hooked are removed and changed. The end of the beam which now preponderates is the longest, and the points of that end are to be moved by the adjusting screw nearer to the centre, or what is the same thing, the opposite end of the beam is to be lengthened in the same manner. The beam is then again to be brought to the horizontal position by altering the weights in each pan, and the scale pans are to be shifted again and again, until the horizontal position of the beam is no longer affected by the change.

This is a most tedious and difficult operation; a whole day's incessant work being sometimes necessary.

Should the double points which bear the scale pan stirrup not be exactly equidistant from each other at both ends, the stirrups will not fit if changed; in this case the operation for adjusting the length of the arms must be modified thus:—The beam with the empty scale pans is to be brought horizontal by putting small weights in the pans, and then a one thousand or two thousand grain weight is to be placed in each pan, and if the arms are not equal, the longest will preponderate; the large weights are then to be removed, the length of the arm shortened by the adjusting screw, and the beam with the empty pans again brought to the horizontal position; the large weights are again to be put in, and this is to be repeated until the beam still remains horizontal after the large weights have been added.

The next thing is to equalize the weight of the scale pans, which is to be done by filing carefully a small portion off the one which preponderates, when the empty pans are hung to the beam as adjusted.

The rough adjustment is then complete; all these operations are then to be again repeated, with the utmost care and attention, and in adjusting the rapidity of the vibrations, the ball on the top is to be screwed up to make them slower, and down to increase their rapidity. It is sometimes customary to adjust a beam so as to 'set,' as it is called, by which it is made less sensible when loaded with a small weight, but the sensibility is increased by increasing the load, by which means the effect of the increased friction of a heavier load is counteracted. For this purpose, the beam alone is made to vibrate quickly by making the centre of gravity low, and the scale pans being hung on, the full load which the beam will bear is placed in them, and the vibrations are made as slow as possible by screwing up the points of suspension. When the load is increased beyond the weights used in adjusting, the beam will upset.

Faraday (Chemical Manipulations) remarks, that in weighing, the beam should always be allowed to settle, but with a fine instrument this is impossible, for a 7 inch beam will take nearly half a minute to pass through one vibration, and will not settle under half an hour, or even much more. It is best therefore to estimate the place where it would settle by taking half of the average arc of vibration, which should not be greater than three or four degrees.

The trouble required to perfect the adjustments of a very fine balance is very great, and great skill, nicety, and patience are required to make them satisfactory. Even when finished, they will not remain perfect for three or four days together, one or the other of the arms shewing a slight preponderance, when the trial weights are again put in.

Dr. Ure (Chemical Dictionary) remarks, that the results of weighing, generally given by authors, cannot be depended upon beyond four places of figures, or one 10-thousandth part of the load, from which it is to be inferred that the balances generally used by chemists in England are very indifferent, and with such instruments, a trifling change in the adjustments may make no great difference. The instruments to which my remarks generally refer, and which I am in the practice of using, are more than 60 times more sensible than such as Dr. Ure alludes to. Even the beam which I am in the habit of using in the analysis of minerals to weigh the crucible with the results, for which despatch is necessary to avoid waste of time, gives the 50-thousandth part, or shews 100 of a grain quite distinctly, moving with it though one degree of a 7-inch arm when loaded with 500 grains.

It has been generally allowed, that weights estimated by equipoises at each end of a beam cannot be depended upon, and therefore Borda introduced what is called "weighing by substitution," for which purpose the substance to be weighed is placed in one scale and exactly counterpoised by small shot, &c. in the other. It is then removed, and weights are placed in the scale until the beam is brought to the same position as it had before, by which the weight is obtained independent of any error in the adjustments.

To adjust a balance for this method of weighing, it is unnecessary to make the zero point and the index agree in the same horizontal line, nor is it necessary that the arms of the beam should be exactly of the same length, nor the scale pans exactly the same weight; all that is required, is to make the beam vibrate steadily and slowly, and to ascertain that the points of suspension are nearly in the same line with the centre of motion.

The objection to this mode of weighing is, that it requires a double operation, and as in using a fine balance 10 or 15 minutes are generally necessary, the time lost when several weighings are required becomes of some consequence. To remedy this I have used a modification of Borda's method, which may be called "supplementary weighing." In this method a weight greater than is generally intended to be used is placed in one scale pan and counterpoised by shot, &c. in the other. The weight having been removed, the substance to be weighed is substituted, and the supplement of the weight is made up by adding weights, from which the weight required is easily known by a single operation. The adjustment of the points of suspension to the line of the centre of motion, is a very tiresome operation, as it must be done by screwing up and down the adjusting screws, in which great nicety is necessary, because half a turn of the screws will cause a very considerable alteration, and it is also necessary to take out the beam and remove the scale pans each time that the screws require alteration.

In adjusting a beam for "supplementary weighing," this is avoided altogether by using a heavy adjusting ball and a long screw upon the centre of the beam, instead of the minute one generally used; and the beam when loaded having been made to vibrate slowly by screwing up the points of suspension, the adjustment is readily completed by screwing up the adjusting ball, so as to raise the centre of gravity of the beam until the moment of the force of its gravity becomes as nearly as possible a very little less than the difference of the moments of the forces acting upon the arms.

This is practically a very great convenience, as it is not necessary to remove the beam to make the adjustment, which can be done readily by hand while the beam is in its place.

In the balance, as commonly adjusted, this cannot be done, because the beam would upset when the heavy load was removed, and lightened weights substituted.

As the counterpoise weight for supplementary weighing is constant, I have made use of a further alteration, by applying a fixed counterpoise, or '*bob*' to the end of the beam, so that its centre of gravity occupies the exact place of the point of suspension of the scale pan, by which method one scale pan is sufficient, and there being only two bearings instead of three, the friction which impedes the motion of the beam, and thereby decreases its sensibility, is reduced to two-thirds.

This 'bob balance' I have found practically to answer most satisfactorily, and the only inconvenience is, that the measure of its sensibility is constant, and whether the weight estimated is large or small, yet still the error in the result is always a fraction of the weight to which the beam is adjusted.

Practically this inconvenience is not so great as might be supposed, the substances to be weighed in the investigations of analysis being generally of nearly the same weight as when in the shape of powders or fluids they are generally contained in vessels in which they have been exposed to the action of heat, &c. to prepare them for the correct estimation of their weights.

However, this objection may be in great measure removed by having a number of '*bobs*' of different weights fitted to the beam, which are readily put on, and then a few turns of the adjusting ball gives the requisite slowness to its vibrations, and thus the balance is readily prepared in a few minutes for weighing light substances, or for adjusting weights whenever it becomes necessary.

The beam of an instrument which I have fitted upon this plan, is 13 inches in length. The scale pan-arm being 7 inches long, and the bob-arm 6 inches, and it is 3 inches wide in the centre, tapering off to each end. It is cut out of a plate of steel $\frac{1}{10}$th inch in thickness, and all the central part is removed except a cross support and two circles which strengthen the arms, leaving a very light frame about $\frac{2}{10}$th inch in width. As this would bend a little when held by one end with a ball of 3000 grains weight at the other, the requisite stiffness is given by soldering on to the lower edge a thin steel strap of $\frac{1}{4}$ inch in width. This is effected by cleaning the surfaces to be joined by a solution of sal ammoniac, and tinning them. The strap is then bound on by a number of pieces of twisted brass wires, and some soft solder and resin being applied along the joint, the soldering is neatly effected by heating alternately each portion in the flame of a spirit lamp. On the upper part of the centre a piece of brass is soldered, a thin side of which embraces the frame on each side, a portion of which is left for that purpose, and through this a triangular hole is worked for the central knife-edge bearing piece. The knife-edge is a triangular bar of steel $\frac{1}{2}$ inch in length and $\frac{1}{4}$ inch in the side, which is hardened by being heated to a bright red heat in a crucible filled with charcoal powder, and then removed by a pair of bamboo forceps, which do not injure the edge, and immersing it slowly end-ways in cold water.

It is worked nearly true by the file and polishing on a flat surface of brass with powdered corundrum previous to hardening; after which the charcoal powder having prevented the oxidization, it is tempered in boiling water, and a little further polishing removes any slight bending which may have taken place.

The knife-edge goes loosely into the brass piece, by which it is easily removed when not in use, and can be rolled up in oiled rag to prevent its rusting. When in use, it is fixed in its place by two short projecting arms attached to the central brass piece at the upper edge of the triangular hole. Through these a small screw is worked about $\frac{2}{10}$th inch in diameter, the flat points of which press upon the upper surface of the knife-edge, and bind it down tight in the socket. The screw holes in these arms serve also to receive two pointed screws, which upon occasions, such as adjusting weights, can be used instead of the knife-edge, by which all chance of changing the position of the bearings is obviated.

The points of suspension for the scale pan are the points of two screws $\frac{2}{10}$th inch diameter, about $\frac{1}{2}$ an inch apart, which are carried by a cross piece of brass soldered on to a square projecting piece at the end of the beam. The screws have capstern heads projecting below the brass piece, by which they are turned when adjustment is required; they are hardened and tempered in the same way as the knife-edge, and worked carefully by hand into cones, the sides of which form an angle of 45° with a point as perfect as can be produced. Upon each screw is an octagon-shaped nut, by screwing which up against the bottom of the cross brass bearing piece, the screws are clamped steady and firm, when the adjustments are complete, and any chance of shake prevented.

Into the upper part of the central brass piece, a vertical steel screw $1\frac{1}{2}$ inch long is fixed, upon which turns freely a cross piece of brass 2 inches long, the ends of the arms of which have a screw thread worked upon them, and carry two little balls the size of a large pea, which traverse freely. The whole weight of this adjusting piece is about 100 grains, and by screwing it up on the vertical screw, the centre of gravity of the system is raised, and the vibrations made as slow as requisite, after the adjustment has been roughly made by screwing up the points of suspension. A nut which is loose upon the screw can be screwed down upon the adjusting piece, so as to clamp it tight when the adjustment is complete. The little balls serve to adjust the beam to the horizontal position, by screwing one of them nearer or further from the centre, the adjusting piece being kept parallel with the beam. Two little projecting points of wire on the surface of the balls allow them to be turned by the touch of a pointed piece of wire, without disturbing the motion of the beam.

The *bob* counterpoise is a polished brass ball with a square hole through it, which slips on to a square extremity of the beam about $\frac{3}{10}$th inch square, on which it is firmly fixed by a clamping screw. Of these I use five, different sized, capable of counterpoising 3000, 1800, 900, 500, and 200 grains each, having the central hole adjusted by filing off a portion from the top or bottom of the ball, so as to bring its centre of gravity into the proper position for making the beam vibrate slowly, whatever *bob* may be attached.

The index needle is 2 inches long, and is fixed into a hole drilled in the projecting end of the beam, or to which the cross brass piece is soldered, which bears the scale-pan points.

The weight of the beam with the 3000 grains, bob, and the scale pan is altogether 5,070 grains.

The case is 18½ inches long, 15½ high, and 12 inches wide, with a drawer at the bottom to receive the beam, &c. when not in use. Frames with single plates of glass are fitted into the back and front, that at the back being fixed, while the front one turns upon the pivots at the upper edge, by which it is raised to admit the hand under the lower edge for the management of the instrument, and it can be supported in the raised position by a brass prop on the left side, which catches into a set of pins at different heights as required.

The centre bearing for the knife-edge is a brass pillar, about 9 inches high, which is screwed to the bottom of the case. The summit of this is divided to let in the beam, and is surmounted by two planes of hardened steel, one inch long and ½ an inch wide, which are worked down perfectly level to the same plane by grinding, and four little pieces of brass screwed on to the sides to prevent the knife-edge from slipping off.

The beam is lifted off the centre support when not required by means of two pillar supports, which are fixed to the bottom of the case, and which are hollow and have in them two sliding rods with forked tops which receive the beam, and these are raised by means of a circular nut on the top of the pillar, which works into a double threaded screw cut into the sliding rod.

The vibration scale for the index is fixed by screws to the left side of the case with the zero point as nearly as possible the height of the centre-bearing planes. It is divided into degrees to a 7 inch radius, and includes an arc of 16°.

The scale-pan is borne upon the points of suspension by a brass stirrup, in the flat part of which two holes are cut to allow a flat plate of hardened steel, which is screwed upon the top of the stirrup to rest upon the points. To prevent the points wandering, and causing the stirrup to touch the beam and impede its motion, two shallow holes are worked in the surface of the steel plate of the stirrup, which are just deep enough to keep the points of suspension in the centre, and the holes are very finely polished until a strong lens shews no scratches.

The scale-pan is hooked to an eye at the point of the stirrup, but the strings of the scale-pan are not immediately attached to the hook, but to the edge of a little circular dice $\frac{1}{2}$ an inch in diameter, into the middle of which the hook is screwed. By this the swinging of the scale-pans is in a great measure prevented, and the rotatory motion which is common when the strings are attached to the hook itself, is altogether obviated.

Levelling screws are quite unnecessary, as the indications of the beam are estimated from the point to which it was adjusted.

This instrument when loaded with 3000 grains and adjusted to 24 second vibrations, will give a decided result of a full degree of inclination on the addition of $\frac{1}{100}$th of a grain, as of course for so large a radius $\frac{1}{2}$ a degree is distinctly visible without mistake; it is sensible with rapid vibrations for practical purposes to the 600-thousandth part of the load; when carefully adjusted to 40 second vibrations, it is sensible to nearly three times this quantity. This heavy beam even with the 200-grain counterpoise, will shew the 50 or 60-thousandth part.

For adjusting small weights, &c. I use a second beam exactly similar to the large one, except that it is only $\frac{1}{4}$ inch wide, and weighs without the *bob* only about 500 grains, which with a load of 400 grains, gives a change of angle of inclination of 8° by the addition of $\frac{1}{100}$th grain.

Knife-edges are generally used in the construction of fine balances, because they are less liable to fracture, or to become blunted than points; but they are difficult to make, and are apt to crack and bend in hardening, and after all it is almost impossible to make them quite straight, in consequence of which, if the bearing points become accidentally shifted lengthways upon the knife-edge, the distance of the point of bearing from the centre becomes shifted, and the same happens if the three knife-edge bearings are not exactly parallel.

A good point, on the contrary, is very readily and easily made, so much so, that an amateur workman could finish one very finely in half an hour, and in making the adjustments they are very readily used, and much complication is saved in making the beam; they cause none of the inconveniences and inaccuracies of knife-edges, and the sole objection is, that they are more liable to injury, and are not so strong as a knife-edge. The points are so easily renewed and re-adjusted when injured, that this inconvenience is of little consequence. Even when worked so fine, that when examined by a microscope the extremity of the point is sharper than that of the extremity of a fine needle, yet they last in daily use for a very long time.

In the *bob* balance, the weight of the beam and bob may be considered as one force acting upon the centre of gravity of the system, and the load and scale-pan as another, acting upon the point of suspension. In the case of an equilibrio, we have the equation

A. $\alpha$. sine ($\frac{1}{2}\varepsilon$+inclin=B. $\beta$. sine $\frac{1}{2}\varepsilon$ —inclin.) by expanding the value of the sine of the double arc

A. $\alpha$. (sin $\frac{1}{2}\varepsilon$ cos inclin. + cos $\frac{1}{2}\varepsilon$ sin. inclin.)=
=B. $\beta$. (sin. $\frac{1}{2}\varepsilon$ cos inclin.—cos $\frac{1}{2}\varepsilon$ sin. inclin.)
Dividing by sin $\frac{1}{2}\varepsilon$ cos. inclin.
A. $\alpha$. (1 × cotang $\frac{1}{2}\varepsilon$ tang inclin.)=
=B. $\beta$. (1— cotang $\frac{1}{2}\varepsilon$ tang inclin.)
Multiplying and transposing

$$A.\ \alpha.—B.\ \beta = A.\ \alpha. + B.\ \beta.\ \text{cotang}\ \tfrac{1}{2}\varepsilon\ \text{tang inclin.}$$

Or,

$$\frac{A.\ \alpha.—B.\ \beta.}{A.\ \alpha.+B.\ \beta.}\ \text{cotang inclin} = \text{cotang}\ \tfrac{1}{2}\varepsilon.$$

If the length of the arms is supposed equal, which will be of no consequence in the present case, we may take $\alpha = \beta$ and then the formula becomes

$$\frac{A—B.}{A+B.}\ \text{cotang inclin} = \text{cotang}\ \tfrac{1}{2}\varepsilon$$

If x = the length of the prependicular from the centre of motion upon the line joining A and B and L = the length of the arm.

$$x = L.\ \text{cotang}\ \tfrac{1}{2}\varepsilon = \text{cotan inclin.} + L\,\frac{A—B}{A+B}$$

which is the same as if the whole weight at both ends of the lever combined with the weight of the beam was to be considered as acting on the centre of gravity of the system, in a point close below the centre of motion, so as to keep the system horizontal, and the disturbing weight as acting at the end of the lever to produce the inclination.

Let the whole weight of the load, counterpoise beam, and scale =A+B= 7840 grains.

$A = B = \frac{1}{100}$ grain.

Angle of inclination produced by adding $\frac{1}{100}$th grains =30′ and L=7 inches.

| | | |
|---|---|---|
| 7840. . . . C.Log. | . . . . . . . . . . . . . . . . | 6.105684 |
| $\frac{1}{100}$. . . . . . .Log. | . . . . . . . . . . . . . . . . | 8.——— |
| '7 Inches | . . . . . . . . . . . . . . . . . . | 0.845098 |
| Cotang inches= 0′ | . . . . . . . . . . | 12.059142 |
| Inclin 0.001. | = | 7.009924 |

Whence it appears, that the centre of gravity in the balance above described, is only one-thousandth part of an inch below the centre of motion.

Transposing the formula

$$A\text{-}B = \frac{A + B.x.}{L} \text{ tang. inclination.}$$

and if the angle of inclination is taken at 4° we have

| | |
|---|---|
| 7840. .. .. .. .. | 3.894316 |
| x .. .. .. .. | 7.009924 |
| 7. C.Log. .. .. .. | 9.154902 |
| Tang. 4° .. .. .. | 8.844644 |
| Grains .. 0.08012 = | 8.903786 |

or 0.08 grains are required to produce inclination of 4° when $\frac{1}{100}$ would give 30′, shewing that within any common arc of inclination, equal weights produce equal arcs.

If the points and knife-edge are supposed to have a sensible diameter, the extremities and edge, then by rolling the length of the arm would be decreased by

2. sin. inclin. + radius of the points, with two scale pan suspensions, and the centre of gravity would also be thrown on one side of the new centre of motion by a quantity =

= sin. inclin. + radius of knife-edge; substituting them in the above formula, we get

$$a = \frac{A + B. \text{ sin inclin. } (x + R.)}{(L\text{-}2 \text{ sin inclin. } R). \text{ cos. inclin.}}$$

When the radius of the points and knife-edge is supposed = R = 0.005 inches.

| | |
|---|---|
| L = 7 = .... | 0.845098 |
| Cosin 30′ .... | 9.999983 |
| | 0.845081 = 6.99970000 inclin. |

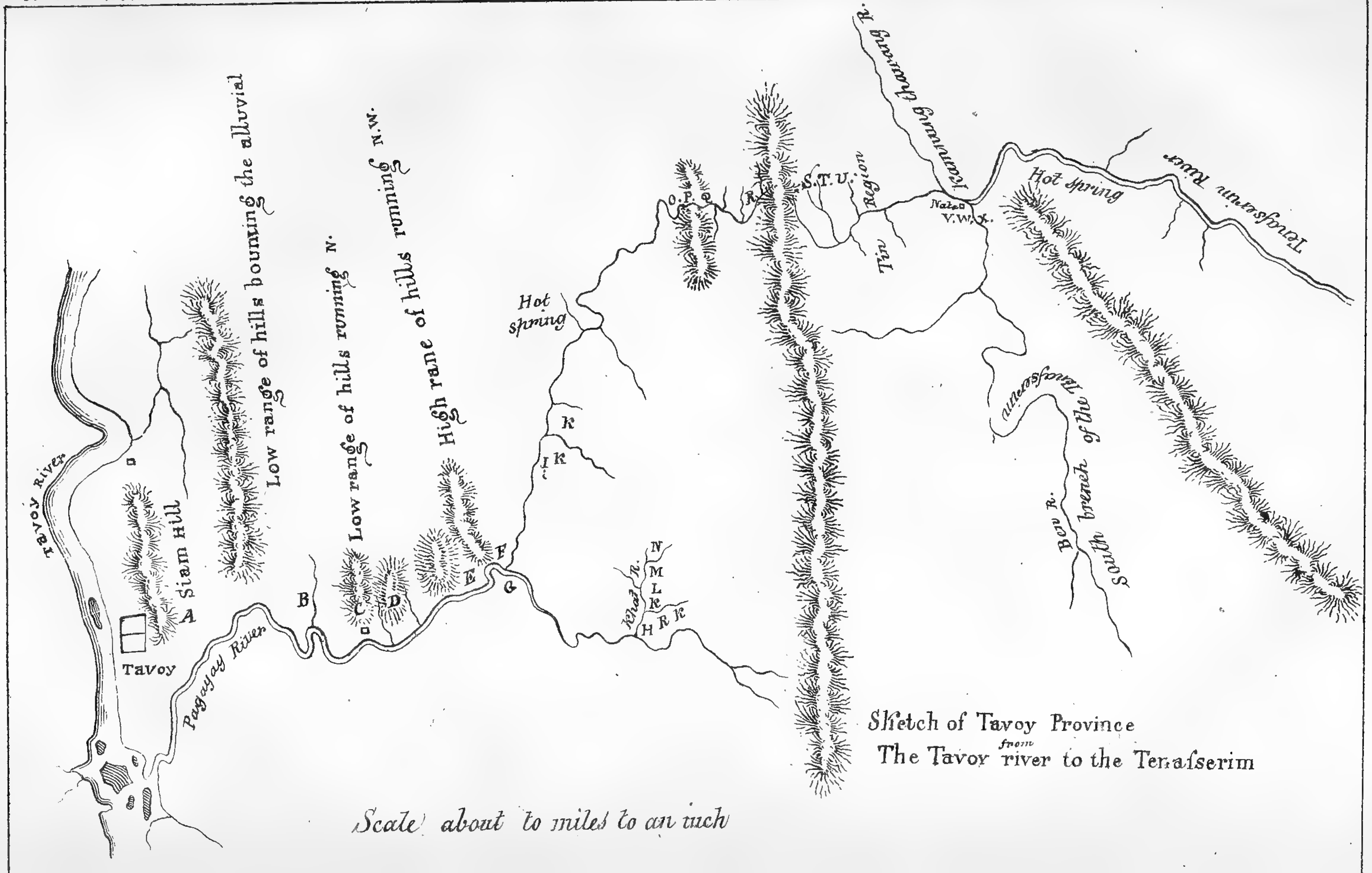
| | | | |
|---|---|---|---|
| 2 ...... | 0.301030 | | |
| Sin 30′ ...... | 7.940842 | | |
| Cos 30′ ...... | 9.999983 | | |
| R = 005...... | 7.998970 | | |
| | 5.940825 = | | 0.00008726 inclin. |
| | 9.000169 = | C.Log. | 6.99961274 inclin. |
| x+R + 001023+.005 | 7.779813 | | |
| Sin 30′ ...... | 7.940842 | | |
| 7840 ...... | 3.894316 | | |
| | 8.615140 = | 0.0412 grains. | |

Or 0.04 grain would be necessary to produce ½ a degree of inclination if the points had a diameter of an hundredth part of an inch, or four times as much as was required by experiment, provided the friction was nothing.

The friction of rolling pivots increases in a very considerable ratio to the diameter, but as we have no data on which to calculate, it cannot be taken into account in the computation; however, it would seem that the diameter of the points does not produce so much effect as might be supposed likely.

A beam fitted up on the bob principle, very roughly finished, as a trial, I have found when loaded with 2,000 grains to be sensible to the five-hundredth part of a grain, or a forty-thousandth part; which would be considered in England as a good balance.

In the balance above described, I have used hard steel bearings, as most easily constructed, but if bearings of agate were substituted it would be much better, as steel bearings require to be freely oiled, or otherwise the friction is very great.




Sketch of Tavoy Province
The Tavoy *from* river to the Tenasserim

Scale about 10 miles to an inch

*Remarks on the Geology of Tavoy.* From a Correspondent.*

An unbroken range of mountains runs parallel with the coast through the whole length of the province, dividing the waters of the Tenasserim from those that fall into the sea and Tavoy river. Its height, east of Tavoy, has been estimated at four thousand feet, but the highest peak which gives rise to the southern branch of the Tenasserim, in about latitude 13° 30′, rises at least a 1000 feet higher, and is called by the Karens "the Great Mountain." Its naked precipices, as seen at the distance of many miles, seem to promise a fine field of observation for the geologist, but its summit is so precipitous, that the Karens say, the top has never been reached. There is good reason to believe, that this range is principally composed of argillaceous slate, or at least slate in some of its forms; for although in no one place where I have crossed it are the strata exposed on both sides, yet in ascending the western side in about latitude 13° 35′, and in descending the eastern side, some thirty or forty miles further north, clay slate of the same variety presents itself on the whole face of the mountain. Adjoining this principal range is sometimes seen an interrupted ridge, which occasionally rises higher than the principal mountains themselves. East of Tavoy, this ridge is composed of gneiss, with a broad dyke of greenstone on its western side. A more irregular chain, consisting of a succession of low ranges of from five to fifteen hundred feet high, leaving a wide hilly valley between, runs nearly parallel with the first, broken by numerous gorges, through which the small rivers that rise in the highest range discharge themselves over rapids or falls; and is the usual boundary of tide waters. This chain, in the latitude of Tavoy, appears to be formed of primitive slate, but after passing the basin of Young-byouk river, thirty or forty miles to the south, the slate strata are left in the interior, and that

* Plate X.

which seems to be its continuation down the coast is a different formation; being wholly composed where I have crossed it, of gneiss, with red sandstone on its western side near the base. That this is the old red is probable from other considerations besides its relative position, for where the range is continued down within the limits of Mergui, its summit in one location is said to be covered with tracks of various animals in the rock,* and "similar forms," says Mr. Murchison, "are found in numberless portions of the old red sandstone, imitating in their outline horse-shoes, rings, almonds, &c."

In the intervening valley are seen several different strata of slate rocks, and occasionally isolated masses of mural limestone, rising in one instance at least several hundred feet high, and abounding in cylindrical pits of a few feet in diameter, but of an unknown depth; resembling wells sunk in the rocks by art. They probably correspond to the cavities existing in the limestone of Wales, which Murchison says, "taper downwards to depths of 30 or 40 feet, and apparently terminate in vertical tubes. As they occur at or near points of the greatest dislocation of the strata, may we not be allowed to speculate upon their having formerly been the spiracles by which certain gases were evolved, during those periods when earthquakes produced the adjoining elevations and depressions of the strata." Tin is found at different points throughout the whole length of this valley, but usually on its eastern border, and in no great quantities; though I have seen traces of former works one or two days travel above Kaleoung, as well as on Talaing-yurva river, some twenty miles north of Tavoy, and the natives say it is found at Young-byouk, and at the head waters of Palouk river, which is within the juris-

* These marks are produced probably by decomposition and weathering of the surface. The conjecture regarding the nature of the rock is probably correct. Its relative position on the one side to primitive rocks, and on the other to slate clay containing impressions of coal plants are in favour of the accuracy of the author's view.—Ed.

diction of the Mergui authorities. Here too are located all the hot springs that are found in the eastern section of the province; and all, it is worthy of remark, are on a north and south line, nearly or quite parallel with the slate strata; and those that have fallen under my observation have slate on the west, and gneiss on the east, excepting one at Pai, which gurgles up among the gneiss rocks themselves, with a heat of 198° of Fahrenheit, only 14° below boiling water; a degree of heat not usual it is believed, for hot springs out of volcanic countries. All that I have seen, seem to possess precisely similar properties. They are wholly free from any sulphureous smell, and although on the stones near the springs an efflorescence resembling sulphate of magnesia is often found, no one of the medical officers to whom I have furnished the water, ever succeeded in detecting any mineral in solution; and as its specific gravity differs very little, I believe, from pure water, there cannot be much to detect. There are however in the Tenasserim valley hot springs of a different character; indicating by their odour, sulphuretted hydrogen gas.

The region west of this last range is occupied by the Deltas of rivers, and what Dr. Helfer denominates, "the plains between Tavoy and Palow," and which he says, "belong to the tertiary formation." In some parts of the region, as at the mouth of Tavoy river, the sea coast is bounded by piles of granite, abounding in large rectangular masses of feldspar. In this section, a few miles east of the old town of Palow, is a large hill wholly composed of shells, with a covering of earth just sufficient to support a thick vegetation; and which appear to belong to existing species, consisting principally of large oyster shells.*

East of the great dividing ridge is the principal tin region. "Tin," says Dr. Helfer, "occurs on the foot of the great range running from north to south, on its eastern side in

* Specimens as perfect as possible of these shells would be highly interesting.—Ed.

stream works. It is found in the debris of primitive rocks, and the soil in which they are buried yields seven feet."* It is rather remarkable, that the richest deposit of this stream tin is, according to native testimony on the summit of a high hill in the centre of the district; and inasmuch as stream tin in Cornwall is connected with rich veins of the ore in slate rocks, we are warranted to indulge sanguine expectations of finding veins in these slate mountains, throwing as they do, their shadows over the stream works. That tin does occur in veins in this country, I cannot doubt, for the Karens have repeatedly told me that tin in Siam is found in large masses; but they represent the locality as in a more southern latitude. Gold, in small quantities, is also found with the tin, both here and near the head waters of Tavoy river. East of the tin region are the tertiary lands, which Dr. Helfer calls "the elevated land of Natamis," at the forks of the Tenasserim. Lignite has been found a few miles north of Mata, which on analysis, gave more than 60 per cent. of carbon, with upwards of 30 per cent. of volatile matter.† Going south two or three days journey, the river runs through high hills, which sometimes come down to the water's edge. In passing down several years ago, I noticed slate rocks dipping to the south west in an angle of more than forty-five degrees, succeeded by pudding-stone or breccia, with here and there solitary masses of limestone, some specimens of which were pronounced marble. On the third or fourth days journey, the rapids and falls cease, the hills recede from the river, and the strata in the banks that had been nearly perpendicular, become as nearly horizontal. Here the natives tell me alum is found, and here commences the sappan wood forests, and I am not sure but with this extensive basin they end; still,

* Query, to a depth of —? Ed.

† In the interstices of some of the specimens before me, I find sulphate of iron, or copperas, from the spontaneous decomposition of the iron pyrites with which they abound.

as the trees never come down to the river, I cannot speak positively on this point.

The accompanying specimens* exhibit the geological features of the country between the Tavoy and Tenasserim rivers, as they are seen in travelling from Tavoy to Mata.

Tavoy stands on an extensive alluvial bottom of so recent a formation, that where the river has washed away its banks, the remains of imbedded fallen trees may be sometimes seen jutting out several feet below the surface. In digging wells twenty or thirty feet deep at Tavoy, a stratum of sand studded with pebbles of white quartz is usually reached. Proceeding east, a mile or more from the river, we reach Siam hill, which stands like an island in the paddy fields, half a mile in width by four or five in length; the lower strata that I have observed in wells near its southern extremity, resemble those of the alluvial plain, as exhibited above in the Tavoy wells, and where its northern point is washed by the river at the village of Hsen-hseik, (handsome country,) the sloping bank is strewn with boulders of white quartz, while the precipitous descent on the eastern side, above the village of Koy-man (broken point,) exhibits masses of which A and A A are specimens. Passing across the paddy fields eastward, we reach Pga-than-khyoung, (snowfish brook,) where from a ledge of rocks that cross the stream below high water mark, the specimens marked B were taken. To rocks on the surface of a small hill east of the village of Pyen-doung, (Sagerstrœmia hill), the specimen C belongs; while D and D D were dug out of a low hill near its base, east of Thabya-khyoung, (muscle brook). At the fords of Pagayay river, a ledge of rocks is seen below high water mark, from which the specimen E was taken. The one marked *d e* is from a ridge of hills some fifteen or twenty miles to the north, whose line of direction seems to me to fall somewhere between D and E.

* See list at the end of the paper; the specimens enumerated correspond with the letters on the map and in following description.—Ed.

As it was broken from a precipice close to greenstone, it may possibly have suffered some change from coming in contact with that igneous rock, and may not be a good specimen of the formation to which it belongs. A little above the fords at E, a precipitous hill comes down to the river, which shews a perpendicular point of fifty or a hundred feet of slate, similar to the specimen marked F; south-east of this locality, the specimen G was taken from the banks of the river near the water's edge. Passing on to Khat brook, we meet with the strata of which H is a specimen; and returning to the northern branch of Pagayay river, where the stream passes between high rocky banks, at the water's edge the specimen I was taken, and fifty feet above that the one marked *i*. The strata of which K is a specimen appears to be of considerable extent, and in Khat brook the same rock shews itself somewhat modified, of which *k* affords a specimen. The one marked *k k* is from a locality a short distance south of *k*, on Dá-thway-khyoung, (knife-whetting brook). Those labelled L, M, and N, are specimens of the rocks that shew themselves on proceeding up the stream, at intervals of half a mile more or less; while *l* is from the banks of Young-byouk river, some twenty or thirty miles south of L in the direction of the strata, and apparently the same rocks. The specimen *k l* again is from the hills south of *l* a few miles, and appears to belong to the same series. Returning once more to Pagayay river, the rocks that next shew themselves are represented by O, P, and Q, which follow each other in quick succession, on a lofty precipitous hill. On approaching the main range of mountains, the rock of which R is the representative, shews itself. The descent on the eastern side exhibits rocks from which the specimens S, T, and U, were taken; the mountain appearing to be principally composed of the one represented by S, and thirty or forty miles south of this locality the west side of this same range is formed of a precisely similar rock. Those marked V, W, and X, are from the horizontal strata beneath Mata, at the water's edge;* while Y and Z are specimens of the petrified wood and lignite, discovered by Mr. Wade, half a day's journey up the northern branch of the Tenasserim; and finally *a* is a specimen of the rocks on the banks of the river in that direction.

The above specimens are by no means offered as a complete exhibition of all the rocks in the region they embrace, but merely all that I have noticed without paying much attention to the subject, the collection having been made for my own amusement only. Still they certainly include the most prominent ones, and geology has made such progress, that a skilful geologist will often be able to supply the missing numbers of a series, and from an imperfect set of specimens, form a correct judgment of the mineral or minerals existing in the region from which they were taken. I am desirous therefore to have these specimens examined by some good geologist, and hear his opinion on them severally. I make no pretensions to geology myself, yet the specimens marked V, W, X, indicate I think coal; and if *f* be graphic slate, it points to authorities in connection with it, while the clay slate *s*, bounding the stream tin region, gives fair promise it seems to me of veins of that ore. I have no inclination to doubt Dr. Helfer's scientific acquirements, but he went so hastily over the ground, that the general views which he gives of the geology of the coast, are but little applicable to this province. He says, "a great portion of the surface of the interior is composed of primitive rocks, chiefly a granite, *great parts* of mountains running parallel from north to south, through the peninsula are *granite of gneiss;*" yet I see nothing in the interior that makes any approach to granite, except the rocks from which the specimen O and Q were taken, and those I suppose, he would call gneiss; and

* These are characteristic rocks of the coal formation. A little further examination at Mata will probably be attended with the discovery of coal, if not already found there.—Ed.

gneiss forms but a small portion of the "mountains running from north to south," as the specimens prove. Slate is manifestly the prevailing rock, and Professor Phillip says, "most of the productive tin lodes (veins) have been found in a slaty country." When the tin veins are discovered, copper will perhaps be found associated with them, for with tin and a little gold as here, Cornwall also produces copper, and Dr. Helfer met with ores of copper on some of the Mergui islands, which may be considered a part of the tin field, stretching as it does down to Malacca. To me it seems probable, that Tavoy is rich in hidden treasures—now all is in a state of nature; there have been no excavations, no borings, no adequate survey of the field; so that our golden sands, and metallic soil, and slaty mountain peaks, are all that can be rationally expected, for veins of tin are never seen on the surface.

When the Romans first landed in Britain, the tin resources of Cornwall were probably as little known as those of Tavoy are at the present moment; for, although the Phenicians are said to have early obtained that metal from England, it was probably in small quantities from the stream works, inasmuch as Diodorus Siculus, who lived in the days of Julius Cæsar, makes no mention of tin, though he is careful to speak of iron among its productions, together with gold and silver, slaves, and *hunting dogs*, (κυγαρ κυνγγετικους.)

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*List of Specimens, referred to in the foregoing Paper.**

A. Sandstone like B, but coarse.

B. Sandstone, (old.)

* These specimens are interesting not only as illustrative of the above valuable observations, but as the first collection of the kind from the same quarter that appears to have been made with the requisite care. They are therefore deposited in the Coal Committee's cabinet, as they seem to bear upon the object of the Committee's inquiries. The relative position of the sandstone to the slate rocks on the one side and the coal formation on the other, its development and peculiarities in Tavoy and other Tenasserim Provinces, would be an interesting object of inquiry.—Ed.

C. Clay stone porphyry.
D. Chlorite slate; D D weathered specimen.
E. Sandstone with veins of quartz.
F. Chlorite slate.
G. A finely laminated mica slate.
H. Ditto, coarsely laminated with layers of clay slate.
I. Sandstone, (old,) variegated white and brown.
K. Clay slate, dark blue, uniformly mottled on the cleavage with dull specks of mica; (k) soils and writes.
L. Ditto, with layers of mica slate.
M. Dark brown quartz rock.
N. Indurated clay slate.
O. Granite.
P. Dark grey quartz rock.
Q. Granite.
R. Indurated clay slate.
S. Ditto.
T. Ditto.
U. Ditto, passing into impure quartz.
V. Indurated slate clay, with impressions of plants.
W. Ditto, with the plants converted into carbonaceous matter, presenting the appearance of plants of the coal formation.
X. Ditto, with ferruginous nodules.
Z. Stems of monocotolendonous plants.
de. Old blue clay slate.
a. Calcareous grit, bluish grey.

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## *Refuting the first Revolution of the Mosaic Geologists; and the doctrine that the Land and Sea changed places during the Deluge. By Capt.* THOMAS HUTTON, *Bengal Army.*

*Introduction.*—There are many persons who firmly relying upon the Bible as the Book of Truth, yet unaccountably persist requiring a system of geology drawn solely from the appearances of strata, and totally unconnected with theology.

If, say they, such a system could be produced, and then be found to tally with the outline of events as given in the history of Creation, we should no longer doubt the correctness of such a system; but we cannot allow a mere assumption that the Bible is correct, to be the basis of any theory of the earth. Separate theology from geology, and then if your system be rational, and agrees with the statements of the Jewish lawgiver, we will deem your theory based on just grounds, and entitled to consideration.

But if then, rejecting the Bible as the book of truth, we proceed to build up a system of geology from the appearances and phenomena of the earth's strata, and collating it with the books of Moses, pronounce it to agree with what we there find recorded; how do we prove one iota more distinctly, the truth of this our system, than, if starting "*ab initio*," with the conviction of the Bible's truth; and taking it for our base and guide, we yet produce a system that is found to corroborate the statements therein contained and prove them to be correct?

In both cases we have arrived at *the same conclusion*, though by different roads; so that it would appear to be far more reasonable to start at once in our inquiry on grounds that were considered to be true, rather than to plunge headlong into darkness, and endeavour to grope our way blindly and with difficulty to the light of truth, which after all our anxiety and labour, merely leads us *back* to the point *from whence our adversary started.*

As the present essay on the theory of the earth is put forth, founded on the History of Creation as a basis, it will be necessary before entering upon the subject to meet these objections, and to endeavour to prove the thorough impossibility of ever producing any sound and permanent system of geology, which is not fundamentally and inseparably connected with theology.

There are two classes of men to whom the geologist addresses his discourse; the first is composed of those who believe the Bible to be the word of God; and the second, of those who disregard it, or deny its truth.

To the last of these it would almost be in vain to shew the connexion of geology with Him, of whose existence they are more than sceptical, and therefore to the first more especially I venture to address myself.

Does it not then appear strange, I had almost said ridiculous, that he who professes to believe, from the bottom of his soul, that the Bible is the word of God, the very essence of truth, should yet hesitate to adopt it as the base on which to build up a system of geology?

Believing, as he says, that book to be correct, is it not rather the very base of all others to be desired and selected?

Yet he tells you, that in choosing a basis for your theory from the passages in that book, you are starting on *assumptions,* which in geology are inadmissible. He tells you indeed, that you *are wrong in assuming truth to be truth;* without perceiving that, *that which is true, is no longer an assumption, but a positive fact!*

How is this contradiction to be understood?

If he believe the Bible to be true, surely in selecting it for the foundation of geology it is no longer an assumption, but *the adoption of fact,* of truth itself, for his basis?

Ask the believer, "Who made heaven and earth?" His answer will be "God."

"Who caused the different hills and strata of the earth to assume their present appearances, and to contain the phenomena which astonish and delight us?"

It is obvious that his answer will still be "God." How then? If God be He who formed the earth, and disposed by his laws the strata as we find them, can we separate the created from the Creator; can we separate the maker from his works?

And if we cannot, then how is geology, the offspring of God's will, to be separated from *its origin,* which is God himself?

The geologist, if he thus believe, will find, *must* ever find, that the closest and the strictest search and inquiry into the strata and phenomena of the earth, will lead him step by step through every difficulty and series of formations, to trace out the author of the whole; until he will at length arrive at that far distant and primitive epoch, when God first gave laws to matter, and thus gave origin to geology.

Thus will he again be led to see, and haply likewise to acknowledge, the inseparability of geology and theology. For it must be at once apparent to a believer that if the statements of the Bible are correct, the climates and condition of our earth must have undergone great changes for the worse since the epoch of creation; and great disturbances and dislocations of strata must inevitably have been the consequences of the great geological revolutions which are recorded by the historian. Now as we are instructed that those general revolutions were brought about *for moral purposes*, by the Divine will, namely as a punishment to the crimes and depravity of the human race, and likewise to serve as a warning for the future, it is evident that they must hold an important place in the history of God's dispensations to mankind, and consequently that they come fairly and properly within the province of theology.

Therefore as the *moral effects* were to be produced by *geological revolutions*, and as both emanated from the will of the Controller of events, we are clearly led to perceive a strong and close connection between geology and theology, inasmuch as the general revolutions of the one, have both been the consequence of an *express exertion* of Divine power on account of the sins of mankind, the discussion of which falls properly within the sphere of the other.

But the case is not much altered even in respect to those who disbelieve the Bible; for they will build their system solely on the appearances which *the strata* of the earth present, and theorise until they lose themselves in the lapse of ages; yet still even they, with all their waste of years, must nevertheless acknowledge that there was once a time when matter had its origin, and although they may hesitate to refer that origin to Him whom the believer terms his God, they nevertheless are compelled to admit, that the matter and its regulating laws must both have emanated from a great First Cause.

Let them then carry back that origin far as they list, even for incalculable numbers of years and ages, still all must spring from a beginning, and call that beginning by whatsoever name they will, it will but resolve itself into *the One, Almighty God, Creator of the Universe.*

Thus they but carry back creation to many thousand years beyond the time accepted by the true believer as taught him in the books of Moses; but they fail to disprove, nay, they even prove, spite of their unbelief, the connection of geology and theology; for they shew that *God created earth,* and therefore that *He is the origin, the very fountain head of all geology.*

*Part* 1.—Geologists may be divided into two sects or classes; one advocating what is termed the mineral, and the other the Mosaic geology.

The distinguishing feature of these two systems is, that the mineral geology founds its theories and doctrines solely on the appearances and phenomena which the strata of the earth exhibit; and erroneously supposing that the Mosaic record furnishes no causes by which such phenomena could have been produced, it at once proceeds on its inquiries regardless of that narrative, and boldly advances its own speculations in its stead.

It can scarcely be necessary to point out to any right-minded person, that as the doctrines which these theorists set forth, are not only unsupported by the testimony of the Scriptures, but actually in many respects directly opposed to them, they must therefore of necessity be falsely based, and consequently untenable. It is in vain that its able and learned advocates assert that their doctrines are not only not opposed to Holy Writ, but actually display in a greater degree the goodness and wisdom of the Creator; for the point is simply enough decided by an answer to the following question: "Do their doctrines and theories agree with the statements of Holy Writ?" The answer is clearly in the negative; for whereas Moses teaches us that the operations of the first creative period were completed in the space of six days; the mineral geology takes upon itself to declare that thousands of thousands of years were necessary to effect the same ends.

And why does it do so? Solely because finding the exuviæ of particular animals apparently confined to particular consecutive strata, it immediately concludes that successive and frequent revolutions at long intervals must have been the agents from which such phenomena were derived. Moreover, although the Scripture teaches that man was contemporaneous with the animals and vegetables of the period prior to the Fall, and that those animals received their generic names from him, the mineralists have declared that he was not an inhabitant of our earth until posterior to the deposition of the chalk, by which time, as we shall presently see, the two scriptural revolutions had been fulfilled, and multitudes of animals and plants had become extinct.

The erroneousness of such doctrines will be more apparent as we proceed with the history of the changes which have taken place upon the surface of the earth.

On the other hand, the Mosaic geologists, as the term implies, are strenuous advocates for a close adherence to the outline furnished by the sacred historian; but although they have wisely seized upon the only sure ground on which a geological system can be based, they have nevertheless unfortunately been the means, in a great measure, of retarding a knowledge of the truth, and thereby adding strength to the position of their opponents, by the unaccountable contradictions and misapplications of the Scripture into which their misguided zeal, and desire to overthrow the theories of the rival sect, have betrayed them.

The mineral geologist cannot strictly adhere to the Mosaic narrative, because, as he avers, he finds no revolution mentioned, by which he could satisfactorily account for the numerous fossil exuviæ of marine animals which are imbedded in a series of strata, to the deposition of which he justly declares the Deluge could undoubtedly have been in no wise instrumental, namely, in the secondary formations. Not perceiving the period when these animals became extinct, although clearly mentioned in the Bible; and finding the first revolution of geologists to be totally insufficient to account for such phenomena, the mineral geologist at once decides that other revolutions must have taken place, and he therefore proceeds to build up a theory according to his own ingenuity and fancy.

The Mosaic geologist being likewise culpably blind to the true period of the first revolution, as assigned by the sacred historian, most unaccountably and unjustifiably persists in referring it to the events of *the third creative day*, that is, to the separation of land and sea, and then immediately proceeds to contradict himself, and upset his own theory, by referring to that *miscalled* revolution, the formation of coal, which he acknowledges to be *a vegetable deposit*, although the very record which he is advocating, distinctly declares to him that the separation of land and sea was completed *before the vegetable world was called into existence.** From this false position he is again led into error with regard to the fossil exuviæ of the secondary strata, because insisting that Moses allows but of two revolutions, he is necessarily constrained to refer the exuviæ of all animals both of the secondary and tertiary deposits to the one catastrophe of the Deluge, which is clearly inadequate to the production of both these forma-

* See passim "Penn's Comparative Estimates of Mineral and Mósaical Geology," and "Fairholme's Scripture Geology."

tions, differing so widely as they do, both in their imbedded fossils and in their structure.

Thus the false position taken up by the Mosaic geologists may be said in a certain degree to give colour to, and warrant, the still worse doctrines of the mineralists; for if they who advocate the scriptural outline of events, thus by their contradictions overthrow their own theories, no wonder that the opposite sect should reject them, and seek for other causes to explain the phenomena of the earth's strata.

But although the foregoing views of the Mosaic geologists are thus seen to be entirely founded in error, yet it must not be forgotten that in many other respects they are decidedly correct, and especially so in declaring that no system of geology which is not strictly and reasonably founded on the Mosaic records, will eventually stand.

Truth will prevail as our knowledge of the subject advances to maturity, and the discoveries of science will prove that the phenomena presented to our view in the various strata of the earth, are all such as may be clearly and reasonably accounted for in the doctrines of Holy Writ.

Let us therefore now proceed in the first place to disprove what appear to be the erroneous views of either sect, and then endeavour to build up a more orthodox theory founded upon the statements contained in the Mosaic writings, and supported by the strong collateral testimony of geological phenomena.

"During a long time," says Cuvier, "two events or epochs only,—the Creation and the Deluge, were admitted as comprehending the changes which have been operated upon the globe."* These, as we have already seen, are the revolutions contended for by the Mosaic geologists, but which Cuvier justly thinks are insufficient, although he has erroneously and arbitrarily pronounced them to "have been numerous."

* Jameson's Cuvier's Theory of the Earth, p. 38.

Nor is it surprising that he should have deemed them inadequate to account for these "changes," since the first of those periods was no revolution at all, but occurred before the vegetable and animal races, whose remains constitute the chief phenomena of our strata, were created, and therefore it could have been in no wise instrumental either to their destruction or deposition. It is evident moreover that this first (so called) revolution could in reality be *no revolution, but a creation.* A revolution implies the overthrow or upsetting of an already established order of things, while here in this first period, we know that there was no overthrow, but an originating or setting in order, of things which *had not yet existed ;* therefore it was a creation or calling into existence an order or system of things which subsequently, as we shall see, were overthrown through the disobedience of created beings. The separation therefore of the land and sea, by which our earth was first called to light, can be looked upon only as a *creation of dry land* which had not heretofore existed; and such indeed it is considered by the sacred historian, for he tells us that in the beginning the materials from which our land was to be formed were called into being, and that *on the third day of creation* (a period evidently remote from the beginning) the interim having been occupied in perfecting other arrangements, all tending towards its welfare, the earth was separated from the waters, and the *existence of the dry land commenced.*

True the record mentions two, and *only two* distinct general revolutions, but the Mosaic, equally with the mineral geologist, has disregarded and passed over the first of them, which occurred not during, but *subsequent to the creation, when man first transgressed the commandment of his Maker.*

Thus it would appear that geologists are right in referring the fossil exuviæ of the secondary strata to a revolution long prior to that of the Deluge, and they have only erred in not assigning to it the actual period pointed out by the record.

The second revolution, or Deluge, is too clearly marked, and its consequence too obvious, to escape the notice of any one; but the historian enters into no details of the means by which the first was effected, although he clearly points out *the effects of it.* This difference in the seeming importance of the two revolutions may have arisen from the fact, that the first did not, like the second, involve the loss of life to the human race, and therefore the record is content to point it out merely by its effects, leaving us at liberty to infer the causes. Or it may even be probable that Moses himself was ignorant of the operations and means by which the facts he recorded were produced, nor was it at all necessary for the fulfilment of his task that he should be made acquainted with more than the effects; for his only object was to lead his people, and through them other nations, to look to the Almighty, as the universal and sole creator of all things, and the dispenser of every blessing they enjoyed; and moreover "it should be borne in mind," as Professor Buckland has well observed, "that the object of the Mosaic account was not to state *in what manner*, but *by whom* the world was made."*

In insisting, however, upon the two Mosaic revolutions as the *only* ones which our earth has experienced, it is merely necessary to shew that they are the *only general,* or *universal convulsions* which have occurred since the creation, and that they have been expressly produced by the immediate and supernatural exertion of the Creative Power for particular purposes, namely, for *the punishment of man's transgressions;* but while insisting upon this, we must not deny the probability that *natural phenomena* existed quite as much in those days as they do now; that is to say, that mineral causes would have produced volcanic outbursts and dislocations of strata as frequently in the former ages of the earth as at present. We may even venture to affirm, that they were

* Bridgewater Treatises, p. 33.

both more violent and more numerous formerly than in the present day, as is clearly perceptible from the many extinct volcanic craters of Central France, and from the dislocations of strata in various formations.

But it will be at once apparent, that such outbursts of volcanic matter would have been no more *general* formerly than now, and they would have formed mere local phenomena affecting a limited tract, as is shewn in the many local disturbances in the strata of our own country.* While insisting, therefore, that there have been but two great or general supernatural revolutions which have extended over the whole globe, it is by no means contrary to Scripture doctrines to declare likewise, that local disturbances from the operation of natural laws "*have been numerous*;" and to this extent therefore the declaration of Cuvier may be true, although certainly not in the general sense in which he made it.

The views which Mr. Penn entertains of the formation of coal, tend better than any thing else that can be urged, to upset the period of this falsely called first revolution of the Mosaic geologists, and I shall accordingly make use of this author's own statements, in order the better to expose the error into which he has incautiously betrayed himself.

He tells us, "that Mr. D'Aubuisson entertains a philosophical doubt, whether this substance ought to be classed with *intermediate*, or with *secondary* formations; and he therefore leaves the point undecided."

That Mr. Hatchett declares his opinions to be, "that coal is a *vegetable* substance, consisting of *vegetable accumulations*, mineralized under vast strata of the earth."† Now since "all naturalists are agreed in this one point, that our *present continents* were heretofore the *bed of the sea;*

* See "Murchison's Silurian System" passim.

† Comp. Est. p. 382.

since beds of coals are found to lie in *concavities* varying greatly in extent, from a few to many miles, and containing numerous strata of coal alternating with *sandstone, clay,* &c. which afford a formation analogous to an ancient sea-bed; since *marine* substances are found in the *adjoining* strata; and since numerous sea shells, and even bones of marine animals are found in *imperfect coal,* as in that of Pomiers in Dauphiny, although none remain recognizable in *perfect coal;* a strong argument of *probability* seems to arise, that if the substance of coal is of *vegetable* origin, we are to seek for that origin in *marine vegetation,* and not in *terrestrial;* that the beds of coals, in their extensive *concavities,* were perhaps immense accumulations of *fuci,* &c. loaded with the various animal substances which shelter among them; and which were overwhelmed by vast aggerations of the loose soils of the sea in the course of its retreat, and were left for decomposition by the chemical action of the *marine fluid* which they contained, and with which the *enclosing and compressing soils were saturated.*"

"And this," he continues, "may guide us to a final explanation of the phenomena which caused M. D'Aubuisson to doubt whether he ought to connect *coal with intermediate,* or with *secondary* formations; in the statement of which doubt, he approximates so nearly to the Mosaical geology. The *intermediate class* (he observes with Werner) pertains to an *epoch* when a *revolution* took place in nature, which, according to the evidence of the numerous indications which we see, was perhaps the *most violent* of those that happened during the formation of the mineral crust of the globe. There is, indeed, great uncertainty in fixing the limits between this class and those which adjoin it; but I think that they will be assigned with sufficient exactness, if we say that the *intermediate class* is composed of the same rocks as the *primitive,* but alternating with some others containing relics of organic beings, and a particular sandstone. We may perhaps farther say, that the *intermediate soils* are those which succeed in the order of time, from *coal beds* to the first appearance of *organised beings.* I purposely avoid affirming, in this definition whether or not the *coal* appertains to the intermediate class." But if *coal* be *marine vegetation,* originally produced in a *bed,* which must have been of the *earliest intermediate formation,* since it was formed by the *first disruption and depression of primitive formations,* according to the Mosaical geology; then it will naturally be found at *the point* at which the definition of M. D'Aubuisson supposes.*

Now were not the elucidation of the several changes which have occurred on our earth a matter too serious to be trifled with, we might almost feel inclined to smile at the absurdity which is involved in these contradictory statements of one, who in his anxiety to upset the theories of what by way of distinction he has termed the "mineral geology," has rushed blindfold as it were into errors, which not only completely overthrow *his own views,* but might even, in the minds of many, bring discredit upon that record which he professes to uphold.

Thus, if his first miscalled revolution is to be dated from the period when land and sea were first separated, which separation he tells us was caused by the deepening or disruption of a portion of the earth, in order to form a bed for the reception of the waters; we at once and without difficulty perceive, that *it was completed before that vegetation from which he derives his coal was called into existence,* and consequently that it could have been *in no wise instrumental to the deposition of that which actually did not exist.* He has himself recorded in a subsequent chapter, the following words, namely, "*that this first revolution took place before the existence, that is, before the creation of any organised beings.*"†

* Penn's "Comparative Estimate of the Mosaical and Mineral Geologies," p. 385, et seq.

† Comp. Estimate, p. 413.

How then he can refer the deposition of vegetable or organised matter to that revolution is indeed truly astonishing, and the more so, since in his detail of the events which occupied the third creative day, he clearly shews us that the vegetation was called into existence after the convulsion which disclosed the earth to view was accomplished and past. "The mineral materials which retained their primitive order and position in the undisturbed *dry land,* were here fractured, severed, and dispersed, or in various ways disturbed; and the soils which had at first rested on their rocky bases, were necessarily displaced by the rupture of those bases, and being precipitated into the new profundity together with the innumerable fragments of the broken webs, formed the shiny or the shingly bottom of the new sea. *On that bottom, and in all the varieties of its parts,* whether in its lowest depths, or upon the submerged masses which lay upon it, marine matter of every kind, *vegetable* and animal, *was produced* in abundance, with the power of perpetual reproduction; and it continued to increase in quantity, in a multiple ratio, during many ages."*

Thus he has throughout his argument most completely contradicted and destroyed the theory he was labouring to establish, and he compels himself therefore, either to relinquish the period which he has assigned to his first revolution, or that of his coal deposits; for if he maintains the former, it is evident that it could not have contributed to the latter; or if he maintains the latter, then must it have been effected by another convulsion than that of the separation of land and sea, and consequently it involves a multiplicity of revolutions, which he has already argued to prove inconsistent with the doctrines of the Mosaic record.

It is moreover evident, that the marine vegetation from which he would derive his coal, must, according to his views have been in existence previous to "the first disruption and

* Ibid, p. 217.

depression of the primitive formations," by which the separation of land and sea was effected, or that revolution could not have deposited it.

This, however, not only finds a decided contradiction in the Mosaic record, but had it been as Mr. Penn states, we should naturally seek the coal, not as he would have us believe, amidst the "earliest intermediate formations," but actually in the primary rocks themselves; for it must be borne in mind, that at the time alluded to, no other rocks were in existence, and the disruption which caused the separation of land and sea, would therefore have buried the vegetation, had any such existed, beneath the debris of primary rocks alone; so that they would have been enclosed between the basal primary rocks, and an overlying primary conglomerate, a circumstance which we know full well is not the case,—the coal lying invariably amidst strata that have been deposited from the bosom of deep and tranquil waters; and widely separated from the true primary rocks by the whole of the old red sandstone and silurian systems.

But we shall presently perceive the reasons why Mr. Penn is so anxious to establish a marine origin for the substance of coal, an origin however which is now satisfactorily disproved, for the phenomena of the enclosing strata have thoroughly established the fact that the coal has been produced, not from marine, but from terrestrial vegetation of a tropical and fern-like character.

It therefore follows that the causes which tended to accumulate and mineralise this vegetable substance, must have been in operation subsequent not only to the separation of land and sea, and to the existence of dry land, but likewise to the furnishing of that dry land with a varied and luxuriant vegetation.

Thus we perceive that every fact is opposed to the theory of the Mosaic geologist, and consequently that his arguments to establish the third creative day, as the first geological revolution are at once completely overthrown and refuted.

*Part 2d.*—The occurrence of the secondary strata over a great portion of the countries of the known world, imbedding numbers of marine shells, sometimes in such profusion as nearly to form the sole constituent of the rocks in which they occur, has given rise to the opinion that the sea must formerly have stood for a long term of years over the continents of the present earth, until at length by some severe convulsion or revolution, the bottom or bed of that sea was raised to form the existing dry land, while the former land in consequence, became the bottom of the present sea.

It has been asserted, moreover, that proof of such an occurrence exists in the records of the Scriptures, wherein it is declared, that "the world which then was being overflowed with waters perished;" from which passage Mr. Penn has argued to establish a theory, that the former earth was depressed in order to form a new bed for the sea, and he then proceeds to shew, that the reflux of the waters in their descent would have swept the animal remains from off the depressed earth, and would again have deposited them over the bed which they were leaving; and thus he would account for our finding *terrestrial* animals entombed in strata overlying those which contain *marine* productions.

He is however compelled to the adoption of this opinion, from his having entirely overlooked the proper period of the first recorded revolution; and thus he is obliged to refer the fossils of the secondary and tertiary beds to the same epoch.

Insisting that the Scriptures mention only two periods of revolution, and declaring the separation of land and sea to be the first of them, he consequently leaves only his second revolution, or deluge, to account for the inhumation of *all fossil exuviæ*; because his first revolution, as already shewn, was completed before the creation of any organised beings.

The words quoted from St. Peter by Mr. Penn, in support of his views, namely, "The world which then was being overflowed with waters, perished;" are by no means intended or even calculated to convey any actual change of places between land and sea, but refer simply to the fact, that a deluge having passed over *the then earth,* caused all within it, or upon it, to perish. This was likewise the opinion, as we learn from Mr. Penn, "of the very learned annotator on Noldius," who declares that, "*terra* diluvio non fuit perdita *quoad substantiam, sicut homo,*—the *earth* was not destroyed by the deluge with respect to its *substance,* as *man* was;"* an opinion, the correctness of which, for obvious reasons, is not allowed by the Mosaic geologist, who thinks "it only shews that the annotator was unaware of the *fact,*" (as he deems it,) "that the ancient Jewish Church understood the *reverse.*"† It will be presently shewn, however, from the words of St. John, that the Jewish Church *could not* have understood the reverse, and the charge that such an opinion could only be entertained on "the ground of an inconsiderate and preconceived hypothesis,"‡ will eventually recoil upon the head of him whose views we are now analising.

The soundness of the annotator's views, is moreover supported by, "the original of this notable passage, נהר יצק יסודם which Michaelis interprets, "*fluvius eluit fundamenta ipsorum,—a flood obliterated their foundations;*"§ an interpretation, which our author highly approves of for his own ends, but which is not only at once corroborative of the opinion, that the *substance* of the earth *did not perish,* as man did; but is likewise in accordance with the effects we should naturally look for after such a catastrophe, namely, the *obliteration* of that surface, or *foundation* on which the sins which had provoked the punishment, had been committed.

Mr. Penn, however, not appearing rightly to understand the import of the threat, "I will *destroy* them, (*i. e.* all flesh) *together with the earth;*" and being entirely misled by his views of the first revolution, founds upon this sentence and

* Comparative Estimate, p. 255.

‡ Ibid, p. 256. † Ibid, p. 256.

§ Ibid, p. 252.

the already quoted declaration of St. Peter, his theory of a change of places between land and sea, or in other words, that *our present earth is the bed of the antediluvian ocean.*

In this, however, it may be perceived, that his desire to subvert the mineral geology has caused him to overlook the fact, that the threat bears equally on "all flesh," both man and beast, as on the earth itself; and yet we know that all flesh did not perish, for the family of Noah was *excepted,* and with it a certain number of animals which were destined to keep their seed alive upon the earth, after the waters should have again subsided.

Thus we may infer, that by the *destruction* of the earth was not meant its annihilation, but only the *obliteration,* or *removal of that surface* on which the sins of mankind had been committed; and which became *virtually destroyed,* when by the waters of the deluge it was *rendered unable to perform its allotted functions,* that is, when it was *no longer able to support and nourish the terrestrial classes of the vegetable and animal kingdoms.*

A thing is said to be destroyed when it can no longer perform the proper duties for which it was constructed; thus in the common parlance of every day occurrences, a watch is said to be destroyed when the mainspring is broken; or a body of troops is destroyed when it has received so severe a check or defeat, as to render it too weak to perform that duty which was allotted to it; not that we mean thereby that *all* parts of the watch are destroyed, or that every soldier is killed; and this reading of the text is the more apparent, since we know that by *repairing* the mainspring, the watch is restored to its former state, and by recruiting the body of troops they are as able to effect their duty as before their defeat by superior power; and so in reality was the earth restored and enabled to perform the purposes of its original creation, when the waters of the deluge again subsided. The words above quoted, therefore, would seem to imply, not the actual destruction of the earth, but the suspension of its proper functions, by which of course the animal and vegetable races would be destroyed. Nor can it reasonably be objected to this view, that the secondary formations are found to stand in direct opposition to it, and give evidence of a change of place between land and sea; for although undoubtedly many parts of our present earth have been reclaimed from the bosom of the waters, this fact by no means warrants the assumption, that the *whole earth* has been so derived; for we have testimony quite as conclusive in the existence of the stratified beds of the diluvial formations, that the tracts now occupied by them *were portions of the ancient or antediluvian earth;* so that we know that in three quarters of the globe, namely, in Europe, Asia, and America, large tracts of the antediluvian earth still constitute portions of our present continents.

Now as it here appears that the antediluvian dry land was not very extensively distributed, but rather that it was of limited extent, so we shall be fully justified in believing that the secondary portions of the present earth are merely additions, which have been derived from the sea and added to the former dry land, in consequence of the farther retirement of the waters, when the last revolution, or *extra natural* convulsion, caused the subsidence of the diluvial ocean.

No change therefore, such as that which is contended for by the Mosaic geologist, has taken place; and indeed as observers in general are now rightly agreed that the animals whose remains are found in the tertiary and diluvial strata must have lived in or near the places where they are now found buried, it is somewhat surprising that they should not likewise have long since allowed that the localities occupied by the last of them at least, constitute portions of that land which they once inhabited.

Again, another argument is suggested by the author's account of the probable manner in which the bodies of the animals destroyed were carried back by the reflux of the waves from the places where they died, to the land we now inhabit. "Let us suppose," he says, that "the eastern coast of America were to yield to the sea by successive subsidences of its land, yet leaving after each subsidence a new resisting coast sufficient to repel the waves; the reflux must still be the same as if the continent remained entire; and the *retiring current must equally make its way back to the coasts of Africa and Europe.*" "The sea," he continues, "has actually transported floating bodies from the West Indies to the shores of Europe;" but he forgets to tell us what those bodies were, whether animal or otherwise.

The exuviæ which are found in northern latitudes are chiefly those of animals which are now extinct, or only living in tropical countries, and it is therefore a matter much to be doubted whether they could have been transported *entire* from those scorching climates in which decomposition commences almost immediately after death, to the now frozen regions of Siberia; yet according to Mr. Penn's views, they must have withstood decay for a much longer period than is now found to be the case even in our reduced temperatures, for he says they were brought to these countries by the reflux of the ocean, when the waters were descending again into the place appointed to receive them; that is, when they began to be transfused from their proper bed, over the former earth, and which transfusion causing, be it remarked, the reflux by which *tropical animals* were carried to *the north,* did not begin until "one hundred and fifty days, or *five months,* from the commencement of the flood."

Truly those waters must have been endowed with great antiseptic powers, to enable them to preserve entire and free from putrefaction during the period of *five months,* and afterwards to leave enclosed in a Siberian iceberg, such a huge mass of flesh as the carcase of an elephant!* He tells us

* See "Account of Siberian Mammoth."

that "the record points out the period when the waters having diffused themselves *a second time* over the globular surface by the subsidence of the former continents, *began to abandon their ancient bed;* from which they continued *to descend,* until they left it *a dry land* as the *former earth* had been rendered *a dry land* by the retirement of the waters. *That period was at the end of one hundred and fifty days, or five months, from the commencement of the flood.*"*

Now unfortunately again for Mr. Penn's theories, we find that existing geological facts give undoubted evidence that no transport from tropical to northern regions could possibly have taken place, but on the contrary, that there are strong indications of the diluvian currents having passed *from the regions of the latter* towards the former; a circumstance which goes far to prove that had the former earth been depressed for the reception of the waters, we ought now to find the exuviæ of northern animals imbedded in the strata of the tropics, or to seek them beneath the bosom of the present sea.† But had the waves of the diluvian ocean met with a steady and permanent barrier to their advance, such as we see in the coast of the western continent, doubtless their reflux might in some measure have had the effect ascribed to it; but as they were *propelled,* according to the shewing of the Mosaic geologist, into a *new bed purposely depressed for their reception,* it becomes evident that *no steady barrier* existed to impede their progress, and thus *no reflux* of *sufficient force* to effect the supposed transportation of animal bodies would have been formed. For if occasional impediments had been met with in the alleged transfusion, still as the former old earth had been *depressed below the level of the former ocean,* those animal bodies which might have been washed off by the reflux would never have had time to reach the northern portions of our present earth, but would

* Comp. Est. p. 268.

† See De la Beche's Geological Manual, passim.

again have been swept onwards with the advancing waters, as each transient obstacle was overcome, into the bed depressed for their reception, because from the depression of the former earth, *a strong current must have set in from the former ocean,* and thus if land and water had really changed places, the exuviæ now so abundantly brought to our notice, would have been buried in the depths of the present sea.

It is evident too, from Mr. Penn's own reasoning, that no obstacles whatever *could possibly* have been opposed to the waters in order to form a reflux, for he tells us, that it was "one hundred and fifty days, or five months, from the commencement of the flood, that the waters began to abandon their ancient bed, from which they continued *to descend* until they had left it a dry land."* Now it must be borne in mind that the waters were standing equally deep over all the globe, so that the earth must have been in its centre, and according to the Mosaic geologist, that portion which had formerly been the dry land, was depressed for the reception of the waters in order to cause the subsidence of the flood.

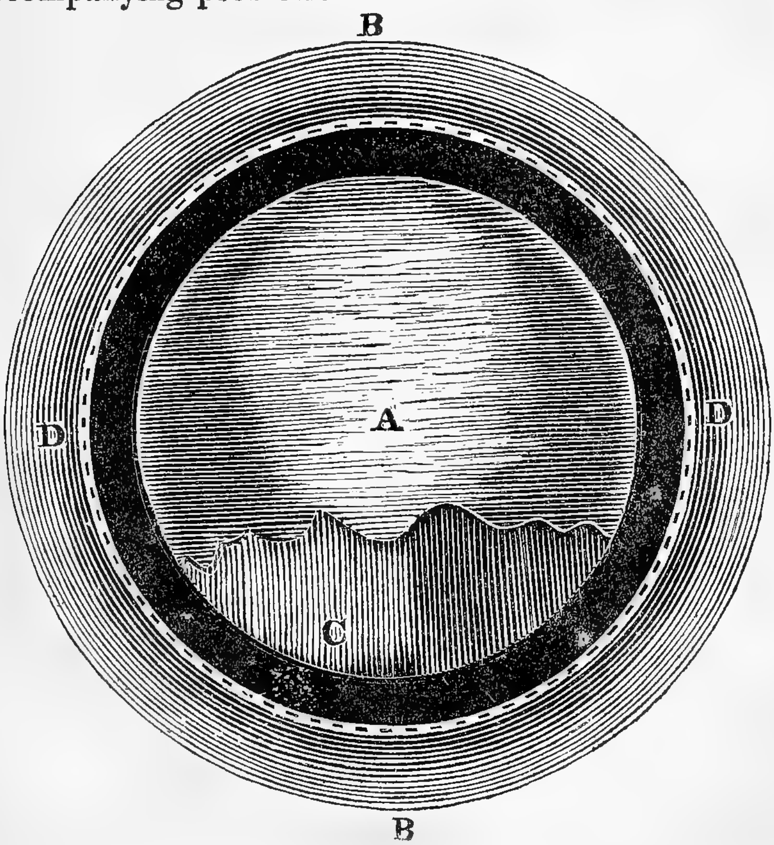
Is it not then manifest that these waters would at once have rushed violently and irresistibly downwards from their equal height, into the hollow below them; and is it not equally manifest that the formation of a long continuing reflux to carry upwards the terrestrial exuviæ into that portion which the waters were rapidly and irresistibly descending from, would have been an utter and absolute impossibility?

But the author has wisely suggested, that "had the former continents sunk *all at once,* the immediate and violent influx of the great body of the ocean, to fill the *vacuum* thereby created, must have hurried the ark into its enormous vortex, and have caused it to be presently ingulfed; whereas the record represents the ark, like an ordinary vessel, riding securely upon the surface of the ocean." I am willing therefore to

* Comp. Est. p. 270.

agree with him, that "the transfer of the waters was gradual and progressive, like that of the waters of *a lock,* in which a vessel descends imperceptibly from a higher to a lower level; which implies gradual and successive subsidences of the former earth, admitting of proportionate advances of the waters.*" But in admitting these facts it only becomes the more apparent that the production of the desired reflux by such means is an utter impossibility; for the successive depressions in the sea-girt mineral mass, would but have caused the gradual subsidence of the waters, not only without producing any reflux whatever, but also without rendering any dry land visible, unless, which is likewise an impossibility, a vacuum could have been produced capable of containing in its bosom the whole of the waters of the ocean!

This point may be reduced to a mathematical certainty by the accompanying problem.




* Comp. Est. p. 270.

Let A represent the spheroidal earth surrounded by the diluvial ocean B B. Then let the portion C be a *vacuum* or depression produced by successive and gradual subsidences, in order to form a bed for the waters and draw them off from the upper portion which is to form, according to Mr. Penn, the dry land or post diluvian earth.

It is at once apparent that the waters would gradually and quietly sink into the depression from their first level, to a lower one, as represented by the dotted circle D D; but no dry land whatever would become visible until all the waters were drawn down and contained in the vacuum, and this we may venture to affirm is an absolute impossibility, because we shall presently see, that those very waters once contained in suspension and solution the whole mineral substance of the globe.

It is evident here that no reflux would be formed. But why, it may be asked, since the Almighty *willed* that the waters should leave their former bed and flow into that former earth which He had *purposely depressed* for their *reception*, should obstacles arise in a succession of lands and barriers to be overcome, to prevent or retard their advance?

Surely His arm was not weakened that He could not as instantaneously and irresistibly execute His will in this second period as He is allowed to have done in the first creation, when the waters were gathered together into one place, that the dry land might appear? No, but it is evident that *without such obstacles* to the progress of the waters, there would have been *no reflux;* and without a reflux the Mosaic geologist cannot account for the presence of tropical exuviæ in a northern climate.

"The first great difficulty," says he, "which the mineral geology has created for itself, occurs in that amazing and principal phenomenon, the remains of animals of all species and climates which are discovered in exhaustless quantities in the interior of the earth; so that the exuviæ of animal species now subsisting only *within* the *torrid zone*, and those of species which *no longer exist at all*, are found confusedly huddled together in the soils of the *most northerly latitudes*." "In examining the mineral masses in the interior of the earth," says D'Aubuisson, "the observer is astonished at the prodigious quantity of the fragments of *animals* and *vegetables* which it contains. He will recollect the order in which organic beings are distributed upon the surface of the globe; some can only live in the bosom of *the sea;* others in *fresh waters;* some are only to be found within the *torrid zone*, while there are others which would perish the moment they should be removed from the *frigid zone;* in a word, each species appears as if it were fixed to an element or climate proper and peculiar to it. Whereas in the strata of the earth *everything* is *dislocated;* the remains of animals which can exist only in the depths of the *ocean*, are found kneaded into rocks which form the *summits* of *mountains;* the bones of those which can live only in the *torrid zone* are found buried in the frozen soil of the *polar regions*. Almost every where he will find relics of animals and vegetables, different from those which now exist. Every thing will indicate to him that the place of his habitation has undergone *great changes* and *great revolutions*."

Pursuing the subject, Penn observes, "the mineral geology contemplating these relics, and reflecting upon the *places* in which they are found, immediately demands a *revolution* different and distinct from either of those intimated by Moses, in order to account for their *presence* in the places where they now lie. But why," he asks, "does it need that *other revolution?* Solely because it reasons thus upon the evidence before it; these exuviæ of equatorial animals *are found* in northern latitudes; therefore their ancient owners must *have died* in those latitudes; therefore they must *have lived in those latitudes!* And yet they could not *have lived* in those latitudes unless a revolution has taken place either in the *nature of the species,* or in the *climates of the earth.* But no such revolution is shewn in the Mosaical record, or can accord with its recital, therefore *other revolutions* in one or other of these must be *assumed* to supply the chasm in the Mosaical record. Thus it reasons in perversion of all logic, and in exclusion of the true explication of the phenomenon."*

Thus mistaking the period assigned by the Mosaic record to the first great revolution or change which our earth undoubtedly *has* experienced in temperature, and twisting the operations and events of the third creative day, *previous to the existence of the animal and vegetable classes into a revolution;* Penn is of necessity obliged to refer the whole of the fossil exuviæ, both of the secondary and tertiary beds, to the period of the deluge, and thus we fathom his great anxiety to make the land and sea change places.

The strictest and most literal reading of the Mosaic narrative by no means warrants this conclusion, but on the contrary, points out distinctly two periods of destruction *subsequent* to the creation of organic beings, which periods too are widely separated. The first of these was produced by a great and decided change in the temperature of the *then existing* countries, by which many species were destroyed both of plants and animals, and therefore, in spite of his unguarded assertion, that tropical species did *not live and die* in the countries where their exuviæ are now found, and that "no such revolution is shewn in the Mosaical record," I shall endeavour presently to prove, both that those animals *did formerly inhabit* "our northern latitudes," and that the historian *has recorded the period of their loss.*

But first let us follow the Mosaic geologist through his argument of the total destruction of the earth.

"Such," he continues, "being the consentient understanding of all the principal Hebrew authorities, it establishes the

* Comp. Est. p. 307, et seq.

term of the threat to signify *the destruction not only of man and of all the animals which co-existed with him, but likewise of the earth itself, which they had hitherto inhabited.*

Nor ought this interpretation to embarrass, or in any way to surprise us; for let us remember that the *earth* had received the *Curse of God* from the moment of the first act of disobedience committed upon it; and "*that which is cursed of Him shall be cut off;*" for it is to be noticed that the curse was not pronounced upon *man*, but upon the *earth* on his account. And although its productions were immediately affected, yet the full consequence of the curse does not appear to have been limited to that immediate and actual affliction. Even at the birth of Noah, that malediction seems to have carried forward the minds of the pious to *some crisis* by which it was to be terminated. On that occasion, his father was led (no doubt by some inspired warning) to exclaim, "This child shall comfort *us* concerning our work and toil of our hands, *because of the earth which the* LORD *hath cursed;*" so our common version; but the Alexandrian interpreters render it with a very observable difference, and with a closer conformity to the Hebrew:—"This child shall relieve us from our toil, and from the distress of our hands, and *from the earth which the* LORD *hath cursed;*" in which word "*us,*" we are not to understand *themselves personally*, but their race. And after the retreat of the waters of the deluge, God did not *revoke* the curse which he had formerly pronounced, because it had been fully executed in "cutting off the cursed thing;" but he declared that he would not again pronounce a curse, *i. e.* pronounce a *second curse* upon the earth; that is, upon the *new earth* which he had provided to succeed that which had been cursed and cut off; *ου προσθησω ετι καταρασθαι την γην*, "non addam maledicere cursus terram;" which implies that the curse was terminated by the deluge.*

* Comp. Est. p. 256. et seq.

It is here clearly apparent that the writer's evident desire to overthrow the theories of the mineral goelogists, and his anxiety to establish his own view with regard to the change of places between land and sea, have somewhat unguardedly hurried him into a misapplication of the inspired exclamation of Lamech at the birth of Noah. From the passages already quoted it will be seen, that Mr. Penn very erroneously considers the curse which was pronounced upon the earth at the fall of our first parents, to have been *fulfilled* by the destructive visitation of the deluge; and he calls to our minds that the curse was pronounced *not upon man,* but upon the *earth* on man's account; and he farther quotes from Scripture as a proof of the soundness of his views, that "that which is cursed of God shall be cut off."

This evidently well-intentioned writer, from totally mistaking the true period assigned by the sacred historian to the first revolution, has necessarily been betrayed into farther errors; and he passes over, with but a slight allusion to it, the fact that the curse pronounced upon the *earth* immediately began to operate, by rendering it less fruitful and productive than it had hitherto been, as is shewn in the words of the Almighty, recorded in the 17th verse of the 3d chapter of Genesis, namely, "Because thou hast hearkened unto the voice of thy wife, and hast eaten of the tree of which I commanded thee, saying, thou shalt not eat of it; cursed is the ground for thy sake; in sorrow shalt thou eat of it all the days of thy life; thorns also and thistles shall it bring forth to thee, and thou shalt eat of the herb of the field; *in the sweat of thy face shalt thou eat bread,* till thou return unto the ground, for out of it wast thou taken, for dust thou art and unto dust shalt thou return."

The effects of this dreadful curse were at once felt, and the earth which had hitherto yielded her riches to man without toil and labour, now became unfruitful unless tilled and cultivated. This *curse* was the *cause* of the *first great revolution* and change or *reduction in the temperature* of climates, and it was in mercy to the human race at once carried into effect. I say, "*in mercy to the human race*," because man had by his transgression rendered himself mortal and subject to death. It was therefore clearly an act of the *greatest mercy* in the Almighty, to render the earth less lovely and attractive to the fallen race, and thus not only lessen the regrets they would naturally have left at being obliged to leave so beautiful a world, but also teach them to look up with hope from the pains and sorrows of this life, to Him, in whom alone consolation could be found.

But it must be remembered also, that the curse was entailed upon the earth as a consequence to man's having rendered himself mortal, and *therefore* it must *remain upon it* so long as man, for whose sake it was cursed, shall *retain his mortality;* consequently it *could not have been removed* by the deluge, but *remains yet* in force, as is proved sufficiently by the fact that man still eats his bread by the labour of his hands and in the sweat of his brow, and is obliged to till and cultivate the ground, which otherwise yields him nought but weeds.

How such a palpable and manifest oversight as this could possibly have occurred to a writer of Mr. Penn's acumen, it would be somewhat difficult to say, did we not learn by every day's experience, how easy it is for an author to be absolutely blind to those facts which are opposed to his favourite fancies, while they are otherwise apparent to every one besides. In the present case, however, we might almost suppose the author had wilfully shut his eyes to the facts of the case, how else could he have misunderstood the passage, "cursed is the ground for *thy sake;* in sorrow shalt thou eat of it *all the days of thy life.*" Could he possibly be unaware of the fact that man still eats his bread in sorrow, and in the sweat of his brow?

With regard to man, the *dreadful consequences of mortality,* which by his disobedience he has brought upon himself, are to be *remitted only* through *faith in Him who took our nature upon Himself*, and died that He might purchase and *redeem* us with His own blood, from the wrath to come. And assuredly to *this* blessed Redeemer, and not to the visitation of the deluge, the inspired exclamation of Lamech of the birth of Noah, had reference; for as yet *no threat* of destruction had been launched against the earth and its inhabitants, nor was it pronounced until *five hundred years afterwards*, for we read in Genesis, that Noah was six hundred years old when the Flood was upon the earth, and we know that the *warning threat* was given about one hundred and twenty years before the deluge actually began; consequently Noah was born nearly five hundred years before the warning threat was given.

Thus it would appear that the exclamation of Lamech pointed out that *through Noah* and his posterity a Saviour would arise to redeem and "comfort us concerning our work and toil of our hands, because of the ground which the Lord *hath cursed*." The words "*hath cursed*" distinctly prove that the exclamation pointed to that curse which man had entailed upon the earth and himself by his first transgression, and not to the curse of the deluge, for as yet *that threat* had not been pronounced. Now the deluge was the fulfilment, not of the curse, *but of the threat*. It was therefore a *fresh* outpouring of the wrath of God upon the earth, and its inhabitants, both human and animal, caused by the increased depravity and crimes of mankind; and although the historian does not *term* the threat a *curse*, yet we see by its consequences that it was such, and all doubt upon the subject is set at rest by the Almighty's promise to Noah after the flood, "I will not *again curse* the ground any more for man's sake; for the imagination of man's heart is evil from his youth; neither will I again smite any more every living thing as I have done. While the earth remaineth, seed-time and harvest, and cold and heat, and summer and winter, and day and night, shall not cease."*

This passage clearly implies that the deluge was considered a curse by God himself, and therefore we see that a *second curse* had been brought upon the earth for man's sake; consequently *this second curse,* and not that originally pronounced to Adam, was the cause of the deluge; and thus it is evident that the exclamation of Lamech points to our redemption by Christ, as a means by which we were to be relieved from the consequences of the fall of our first parents, and had no reference to the destruction of the earth by the deluge, as supposed by Mr. Penn, who has somewhat unfairly assumed the passage, "I will not again curse the ground," to signify that God had as yet only pronounced *one* curse upon the earth, and that it contains a promise not to inflict a *second* curse. The words of the text, however, do not admit of such an assumption; and we perceive again that the desire to establish his theory of a change of place between land and sea, has caused that author to overlook the true import of the passage.

The word "*again,*" would have been equally applicable had half a dozen curses been pronounced against the earth, although Mr. Penn arbitrarily restricts its meaning to a *second* curse only.

Thus we perceive that *two distinct curses* have been pronounced upon our earth, and that each, as a consequence, has brought about a *general revolution.* Both of these *are recorded in the pages of Holy Writ,* and both are subsequent to the operations of the creative week. The *first* was pronounced at the *fall of man,* and immediately operated *in reducing the temperature* of climates, by which the earth became *less fruitful,* and by which numerous species of *animals* and *plants* became extinct. The *second* was drawn down by the utter depravity of the human race, about sixteen hundred

* Genesis, chap 8, v. 21 and 22.

and fifty years later, and produced the deluge, by which the temperature of climates was *still farther reduced,* and various species of plants and animals were destroyed.

Of the means by which a reduction of temperature was effected, I shall have occasion to treat in a succeeding essay.

These two Mosaic revolutions will be found fully sufficient to account for all the fossil phenomena of the earth's strata; the first having been instrumental to the production of the *secondary,* and the *last,* of the *tertiary* and *diluvial formations* of geology.

One, yet more convincing argument against the change of land and sea, as advocated by the Mosaic geologist, and we may dismiss the subject.

He affirms that the Hebrews understood the *destruction* of the earth, and that St. Peter confirms their traditions, by adverting, in his second epistle, to the catastrophe of the deluge, expressly stating, "that *the world which then was being overflowed with waters, perished;*" to which "world which then was," he opposes "*the earth which now is,*" and he proceeds to declare, that the earth which "*now is,*" is reserved for destruction *by fire,* as the earth which "*then was,*" sustained destruction *by water.* He thus enables us to judge of the extent of the destruction of the former by affirming the destruction of *both* to be equal, and therefore rendering them *rules* for mutually explaining each other. Of the *latter* we are apprized, that its destruction *by fire* will be final; and we are therefore in consistency to infer of the *former,* that its destruction by *water* was also final; the instruments of destruction are different, but their *effects* are coextensive according to the diversity of their natures. So that the sense in which the old interpreters understood the words, namely, "*and,*" or "*with the earth,*" is thus both expounded and confirmed by the highest authority in the Christian church."*

* Comp. Est. p. 251.

Now it will be as easy to give a different, and I trust more correct meaning to these words of St. Peter, as it was to extract the true import of the inspired exclamation of Lamech at the birth of Noah, that "the earth which *then was* being overflowed with waters, perished," need not be disbelieved any more than that "the earth which *now is*," will assuredly perish *by fire;* but that the effect of that latter destruction will be *to annihilate the matter* from which our earth is formed, is no more necessary to be believed than that it was annihilated formerly by the waters of the deluge. That the destruction of the earth *by water* was *final,* we are assured by God himself, in his promise, "*neither shall there any more be a flood to destroy the earth;*" and that its destruction *by fire* will be *equally final* we know from the same source, because our *mortal* career and earthly probation will *then be ended;* and we may safely infer that the latter and still future destruction of the earth will be *equal* (although St. Peter does nowhere affirm it,) to the former destruction; that is, as all trace of the former surface and its animal and vegetable productions were swept off and *obliterated* by the waters of the deluge, so as afterwards to present a totally new aspect; so the latter destruction by fire will entirely and thoroughly purge and purify our mortal habitation from the pollution of our sins, "and a new heaven and a new earth" will appear, in the which will be established "the heavenly Jerusalem." Thus as by man's disobedience the earthly paradise in which he was first placed was lost and subsequently effaced from our earth by the first great revolution, consequent on the curse of an offended God; so in the latter end, through the merits and *atonement* once offered for us by the Son of God, will a *final revolution* again *restore to us* the blessings we have so justly forfeited.

But again, if the *first earth,* had totally perished at the deluge, as pronounced by Mr. Penn and others, it will necessarily follow that *this our present*, must be the *second earth;* how, therefore, does St. John in the 21st chapter of the book of Revelations say, "And I saw a new heaven and a new earth; for *the first heaven and the first earth* were passed away; and there *was no more sea?*" This was the record of a vision of future events, and yet there is no distinction made between the antediluvian and the present earth, from which a *traditional sense* of its *total destruction* can be gathered; and yet had such an event occurred, St. John could not have failed to know it, and to consider "the earth which *now is*," as a *second earth*, and therefore in recording his vision, he would not have told the Jews, what Mr. Penn affirms *they were already well aware of*, namely, that the *first earth* had passed away. But from his coupling the "*first heaven*" (of which as yet there has been *no destruction*,) with the "*first earth*" it becomes evident that St. John considered *our present* to be *identical* with the *antediluvian earth*; and again from his saying that on the destruction of the "*first earth*" there "*was no more sea*," we at once perceive that *the first earth has not yet passed away;* consequently the Mosaic geologist is again in error, and the destruction caused by the deluge, must be limited to the extent to which I have alone received it.

"And I saw *a new heaven* and *a new earth;* for the *first heaven* and *the first earth* were passed away; and there was *no more sea.*"

"And I, John, saw the holy city, new Jerusalem, *coming down* from God out of heaven, prepared as a bride adorned for her husband."

"And I heard a great voice out of heaven, saying, Behold the tabernacle of God is *with men*, and he will dwell *with them*, and they shall be his people, and God himself shall be with them, and be their God."

"And God shall wipe away all tears from their eyes; and


Pteromys oral

there shall be no more death, neither sorrow, nor crying, neither shall there be any more pain; for the former things are passed away."*

Thus the views of the Mosaic geologists regarding the alleged change of place between land and sea, are at once refuted both by sound and reasonable criticism, and by the crowning fact, that portions of our present continents are identical with the antediluvian earth, to which have been added by the greater elevation of the land in these latter times, large tracts of secondary deposits which were laid bare by the retirement of the sea at the period of the last great revolution.

THOMAS HUTTON, *Capt. Bengal Army.*

*Mussooree,* 21*st August,* 1841.

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## *On the Orál, or Singbhoom Flying Squirrel. Pteromys Orál. Plate* xi. *By Lieut.* S. R. TICKELL, *Bengal Army.*

Order V.—RODENTIA. Genus SCIURUS.
Sub-genus PTEROMYS.—Species *Orál* (Mihi.)
*Orál* of the Koles.
No Hindustanee name.

*Dimensions and description of a mature Male.*

| | *Ft.* | *Inches.* |
|---|---|---|
| From tip of nose to tip of tail, excluding hair, | 2 | 11 |
| Of which—Head, ... ... ... ... | 0 | $3\frac{1}{3}$ |
| Foramen magnum to insertion of tail, ... | 1 | $0\frac{1}{3}$ |
| Tail, ... ... ... ... ... ... | 1 | $7\frac{1}{3}$ |
| Breadth, from tip to tip of parachute extended to the utmost, ... ... ... | 2 | 0 |
| From tip of parachute to articulation of its extending spurious bone into condyle of ulna,... ... ... ... ... ... | 0 | $4\frac{1}{2}$ |
| From said articulation to side of body, ... | 0 | $7\frac{3}{4}$ |

* Revelations, chap. 21.

| | Ft. | Inches. |
|---|---|---|
| Length of humerus, ... ... ... ... | 0 | 4 |
| Of radius and ulna, ... ... ... ... | 0 | 4 |
| Of paw, (excluding the claws), ... ... | 0 | 2 |
| Breadth of parachute, from one calx to the other,... ... ... ... ... ... | 1 | $1\frac{3}{4}$ |
| Length of femur, ... ... ... ... | 0 | 4 |
| Of tibia,... ... ... ... ... | 0 | $5\frac{1}{3}$ |
| Of hind foot, (excluding claw,) ... ... | 0 | $2\frac{3}{4}$ |
| From insertion of tail to edge of parachute,... | 0 | $4\frac{3}{4}$ |
| (That is, the parachute borders tail for $4\frac{1}{2}$ inches.) | | |
| Across the head, from ear to ear, ... ... | 0 | $2\frac{1}{2}$ |
| Length of ear, ... ... ... ... ... | 0 | $1\frac{3}{4}$ |

*Fur.*—The fur is of one kind, thick and soft, filmy near roots, ending (for the most part) in a thicker opaque filament. The parachute is more thinly clad, but fringed with a thick border of fur. Tail round and villose. Face and anterior part of limbs clothed with smooth short hair.

*Teeth.*—Formula, $\frac{2.\ 0.\ 5,5.}{2.\ 0.\ 4,4.}$

The teeth are brownish orange coloured. Incisors proceeding far into sockets, as in Hystrix. Upper molars very broad—transverse, inner half smooth, outer half tuberculous. Lower molars square, flat, smoothly tuberculous.

*Physiognomy.* — Nose bare, thick, tumescent, nostrils small, round, separated by a thick septum; upper lip and brows clothed with long vibrissæ; some black, some grey. Eyes large, full, suited to darkness. Upper lip cleft almost to nose. Head broad, flat. Ears rounded, without tuft or fringe; no cheek pouches.

*Feet.*—As in Sciurus generally, but no vestige of the tubercle supplying the place of a thumb, although the Orál feeds by the help of its fore-paws in the same way as other squirrels. Claws semicircular, sharp, and compressed. Feet clothed with short hair. The soles of the fore-feet bare: of the hind feet half bare and half hairy, the hair clothing the outer half of the sole, and extending diagonally and longitudinally across it.

*Tail.*—Not flat, as described in Pteromys generally, but round, full, furry, and villose, incapable of eradiation, but erectile—generally wrapped round the body in repose.

*Mammæ*—are 6—two pectoral and four ventral, at least so I have counted them in two specimens. Cuvier says, "six ventral."

*Colour.*—Full neutral or bluish iron grey above, the fur being blackish for the first or root half, and hoary whitish grey the rest, so that the fur has a mottled appearance. All the lower parts mealy white ; eyes black ; nose flesh colour ; hair round nose, on eye-brows, and upper lip rusty. Triangular patch of black above the nose ; eyelids and bases of whiskers blackish ; from eye to ear darker grey ; cheeks grey mottled with pale tawny hairs, fading off to white of under parts ; paws (hind and fore) rusty greyish black, which colour also anteriorly edges the parachute bone. The edge of parachute all round is pale mottled grey, slightly rusty, and within this an ill-defined cloud or band of darker grey extends inwards.

The fore-arm is anteriorly rusty, mottled, and there is a slight shade of the same in the parachute and hind leg. The tail is as the back, but gets rapidly darker towards end, and is at the tip as black as the paws. Claws a rusty horn colour.

*Parachute.*—Completely encircles the body from shoulder to shoulder, forming a chord to the flexure of the fore-arm, gradually diminishing from wrist to the calcis, and embracing about one-fifth of the tail. The membrane is thin, flexible, vascular, and above and below clothed with thin downy fur. It is supplied by two large veins from near the axillæ and lumbar region, which ramify over the surface. The parachute is extended considerably beyond the utmost stretch of the arm, by a supplementary bone, which articulates on to the space between the condyle of the ulna, and the carpal bones, this is pliable and semi-cartilaginous, and moved by two tendons, inserted into the muscles of the fore-arm, which serve to retract or extend it. The tendon extending the bone, is inserted into a muscle on the inner or thumb side of the arm, which acts on a ligament, spreading over the *palm*, and adhering to the parachute bone along its anterior side; the other ligament passes forward from the head of the bone, towards the outer or little finger. The parachute bone has a regular condyle at its articulation and ends in a blunt cartilaginous point. There are no muscles or tendons in the parachute membrane itself, which is passive and alone acted on by the fore and hind extremities.

*Tongue.*—Is long, rounded, and broad at the end; not cleft or furrowed, smooth. The Orál drinks by lapping slowly.

*Habitat.*—All the deep saul forests west of Midnapoor, Jungleterry districts, Singbhoom, and southward and westward, avoiding the high table land of Choota Nagpoor. How far the Orál extends beyond these limits I cannot say.

The several known species of the flying squirrel affect either cold climates, or the highest and coolest situations of warm ones. The Orál, however, although thickly clad with fur, is found in the lowest parts of the jungles, frequenting indifferently the hot sultry spots at the bases of hills, or cool shaded coverts near streams. It never ascends the hills, but rambles along from tree to tree, coming near villages into the mowhooa and mangoe plantations, as the night advances. It avoids, however, the dry stony tracts, covered with a scanty grass vegetation, assun, polás, kéond, (or ebony,) which form the principal feature of the jungles in the above named districts, and keeps to the water side, or to narrow vallies, or bases of hills, where a richer soil accumulates, and allows of the growth of large timber.

*Manners, &c.*—The Orál is very easily tamed even when caught adult, and when young becomes a most engaging pet. It can be reared on goat's or cow's milk, and in about three weeks will begin to nibble fruit of any kind. During the day it sleeps much; either sitting with its back bent into a circle and its head thrust down to the belly, or lying on its back, with the legs and parachute extended, a position it is fond of in sultry weather. During the night time it is incessantly on the move. In spite of its flying paraphernalia, the Orál is by no means so agile as other squirrels; its pace on the ground is a hobbling or hopping kind of gallop, nor is it particularly nimble even on trees, the parachute flapping about and impeding its movements in moving from branch to branch. In a wild state it scrambles in this manner all over a tree, and when wishing to pass on to another at some distance, does not descend to the ground, but leaping from the topmost branches sails through the air by means of the parachute, and reaches the lower part or trunk of the adjacent tree. These leaps or flights can be extended, I am told, to ten yards or upwards, (always of course in a diagonal and *lowering* direction). I, myself, have never witnessed them, and on the only occasion in which I ever tried the powers of flight of the animal, (by throwing it up to the ceiling,) it came down again to the floor on its belly, with a *thump* that put me in fears for its life, indeed, any cat in a similar predicament, would have managed more cleverly.

The Orál is a characteristic and fitting appendage to the secluded and beautiful spots it is generally found in. And the hour in which it appears, adds to the wildness of the association; for it is when day-light begins to fade away, and darkness accumulates faster under the umbrageous trees which cluster round steep ravines, or entwine their branches over running waters, that its faint querulous cry is first heard, and it creeps stealthily out of its diurnal retirement, some deep hole in the decayed trunk of a tree. It may then be seen, pausing for awhile as if but half awake, washing its face in the manner of a cat, and cleaning scrupulously its fur; presently after which, it commences its nocturnal rambles, visiting the jamoon, bur, peepul, kéond, piâl, or any other jungle fruit tree that happens to be in season, also the mangoe and mowhooa. It also devours the bark of one or two species of trees, of which I have only been told the Kole name; and will also readily capture and eat larva and beetles. It does not feed on grain of any kind, nor hoard provision, which is an instinctive trait in the Sciurines of cold countries, exposed to vicissitudes in the supply of provision. I suppose no animal in India, or in any plentifully supplied country, hoards provisions? It drinks water freely by lapping. They tell you that the squirrel in England never drinks. I do not remember the fact one way or the other, but the Orál drinks heartily, and so does the Kondeng, (*Sc. maximus,*) and the little Gilhéree, (*Sc. palmarum.*)

The voice of the Orál is very seldom heard. It is a weak, low, soft monotone quickly repeated—so low, that in the same room you require to listen attentively to distinguish it. It is to the Koles, a sound ominous of domestic afflictions, and one of the signs they regard much in their marriage negociations, so this pretty, gentle little creature gets a bad name. When angry the Orál seldom bites, but scratches with its fore-claws, grunting at the same time like a guinea pig. Its nature is gentle and slothful.

*Young, &c.*—The female is smaller, slightly, than the male, but does not differ in colour or appearance. The young are born naked, but not blind, and generally two or three in number; they are slow of growth considering the size of the animal, and when born are not above the size of a largish mouse. The male and female pair from the setting in of the rains, nearly all through the cold weather.

They make a large commodious nest of leaves, grass, fibrous roots, &c. in the hollow of a tree. I do not know how long the female goes with young.

*Nomenclature.*—The Orál I believe has not before been described, or found its way into our collections. The animal has been seen by, and kept alive in the possession of other gentlemen, but no description of it has, to my knowledge, been given to the public. I have therefore now, I believe, the good fortune of introducing a new and interesting addition to our East Indian Fauna, which in dimensions, if not in beauty, takes the lead of the *Pteromes* described by Horsfield and others, as inhabitants of this country, and of the adjacent islands.

In that most difficult part of the business, the choosing a specific name, I have been induced to adopt a vulgar and familiar designation, notwithstanding the objections that exist against such a choice; for in the present subject I really know not what peculiarity or distinguishing trait I can seize upon, on which to coin a name; and naming an animal from its colour, size, habitat, or manners, unless those should be most striking, singular, or indeed aberrant from those of the rest of the genus, is just as faulty. I therefore beg leave to name our subject "Orál," as it is so called by the Koles, the only people I have met with, who appear to be acquainted with the animal. The Hindoos have no name for it, calling it either a bat, or a "*chiria;*" though of course those of the upper provinces are acquainted with the two known species of flying squirrel found in the hills there—a large chesnut coloured and a small grey one, (***P.*** *petaurista* and ***P.*** *lepidus?*)

The foregoing description I have collated from notes taken at various times, and from observations made on eight specimens, of which two are now alive and in good condition, and will I hope reach the Barrackpore park menagerie in safety after the rains. All these have been procured in the forests of the Jungle Mehals and in Singbhoom; and from the animal not having as yet been described by those best acquainted with the Mammalia of Central and Southern India, it may be conjectured that the Orál is confined to the deep woods of the above mentioned tracts, the natural productions of which have been as yet very slightly investigated.

References to Plate XI; *a,* fore right paw, inner side; *b,* fore sole or under side; *c,* fore with skin dissected off to shew the articulation of the Parachute bone; *d,* sole of right hind foot; *e,* skull of the Oral; *f,* under and side view of one of the upper Molars; *g,* upper incisor; *h,* lower incisor.

S. R. Tickell.

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## *On the habits of a species of Hair Streak, belonging to the genus Thecla. By* E. T. Downes, *Esq.*

I am desirous of ascertaining whether any observations have been made on this side of India, with reference to the caterpillar of the butterfly which is so destructive to the fruit of the pomegranate.* I am induced to call the attention of entomologists to the subject, as my observations regarding its habits do not correspond with a very interesting account published in one of the numbers of the *Transactions of the Entomological Society,* although I read the history of it whilst in England. I cannot recollect much of the details, yet I hope sufficient for my present purpose, as a means of contrasting the difference between this and the Madras side, with regard to the situation in which the caterpillar undergoes its transformation.

The very interesting account from Madras states, that the caterpillar eats its way through the hard skin of the pomegranate, and proceeds to spin a web, connecting the base of the fruit and stalk, which is considered to be a precautionary measure to prevent the falling of the fruit in the event of a

* Punica Granatum.

separation taking place by the breaking of the stalk; the caterpillar having secured its house from falling during the period it has to remain in its chrysalis state, returns to the interior, and there undergoes its transformation; the perfect insect emerging by the hole made by the caterpillar at a period when it was provided with the proper apparatus for so provident a purpose.

At the time the pomegranate is in flower, and at a very early period, the Hair Streak may be seen very busily occupied about the flowers, and I have little doubt that the eggs are deposited at the bottom of the calyx, from the position in which I have seen the abdomen of the butterfly placed; as the fruit enlarges the eggs are enclosed, and in this situation matured.

Recollecting the history of this insect, I determined to enjoy the pleasure of seeing it go through its various stages, (the pomegranate tree being close to my door.) In order that I might obtain a perfect insect, I surrounded several of the fruit with fine gauze, but in such a manner as not in the least to interfere with the caterpillar in its labour of connecting the fruit and stalk by means of the web, but to my astonishment and disappointment this never took place; the caterpillars issued from the fruit, and finding their escape impeded, underwent their change on the external part, and so soon as this was effected, I removed the fruit from the tree for the purpose of placing it in a mosquito gauze house in my room. Subsequently I examined several of the fruit, but I never found any chrysalidæ, or the remains of any inside the fruit. I was very careful in my observations, and I came to the conclusion that the caterpillars in this instance deserted the fruit when ready to undergo their change, and I have very little doubt of the butterfly being the same, viz. "*Thecla Isocrates.*"

I have recorded this as the result of my own observations, without for a moment doubting the accuracy of the history to which I have briefly alluded; but I considered it of sufficient interest to make it public, as shewing a difference of habits of the same butterfly in different localities.

The fruit of the Leechee is subject to similar depredations; in this instance the egg is deposited by a small moth (species not yet ascertained) and matured, the caterpillar is hatched, and it forms a groove for itself around the hilum of the seed, as well as in the fleshy part of the fruit, but this residence soon becomes too small for the increased growth of the caterpillar, when it eats its way into the seed, and in this situation undergoes its transformation. (Scytalia Lichi.)

E. T. Downes.

Calcutta, 13*th Sept.* 1841.

P.S.—In your January number I find mention made by Captain Jack, of the existence of the Tailor Bird at Neemuch. I merely call your attention to it for the purpose of stating, that my friend Captain Hutton, 37th Reg. N. I. gave an account of the birds and their nest some years ago; and if my memory is not treacherous, it was published in the *Asiatic Society's Transactions,* but of this I will not be certain, but I have read it somewhere.

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## *Memorandum as to manners of Rhizomys Badius, described in No. 5. By* B. H. Hodgson, *Esq.*

Since the account of the Bay Bamboo Rat was furnished to you, I have had one alive for several weeks, and been enabled to observe a deal of his manners, because his easy confident carriage towards mankind, and his slow pace, rendered it possible to turn him loose without the least risk of losing him. I never saw such another confident, saucy, and yet entirely innocuous creature, except it be the Marmot of Tibet, which greatly resembles it in this respect, as in others.

The principal habitat of the Bamboo Rat is the Central region, though it be also found in the Northern. The one procured for me alive, was caught at Muckwanpoor. It was a mature male, and though just taken wild, was produced out of the sleeve of the bearer, and placed on the table, with as little apprehension of his running away, as there had before existed of his biting his carrier. This man told me, that the species live in small groups in burrows, which are usually constructed under the roots of trees or shrubs, and that they may be taken as easily as a domestic animal almost, from their extraordinary boldness, or apathy of nature. Mine I turned out frequently, and left it abroad for hours. As soon as it was free of its cage, it walked slowly to the root of some bush or tree, and immediately commenced digging. In less than a minute it was under ground, making way principally with its powerful head and jaws, and using the feet less to penetrate unbroken soil than to remove that which had been broken by the snout and teeth. Its burrows were long, but superficial, and possibly the object was as much food as shelter; for roots seemed to be searched for perpetually, and they constitute in fact the chief sustenance of the genus. My animal could not climb at all, and on the ground he was far less active than any of his congeners I know, save the Marmot. He scorned to run, if he could; and when urged to quicken his pace, would turn to threaten with his formidable incisors, grunting at the same time his displeasure. Most part of the day he slept, rolled into a ball, but resting on his feet, or rather on the hind feet only, for the fore were used more effectually to cover his head, which was tucked under his belly between them. He was fed on sugar-cane, plantains, and cerealia, but liked the first named best. He died from the effects of exposure for a quarter of an hour to the sun in his cage, when the temperature could not have been 90°; and hence must be allowed to be singularly impatient of heat, which is not remarkable with his nocturnal and subterranean habits.

## *Appendix to account of Cúón Primevus, the Wild Dog, or Buânsû.* *By* B. H. Hodgson, *Esq.*

The pungent or peculiar odour by which the Buânsû, in common with the Fox, Jackal, and Wolf, is distinguished, is a subject of much interest in reference to its origin and uses, and I shall therefore add to this paper a short notice of the results of an examination of one male Buânsû, one male Jackal, and one male domestic Dog, each and all of mature age. Round the entire margin of the anus, then, of the Buânsû, was found a series of palpable distinct pores, all of equal size, and equi-distantly disposed, and in number amounting to ten. Of these all but the central one on either side were shallow, and consisted of little more than a reduplication of the skin; nor did they yield any secretion on pressure. But the middle one on each side was found to lead by a very short straight neck to a large hollow gland or reservoir, which was filled with a thin, whey-like secretion, of pungent, certainly, but not *very* offensive odour, and nearly, though not quite identical with the characteristic effluvia from the body of the animal, as perceived by any one approaching it when alive. These central pores now adverted to, were each of them big enough to admit a large quill, and the straight neck by which you thence passed into the sac or reservoir, had the same diameter with the pore, but no muscular ring, and hence the contents of the sac could not be ejected with force, though they trickled freely out on pressure, or on simply raising the lower end of the sac. The sac (each) was as big as a sparrow-egg, with thin sub-membranous walls, and a delicate smooth lining like silver paper; the secreting gland, by no means palpable; and the direction of the sac *downwards*, whereby its contents were retained, except when very full; and I perceived no other means of retention, or of rejection at the will of the animal. With regard to the other pores, before spoken of, these disappeared when the external skin of the anus was dissected off, as I had anticipated from their shallowness: but the margin of the anus around them shewed some scattered glandlike spots, that might possibly be contributory of some secretion to them. In the Jackal, the great central lateral pore, sac, and secretion, were found on either side the anus, precisely as in the Buânsû, only the odour of the secretion was less pungent. None of the other pores were discovered. In the domestic Dog also, the latter pores were wholly wanting; but the central one on either side existed, though evanescently, and without sac, or secretion; whence it would seem to be explained, this animal's freedom from the villainous taint peculiar to its wild congeners, and which in them doubtless is subservient to important ends, is superceded *possibly* by domestication, for I would speak with caution, as having yet made but limited examination of the facts. In the meanwhile it should be remembered, that the Buânsû's anal apparatus has some peculiarities exclusively proper to it.

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*The Editor of the Calcutta Journal of Natural History.*

Sir,—The hurried and piecemeal fashion in which the Catalogue you have just published of Nipalese Mammals was sent you, has naturally caused several errors and omissions on the part of your printer, which the following paper will correct :—

P. 215. Genus Felis, *dele* the word subgenera from the line, and place it above and separate: add the species *Macrocelis,* which is omitted.

P. 213. *Dele* subgenera from the line, as before, and place it above.

P. 214. Genus Mustela: add the new species *Calotus,* making four species in all.

Same page, *dele* the N. B. after the genus *Mesobema,* and place it above, under the genus Gulo. It is our Gulo Nipalensis, which Gray describes as the Helictis Moschatus from China.

Same page, genus Ursitaxus, *dele* the *second* 4-4.

P. 215. After genus Sorex *insert* genus Erinaceus, 3 sp. Spatangus, Collaris et Grayii auct. Genus Talpa, 1 sp. new, Micrurus nob. By the way, its specific description is put in at the end of the Catalogue without the dimensions, and referring to its position in the Catalogue.

Same page, line 52, for Sub *read* Sus.

Same page, line 54, *dele* subgenera, and place it above and apart as before.

P. 218. Genus Capra, 63 add Capra Ibex. var. Hemalayanus; and two more tame species called Sinal and Doogoo, which are omitted.

Same page, genus Ovis, *add* one more tame species called Silingia, which is omitted.

P. 220. Genus Stylocerus, *dele* the N. B. and subjoin it to the genus Rusa and species Jaraya, or 71. It is shifted out of place.

Same page, genus Sciuropterus *add* the new species Crysostrix, (resembles Magnificus save that it has three golden lines down the back) making three species instead of two.

Same page, genus Mus. for four *read* five species.

Same page, after Lepus for Dios *read* Oïos-tolus.

Same page, after Lepus *add* the, omitted,

Genus Lagomys, 1 sp. new Nipalensis nob. Here ends the Catalogue, the postscriptum to which is at present printed in a strangely disjoined fashion, and *dele* the whole and substitute as follows:—

Postscriptum.

The above Catalogue contains above one hundred species, more than half of which were new when first published. Their descriptions will be found in the *Journal of the Asiatic Society*, or in the present work, with four or five exceptions only of species yet unpublished. The Catalogue has been greatly added to since it was last published, and contains all discoveries up to the present moment.

I remain, Sir,

Yours faithfully,

B. H. Hodgson.

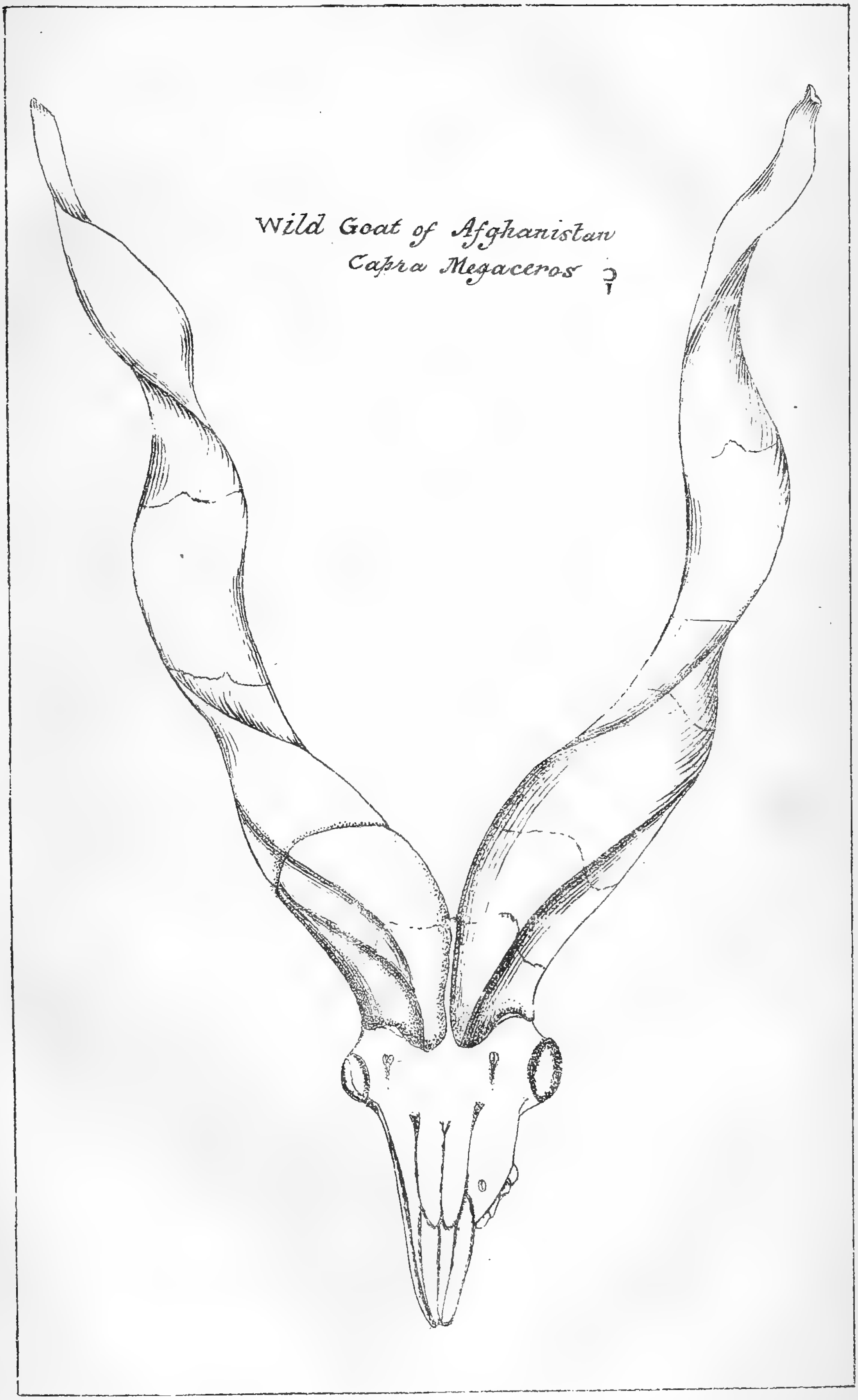
*Nipal, August,* 1841.

*Further notice of a Nondescript species of Deer indicated in the 4th Number of the Cal. Jour. Nat., Hist. extracted from a letter of Lieut.* ELD, *Assistant to the Commissioner of Assam dated 21st May,* 1841, *with a drawing of the Horns, plate* xii.

Thanks for the *Calcutta Journal of Natural History*, No. 4, which I had the pleasure to receive by to-day's dâk. In it I observe mention made of a new description of Deer, said to exist between Munipore and Cachar; some specimens of the horns of which were procured in the latter place by Captain Guthrie. From the drawing, it is evident to me that the Deer alluded to is of the kind originally discovered by myself in the valley of Munipore in the beginning of 1838, and several pairs of the antlers of which were given by me to Captain Guthrie in the same year. I had intended at the time to send a description of the animal to one of the Journals, but was told that a similar Deer was to be found in the North-western jungles. As this however does not appear to be the case, I now forward you a correct drawing of a pair of the horns in my possession, together with a short account of the animal &c. taken from notes made at the time in my sporting diary; and which you are welcome to make use of in any way you please.

The *Sungraëë*, as it is called by the natives, or large Deer of Munipore, is only to be found in the valley of that state, but neither in Cachar, nor the Kubo valley, nor in any of the Naga hills surrounding Munipore. Its favourite haunts are the low grass and swamps round the edge of the Logta, (lake) at the western end of the valley, and the marshy ground at the foot of the hills. It is gregarious in its habits, and after the annual grass burning, I have frequently seen herds of two and three hundred. The colour of the males from the month of November till about the end of May, is of a dark brown, nearly approaching to black, and their bodies are covered down to the knee joints with thick shaggy coats, resembling split whalebone, of four to eight inches in length.

The hair about the neck is very thick, and just like a horse's mane, and the appearance the stag presents when roused, with his shaggy mane standing on end, coupled with the strong smell which at this season proceeds from their bodies, perceptible at forty and fifty yards distance, is so formidable, that I have known the boldest elephants refuse to approach them. In June, the stags commence shedding their horns, and the new ones have nearly attained their full size by the end of November, but are in perfection in February and March; about this time also (June) they change their coats, which lose their whalebone texture, and become of a beautiful glossy chesnut colour, and about half an inch in length. The contour of their peculiarly small heads, and the perfect symmetry of their forms, divested of their long bristly coats, are now fully developed, and at this season they are, in my opinion, the most beautiful and graceful of the Deer species. The height of the full-grown stags averages about eleven and a half hands, and that of the does three or four inches less. The colour of the latter is always the same—a bright bay, but more glossy during the rains than at any other time. The principal distinction between the *Sungraëë* and others of the Deer species, consists in the peculiar shape of the lower antlers, which instead of breaking off at an angle where they are set on the head, preserve the continuity of curve downwards, and project over the eyes of the animal, which they nearly hide, their semicircular shape giving the Deer when at gaze, or in motion, the appearance of having two distinct pairs, the one inclining forwards and the other backwards. The generality of the stags have from six to ten branches or snags, but I have killed very old ones, with no less than sixteen clearly defined branches.


Wild Goat of Afghanistan
Capra Megaceros ♀

It would be a great object gained could any live specimens be procured for transmission to Europe, but it would I fear be attended with much difficulty. I have known several instances of the fawns being caught, and thriving well for months, but at about a year old, they invariably pined away and died; nor have I known or heard of a single instance of one having arrived at maturity, this too in their native climate, and I therefore think the chances of one surviving a voyage home but small. I have written to a friend in the valley to send me a complete skeleton of one with the skin, &c. and he has kindly promised to do so if he can succeed in procuring one, but says he can hold me out but slender hopes, as the Deer now seem to bear a charmed life, and roam about unpersecuted by any body.

PERCY ELD.

*Note.*—The above communication, together with a drawing of the horns, plate xii. has been forwarded by a correspondent, who suggests that the animal be called *Cervus Eldii.* It would however be premature to name it before its zoological characters have been clearly defined by an examination of a complete skin, and if possible a skeleton. Had we not thought these parts essential, we should have named the species three years ago from the horns supplied by Capt. Guthrie, which were evidently of a young individual. Subsequently to the appearance of our notice, which appears to have elicited the above interesting remarks, Capt. Guthrie presented us with a complete head of an adult and by that gentleman's exertions, together with those of Lieut. Eld, we hope soon to be put in possession of the living animal itself.

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## *Report on the Tenasserim Coal Field. By Captain* TREMENHEERE, *Executive Engineer*. t. xiii.

This coal field is situated on the great Tenasserim river, about sixty-seven miles from the port of Mergui. The delta of the river occupies twenty miles of coast, within which space there are many outlets, but the navigable channel discharges itself three miles south of the town. Its course in ascending has a south-eastern direction for thirty-eight miles, when it turns suddenly to the northward; it is here joined by the little Tenasserim river from the south, and the ancient capital of the province. The town of Tenasserim is situated at the point of junction. The coal is seventeen miles due north of Tenasserim, but the sinuosities of the river increase the distance to twenty-nine miles.

2. The banks of the river are in a few places one hundred, and one hundred and twenty yards apart, but two hundred yards may be called the average breadth above Tenasserim, below this it is in no part less than three hundred.

It discharges a large body of water during the south-west monsoon. The greatest difference of level at different seasons observed at the coal site is thirty-five feet, and though there is a rise of tide at Mergui of eighteen feet, ships at anchor there during the freshes are said not to swing to the flood. At Tenasserim, the daily rise and fall is six feet, which, sixteen miles higher up, is reduced to one and a half feet, and though the highest springs are felt within eight miles of the coal, the tide cannot be said to assist navigation for more than fifty-four miles.

3. I passed up the river for the purpose of inspecting the coal mine, between the 12th and 16th of April, when the channel is confined to nearly its narrowest limits. For the first forty-nine miles it is little affected in point of utility by the changes of season; it affords for that distance a broad and deep channel, entirely free from rocks or other impediments, and is at all times fit for inland navigation of any description. Above this, the course becomes more tortuous, and the rise of its bed increases by a succession of platforms, the edges of which present, at this season, sloping ridges of gravel across the stream, which cannot be avoided.

They are fourteen in number, but the difference of level at each step not great, and the current not accelerated thereby at any one point to more than four and a half miles per hour. The depth of water above and below was usually three feet, but on these gravel banks it varied from one foot ten inches to one foot six inches to thirteen inches. They are from forty to eight yards in extent, and form with the sand banks some sudden turns in the stream. Its width for the last eighteen miles was very variable, but there is, one point excepted, abundance of water way, and no other obstructions than the banks just described. At the point alluded to, the stream was restricted to seventy feet, with a current of three and a half knots. The current at other parts being about two knots.

4. The time occupied in proceeding from Mergui, in a boat drawing two feet of water, was four days. Delays occurred at each of the shoals, but not of long duration; the gravel was easily moved with the aid of the current, and the boat dragged over it.

5. It has been mentioned that the general course of the river above Tenasserim is from north to south, which is likewise the case at the locality of the coal. It here passes through a valley four miles long in this direction, and two miles across in its broadest part from east to west. On the east it is bounded by a high range of hills to which the river is nearly parallel; and on the west by a minor range which touches the river at its northern and southern extremities, and turns away from it one mile in the centre. There is a gorge at the central part of this minor range, giving rise to a stream which has been hitherto known as the Coal Nullah, as the coal was first pointed out by the late Dr. Helfer in the bank of that stream at the point marked I in the plan, from which spot the coal exported recently from Mergui has been obtained.

6. The bed of coal, which has been worked under the superintendence of Second-Lieutenant Hutchinson, is six feet in thickness, and crops out to the clay in the left bank of the stream; its upper surface being on a level with the water in the dry season, and covered by a few feet of shale with the soil above. It dips to the east, or towards the river, at an angle varying from 24 to 29 degrees. There are several smaller seams below this alternating with clay to the depth of eighteen feet, but the upper one of six feet is the only workable bed.

7. The mine was opened from the outcrop of the coal, and carried down the angle of dip; the chief working has been to the left or north of the first excavation, as the dip on that side is less by five degrees. Being situated in the bed of the stream, and covered only by porous material, it was much impeded by water during the rains, and though the course of the stream was turned, the pumps in use, of five inch diameter and one foot lift, were insufficient for unwatering the mine at each fall of rain and rise of the water level in its immediate vici-

nity. The pumps were worked by hand-labour. In December last a marine engine of 10-horse-power was received for this purpose, which was put together on the spot, and enabled the work to proceed. The pumps were then connected with the engine, making 40 revolutions per minute, a speed which, owing to the smallness of the diameter and lift it was necessary to maintain, but which is totally unadapted to mining operations. No pipes were received with the pumps, but hollow bamboos were substituted, and the means supplied were in my opinion quite inadequate for working a mine of any extent, or to the expectation, except under the most favourable circumstances of a profitable return for money expended. The angle of dip at which the work has been carried on is one of great practical inconvenience, and I have much doubt whether, even with complete machinery, coal could have been obtained from this mine, excepting for a very short period, so as to be shipped at Mergui at a rate at all approaching to the average price of coal in India. Much however has been done by the exertions of Lieutenant Hutchinson. About one thousand tons of coal have been got out during the twenty months since ground was broken, and the skill and ingenuity shewn in the management of the very imperfect means placed at his disposal, are highly creditable to that officer.

8. The operations should not, in my opinion, be considered as those of a coal mine, but as an experimental working, and when the large sums of money expended at the commencement of undertakings of this nature in other countries before coal is reached are also considered, I shall, I trust, be able to make it appear that the prospects from this coal field are not discouraging.

9. Nothing satisfactory appears in the nature of this coal deposit, to enable me to refer it to the true coal measures of the carboniferous system. There is no trace of limestone of any description, or of red sandstone, either old or new, within the distance of several miles, to which observations of the structure of the country have been made. The surface of the hills on either side of the basin, and for a considerable space towards the centre, is covered by an overlying claystone porphyry, which bears no relation to a deposit of coal. This is thickly penetrated by veins of quartz, and the hills on the West, judging by the large masses of quartz with which the ravines abound, consist principally of that rock, while the streams on the East containing tin

and fragments of slate, denote the primitive structures of the mountains on that side of the river. The only other rock in the neighbourhood is a ferruginous gritstone, dipping immediately below the coal beds; but I saw in it no character to allow of its being placed so low as the carboniferous system.

The shales from the roof of the coal have numerous vegetable impressions, but of small size, and they appear to be allied to existing species. The series of beds above the coal which are seen in the opposite side of the river, and will be hereafter described, amounting to 500 feet, consist chiefly of soft shales of various colours, sandstone, and shale conglomerate, composed of the debris of other strata similar to their own. They are also intersected in two places by parallel dykes of igneous rock, but none of them seem to have undergone that degree of pressure and solidification, which is apparent in coal measure shales of the older periods, nor have there been yet seen any remains of organic substances amongst them to authorize their being referred thereto.

10. In the absence of guides by which these questions are usually decided, and with the anomalous character of the adjoining rocks, the true nature of the coal must be determined by external characters, by its behaviour in the fire, and by its composition.

11. It is found in a hard and solid bed, consisting of layers of slaty structure parallel to the bed, and is easily separated in that direction. Between the laminæ there are thin plates of arsenical iron pyrites. It is bright to the surface in cuboidal pieces, which do not however preserve their size under rough treatment. Its cross fracture is conchoidal, and it is fibrous, dividing into thin plates in the opposite direction, while its flat surfaces present a ringed appearance, much resembling the ringing of wood, as seen in transverse sections. Its lustre is somewhat glistening when freshly broken in the mine, and colour dull black, but after exposure to the atmosphere it loses this appearance, and assumes a brownish black colour. It does not soil the fingers, but is deficient in that "glow," or metallic lustre, which is eminently characteristic of mineral coal. Its specific gravity is 1.2. In the flame of a spirit lamp it exhibits some inflammable gas, and gives off a small quantity of brown oily bitumen; it does not swell, and emits but little smoke. It consists chiefly of carbon, and leaves when well burnt, a very small proportion of residue.

| | | |
|---|---|---|
| 100 grains of this coal gives, of volatile matter, | grains | 95.80 |
| ,, ,, ,, soluble matter, ............... | ,, | .98 |
| ,, ,, ,, insoluble ditto, ............... | ,, | 1.56 |
| ,, ,, ,, earthy residue, ............... | ,, | 1.66 |
| | | 100.00 |

In an open fire it refuses to inflame without the action of the bellows, and will not do so without a strong draught. When burnt in the fire, its appearance very much resembles that of common charcoal, the thin plates before mentioned assuming that divergent shape observable in charred wood. The conclusion to which, from the foregoing considerations I have arrived is, that it belongs to that description of coal termed wood coal, or lignite.*

12. Its serviceable qualities are not best determined in the laboratory. It burns well in the fires of the marine engine at the mine, and no difficulty is found there in keeping up the steam. The fire bars were placed at small intervals to suit the coal, which is liable to break up into small pieces. No rate of expenditure has been determined, as the engine was worked much under its full power; 20 tons were shipped at Madras in the India Steamer, and the report by the commander, Captain Henderson, and of the chief engineer on board, which was published, is satisfactory. It is stated to require "great care and labour to manage the fires well, but not more than is required with the Burdwan coal; that it has a strong heat, and could keep good steam with careful firing." Its consumption, when compared to

* We should rather be inclined to regard this coal, in the absence of any evidence to the contrary, to be equivalent to, and identical with the coal formations in other parts; particularly as true coal strata are stated by Capt. Tremenheere to occur abundantly in the same vicinity (vide paragraphs 15 and 18.) As to the mineral characters of coal, scarcely two beds in the same mine are any where found to agree. One may be slate coal, another splint, a third cannel, and so on. The bed which has been worked in the present case seems to have consisted of layers of different kinds of coal and shale, indiscriminately taken for a single bed of coal. Consequently hardly any two reports as to its quality will be found to agree. In small selected specimens it will be a free-burning pure coal, in larger samples intermixed with slate it will be better or worse according to the proportion of the latter; and in still larger quantities in which from the uncertainty of its characters the chances are increasedof pyritous coal being mixed up with it, the whole will be condemned as subject to spontaneous combustion, as was the case with the Tenasserim coal sent at a great expense to Singapore. This bed of coal should never have been worked, at least without discrimination, confining the workings to that portion of the bed only which consisted of pure coal. From the report of Capt. Tremenheere it is quite clear that other workable beds occur in the vicinity, belonging probably to a lower position in the series, but essentially the same formation.—Ed.

English bituminous coal, was estimated as four to three during a short trial, and from 10 to 12 lbs. per horse per hour. I have heard however other statements which are not so favourable. I find that a ton weight of the loose coal occupies 165 cubic feet. There are at present about 100 tons at Mergui, and I would suggest, that a careful trial be made of this quantity, to ascertain its real effect in the duty of steam engines.

13. I proceeded to trace the connection of the bed with the adjoining rocks, and to ascertain if possible, the position of the coal beds of this locality. The ground had been penetrated in four other places besides the mine, marked 2, 3, 4, 5, in the plan, all in its immediate neighbourhood. No. 2 shaft passed through the six feet bed at the same level as in the mine, and it was found to dip at the same angle; below this, smaller seams, not exceeding one foot, alternated with seams of under-clay for 18 feet; 20 feet of a quartzose rock and conglomerate were penetrated afterwards, and the shaft then discontinued for want of means to get the water out. The object of this sinking was to find deeper coal. A detached fragment of coal containing some bitumen was found. No. 3 shaft was driven through 40 feet of shale with vegetable impressions, covered only by the soil, and abandoned. No. 4 shaft was sunk with reference to future work; after going through the clays and sands at the surface, and 61 feet of conglomerate, dipping in like manner with the coal, it stopped at 95 feet, till means should be available for carrying it deeper; it being the intention to move the engine here at the commencement of the monsoon, when the old work would be no longer tenable, and if the dip of the coal continued the same, it was expected to be reached at 300 feet. Boring No. 5 was carried 40 feet lower than this shaft, but without shewing any indications which could be relied upon.

14. It will be seen on the plan, that the site of these shafts is in the immediate vicinity of the central part of the minor range of hills on the west bank of the river before noticed; their steep slopes extend within 250 yards of Nos. 1, 2, and 3, which are either upon or close to the upturned edge of the bed of coal. As this, as well as all the accompanying strata penetrated, rested at the inconvenient angle of not less than 24 degrees, my first objects were to ascertain the extent of the coal field, and whether the same or other beds might not be found in a position more convenient for practical purposes.

15. The configuration of the ground—an elongated trough or basin between two ranges of hills,—gave me reason to believe, that these were the natural limits of the coal beds which had been exposed to view; and having on my passage up the river observed shale and sandstone, with vegetable impressions in the left or east bank, about a mile below the coal wharf at V, I examined at an early period of my visit the rocks on that side. I found here the whole series of coal beds consisting of sandstone shales and coal interstratified and lying with great regularity and low angle of dip between O and C for three-quarters of a mile on the line A B on the plan. They are inclined down the stream, or towards the S. E. on the direction of the bank, and rest upon each other for the space mentioned at an angle of from 9° to 7°. Tracing the beds from point V in the plan, two faults are found at S and O, between which points the strata are thrown down in the same direction, and to the East at an angle of 30°, but in the North side of the fault O, they are undisturbed, and dip at an angle of 7°. At N a small seam of coal appears, at *e* the shale is of blue colour, with numerous vegetable impressions and coal, and at *e* there is a seam of coal cropping out at the level of the river. The intermediate shales are variegated, brown, white, striped blue, and black.

16. Section No. 1 represents these beds as they appear at different points above the level of the river along the line of bank A. B. The measurements taken on the line and the uniform angle of dip gives a total thickness of 500 feet.

17. At the point *c* there is a change in the rocks, a hardened red clay with rounded fragments of shale passes into the shales, but without any alteration on the angle of dip, and at 200 yards up the stream they cease altogether, the bank being then composed entirely of clay.

18. In proceeding higher up the river, with a view to trace these beds, and ascertain their true angle of dip, and after passing the hill at E, the northern extremity of the lesser range, there is a reach of the river bearing East and West, or nearly at right angles to its general course; and at the western part of this reach I again found the same series of coal beds, well exposed on the bank, for half a mile along the line C D, as shewn in section No. 2. They have evidently been the cause of this short and sudden bend in the river. The rocks first appear in this reach near the point D, where for a

short distance, as at *b c* on the other face, they are hardened by contact with a dyke of igneous rock, which shews itself at C in the line C D. At *p* soft shales with seams of under-clay and coal are found, at *d* a seam of coal crops out at the level of the river, which being at the same level, belongs without doubt to the same beds which are indicated on the other side of this tongue of land at *d*. The beds upwards from *d* consist of striped, blue, and soft grey shales, the whole resting uniformly upon each other, and dipping at an angle of 12° up the stream, or to the eastward till we arrive at the point O, where there is another igneous dyke, and the strata are thrown down thereby to the eastward at an angle of 30°. These were followed as far as the point S in the Yaibon river, to which they continue at the same high angle, but beyond this, and for some distance higher up the Yaibon, all trace of them is lost.

19. The correspondence of the bed C C, *d d*, of the dykes C C, O O, and faults S S and the phenomena accompanying them leaned at once to the inference, that the edges of rock, as seen along the lines C D, A B, present two views of the same beds, that their angle of greatest dip is 12°, and that they are continuous from one side of this tongue of land to the other. In examining the country inland, the dyke *o* was distinctly marked at various points between *o* and *o*, and its direction is shewn on the plan. Igneous rock was also found at intervals between C Y C, denoting, that though these igneous dykes passed through the coal field and disturbed the continuity of the beds, they remained between the two dykes and across the tract between O C, C O, unbroken, and resting on one another with great regularity at an angle with the horizon varying from 7°, 9° to 12°. The space covered thereby is 1¾ miles in length by 400 yards in average breadth.

20. The bed of coal at *d d* I believe to be of the same thickness and quality as that which has been worked at the mine. There is in the bed of the stream near the opening of the mine at I, the fractured edge of a ferruginous rock distinctly marked, which dips immediately below the coal at the same angle with it, and has been forced up at the same period. The bearing of this edge is 2½ degrees East of North, which is denoted by a black dotted line in the plan. The position of the outcrop of coal *d*, which was arrived at by observations independent of the line of bearing alluded to, is as nearly as possible upon this line, and the coal shewn at these two points formed, I con-

ceive, at one period a continuous bed. A quantity of hard specimens were collected at the points *d d* as soon as the coal was pointed out, but being on a level with and below the water, with a high precipitous bank above, the depth of the bed could not be ascertained immediately.

21. Instructions have been left with Lieutenant Hutchinson to penetrate the coal near the two points *d d*, and report on the thickness of the working bed without delay.

22. Section No. 3, which is taken in a direction from west to east, from the gorge of the lesser range at G to the east bank of the river at *m*, shews the relative positions of the coal which has been worked, and the bed *d d* at the point *m*, where the section strikes the opposite bank. It includes the shafts and other excavations, the depths of which are shewn at their proper level. The space between these and the river is covered by sands, clays, and other superficial deposits, without any indication of coal. The beds are broken off abruptly along the line A B, and the depth at which they might be found on the west side of the river, in the absence of any other indication than the disturbed strata at 1, 2, 3, 4, would subject to much uncertainty. The space to the northward of this between the line G, W, H, and the outcrop of coal at *d*, and the points *d z*, would be subject to the same chances; but supposing the bed to be continuous with regularity across the river to the south, it would not be reached at any intermediate point between *z* and *m*, along this line, at less depth than 330 feet below the lowest level of the river.

23. For these reasons I am compelled to recommend that the work hitherto prosecuted on the west bank shall be entirely abandoned, and, if it be desired to raise coal from this coal field, that the operations may be transferred to the other side of the river, within the limits of the space marked by a dark shade on the plan and bounded by the igneous dykes before mentioned. The coal measures within this space lie in a manner unusually favourable for mining, as, independent of their moderate angle of dip, they are protected from all but surface waters by the high inclination of strata on the outer side of the igneous dyke O O, which dips away from them to the east at an angle of 30°, and the coal may be reached within the limits of the space *o d* and *d o* in the plan, at such depth as may be selected with reference to the extent of work intended, vide Sections No. 1 and 2.

The total depth of these beds ascertained, is 500 feet. There is every reasonable probability of their containing the six feet seam of coal (a most convenient size for working) as indicated at *d* and *d*, and within this mass of coal-bearing strata, there may be other beds of workable coal. Experiments below the lowest beds here seen, would not, I think, be attended with success.

22. The superficial area covered by the portion of the bed of coal on this side of the river considered workable, I estimate at 280 acres. Its dip varies from 12° to the N. E. by N. at the northern extremity C D, to 9° and 7° to the S. E. by S. at its southern edge A B. It crops out at the surface at the two points *d d*, and to the eastward of a line joining these points, for the distance of 440 yards, it may be reached at any depth not exceeding 50 fathoms from the river level. Experimental shafts are in progress near the points *d d*, but pits for work should be placed first along the line *e g*, parallel to *d d*, and distant 160 yards, where the coal will be found at 100 feet below the same level, provided the field is not otherwise broken up by more faults and dykes than the two longitudinal igneous dykes represented in the plan. No indication of such further disturbance has been yet observed, but to provide for the contingency, I should recommend that the line for pit-work should be kept, as above suggested, within a moderate distance to the eastward of the line of outcrop of coal. The ground near this line is low and favorable for work, and coal may be raised at either end of the bed at 500 yards from the river, and lowered from the bank over deep water.

23. It would lead however only to disappointment if work be commenced on this side of the river, without some important additions to the machinery at present available. The engine itself is of old construction, and requires frequent repair, but for power it is effective when in order. Its speed, 40 revolutions per minute, is not adapted for mining purposes, which must be reduced to 15 per minute by additional wheel-work to make it available as a pumping engine. The rest of the machinery on the spot consists of one forcing pump, five in diameter, and 10-inch lift without air-vessels, three suction pipes five inches in diameter and — feet lift without pipes, seventy-two feet of 3-inch pipe, and two iron winches worked by hand. These, excepting the winches, are too small for use, and pumps of proper dimensions are indispensably necessary, and should be supplied before

it is attempted to raise coal. A memorandum of the machinery and stores required for immediate use, together with drawings of gear, &c. by Lieutenant Hutchinson, is submitted herewith, enclosure No. 1. It involves the smallest outlay which will enable the work to proceed with advantage.

24. The following is an account of the expenses of the present establishment, and of that which would be required after the requisite additions to the machinery have been made:—

*For one Month..*

| *Present Establishment.* | *Amount.* | *Number required when Machinery is Complete.* | *Amount.* |
|---|---|---|---|
| Superintendent, .... Rs. | 200 0 0 | Rs. | 200 0 0 |
| Sub-Assistant Surgeon, .... | 185 0 0 | ... | 185 0 0 |
| 1 Overseer, .... .... | 50 0 0 | .... | 50 0 0 |
| 4 Miners, at 30 Rs. each, .... | 120 0 0 | .... | 120 0 0 |
| 3 Smiths, at 30 ditto, .... | 90 0 0 | 4 Smiths, at 30 Rs. .... | 120 0 0 |
| 1 Ditto, at 40 ditto, .... | 40 0 0 | .... | 40 0 0 |
| 1 Capenter, at 45 ditto, .... | 45 0 0 | .... | 45 0 0 |
| 3 Ditto, at 35 ditto, .... | 105 0 0 | .... | 105 0 0 |
| 4 Ditto, at 30 ditto, .... | 120 0 0 | } Not required after the machinery is erected. | |
| 1 Ditto, at 20 ditto, .... | 20 0 0 | | |
| 1 Head Cooly, at 13 ditto, .... | 13 0 0 | .... | 13 0 0 |
| 6 Coolies about the mine and work shop, at 12 ditto, .... | 72 0 0 | .... | 72 0 0 |
| 4 Coolies cutting trees for the Mine, at 10 ditto, .... | 40 0 0 | .... | 40 0 0 |
| 1 Felling timber, at 10 ditto, | 10 0 0 | .... | 10 0 0 |
| 10 Building and repairing, at 10 ditto, .... .... | 100 0 0 | .... | 100 0 0 |
| 16 Carrying rice and other stores from the river side, .... | 160 0 0 | } Not required after a train road is placed. | |
| Total, ... | 1,370 0 0 | Total, .... | 1,100 0 0 |
| *Convict Labour.* | | *Convict Labour.* | |
| 21 Convicts about the Jail Hospital, and in charge in tools, | | 21 .... | |
| 1 Carpenter, .... .... | | 1 .... | |
| 8 Sawyers, .... .... | | 8 .... | |
| 32 Colliers, .... .... | | 30 .... | |
| 53 Passing away and heaving coal | | 15 .... | |
| 10 Lower pump, .... .... | | Not required, .... .... | |
| 21 Road-making, .... .... | | 20 .... | |
| 2 Oil Mill, .... .... | | 2 .... | |
| 7 Paddy cleaning, .. .... | | 7 .... | |
| 9 Cooks, .... ... | | 6 .... | |
| 31 Sick and convalescent, at 16 per cent. .... .... | | 11 at 10 per cent. for lighter work, .... .... | |
| 195 Convicts at 5 Rs. .... | 975 0 0 | 121 Convicts at 5 Rs. each, .. | 605 0 0 |
| Boat hire & other small expenses. .... .... | 150 0 0 | .... | 150 0 0 |
| | | Supervisor of Bamboo Forests, | 20 0 0 |
| | | 1 Engineer, .... .... | 50 0 0 |
| | | 4 Coolies on account of Machinery, at 12 Rs. .... | 48 0 0 |
| Present Monthly Expenses Total, .... .... | 2,495 0 0 | Total, .... | 1,973 0 0 |

An addition to the salary of the European overseer, who has the responsible charge of all tools, materials, &c. of 30 rupees per month is recommended, and I venture to suggest, that if the work proceed on the scale proposed, the allowances of the superintendent be placed on the same footing as those of engineer officers holding charges of equal importance and responsibility. I consider Second Lieutenant Hutchinson qualified in every respect to conduct any operations at the coal field that may be determined upon.

25. It is proposed to raise the coal from two shafts by means of cattle whins, which can be constructed on the spot from a model, which has been left with Lieutenant Hutchinson. There is abundance of good timber at hand (the *peemah*) for this purpose.

26. Placing the utmost limit of expenditure, with the means above detailed, to provide for all contingencies at 2200 rupees per month, the cost of coal at the pit's mouth, when the machinery is fixed and the mine fairly open, may be thus estimated. If only 10 tons be raised daily from each shaft, 20 tons per day, 25 days=500 tons per month, at a cost of 2200 rupees. The cost of one ton will therefore be 4 rs. 6 as. 5 pie, or 2 as. 6 pie per maund. The coal is at present brought down the river on bamboo rafts. The present cost of transport to Mergui by contract, amounts to 2 as. 9 pie per maund, being carried on men's shoulders a distance of 1300 yards to the river ; but if conveyed on a train road and lodged upon the raft, for which the new arrangements provide, the cost of carriage to Mergui would be reduced to 1 a. 7 pie per maund, making the total cost of coal brought alongside shipping at that place, four annas one pie per maund.

27. While upon the raft, the coal is almost wholly immersed in water. Landing it at Mergui should be avoided as much as possible, and it should, in all practicable cases, be shipped from the rafts.

28. During four months of the year, from 15th June to 15th October, a steam tug with tenders lashed alongside might be usefully employed in conveying coal to Mergui, and would perform nine trips in the month; but owing to the sudden turns and set of the stream in various places before noticed, together with the shallowness of the water, and the rapidity of the current at those parts during the rest of the year, I am unable to suggest any better or more economical method of conveying coal down the river during that period, than by the bamboo rafts hitherto used.

29. There is no apprehension of a deficiency of bamboos for their construction for an unlimited period, but to secure an unfailing supply within a moderate distance of the coal field, and to prevent waste and destruction by the contractors supplying the rafts, the services of a native supervisor are necessary. The wages of such a person are provided for in the estimate of future expenses.

30. On the 2nd of May I quitted the coal field. The river had then risen one cubit, but it fell afterwards to its former level. The water this year was considered unusually low. Some loaded rafts which had been despatched on the first rise, were, after proceeding a few miles, detained at one of the shallows, and had not arrived at Mergui on the 20th, the day on which I embarked.

G. B. Tremenheere, *Capt.*
*Executive Engr. Tenasserim Provinces.*

*Moulmein* 30*th June,* 1841.

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## *The Assam Tea Plant.*

The Agricultural Society in awarding its medal to Capt. Charlton, the discoverer of the Assam Tea plant, appears to have vindicated its own independence, and established that gentleman's claims to the discovery of the plant, as first ascribed to him by Dr. Wallich, but afterwards, for some unaccountable reason, denied by the same, authority.

On the arrival of Dr. Wallich and his companions at Suddya, in January 1836, he took up his quarters in the house of Capt. Charlton, which had been allotted to his accommodation by its owner, free of expense, during his stay in Upper Assam.

Here the Deputation had an opportunity, for the first time, of inspecting the Tea plant growing in Assam. Capt. Charlton's compound had been converted into a tea nursery, to which he appears to have devoted much attention, the plants generally being from two feet to three feet in height, and probably about one or two thousand in number.

Shortly before the arrival of the Deputation, the enclosure surrounding the nursery, (the first ever formed under European superintendence in Assam,) had been trampled down, and the plants destroyed in a great measure by cattle. This would seem to have happened during the absence of Captain Charlton on the service on which he was wounded, or shortly after that accident, which placed his life in danger for several years, and deprived the Deputation of his services at Suddya.

In consequence of the absence of Capt. Charlton from this cause, Mr. C. A. Bruce, his overseer, being the only resident at the place, was requested to accompany the Deputation to those parts of the adjoining district from which the Tea plants had been brought.

Mr. Bruce's account of the state of the district, and the difficulties to be overcome, was such, as to induce Dr. Wallich to declare he would go no further; a determination he was only induced to alter, on finding his companions inclined to proceed without him.

The truth is, Mr. Bruce himself had never, up to this period, though ten years resident at Suddya, visited any one of the places from which Capt. Charlton's people obtained the plants; and in order to reconcile this circumstance with the excessive zeal which he professed, Mr. Bruce certainly made the difficulties appear to be much greater than they really proved to be.

After Capt. Charlton had been compelled to leave Suddya, or about a month before the arrival of the Deputation, Mr. Bruce assumed charge of the establishment of Chuprasses, Nursery-men, and Coolies; and as these persons, under the superintendence of Capt. Charlton, had been in the habit for two years before of collecting Tea plants from various parts of the forests, they knew exactly where they were to be found, and accordingly acted as guides to the Deputation, the arrangements being left to Mr. Bruce.

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## *Botanical Garden at Kew.**

The Report of Professor Lindley upon the present condition of the Botanical Garden at Kew, contains the following observations, which are well deserving of attention :—

* The above report of Professor Lindley appears to have led to the removal or resignation of the Superintendent of Kew Garden, who had been five and twenty years in that office, and to the appointment of Sir W. J. Hooker in his place. The report and its consequences are important, as shewing the little disposition that now exists at home to allow public institutions to become subservient to the private convenience of individuals. We hail it and its effects, as the commencement of a new era. What would Professor Lindley say, to a *Botanical Garden* without cultivation, without arrangement, without nomenclature, without an herbarium—without an object, as far as can be gleaned from the Report of the Superintendent himself, which we had the honour to notice in our last number? — Ed.

" So far as the mere cultivation of this place is a subject of observation, it is due to those who have charge of it to say, that it does them credit, considering the crowded state of the houses, and the inadequate funds allowed for its support.

" It is impossible to speak of the general management in similar terms. It has always been maintained as the great Botanical Garden of this country, and whether, as a private or as a public establishment, it was the duty of the officer entrusted with its administration, to render it effective to the extent of his means as a Botanical Garden, that is, as a garden of science and instruction ; yet no kind of arrangement (one of the first features in a Botanical Garden) has been observed ; no attempt has been made, till lately, to name the multitudes of rare plants it comprehends, and thus to render it a place of public utility ; no communication is maintained with the colonies ; nor any other thing done, so far as can be discovered, to fulfil the objects of its institution, except to raise the seeds which government collectors and other persons have profusely contributed, and then to take care of the plants.

"It is admitted that there is no classification observed in the Garden.

" What names are to be found in the Garden have been furnished by Mr. Smith the foreman, and the Director does not hold himself answerable for them. This was most particularly inquired into, and most distinctly avowed; so that by far the most difficult part of the duty of the principal officer ; a duty on the perfect execution of which the credit and utility of the Garden essentially depends ; a duty which can only be executed properly by a man of high scientific attainments, aided by an extensive herbarium and considerable library. This most important duty is thrust upon a foreman, paid small weekly wages for cultivating plants, who, whatever his zeal and assiduity may be, (and in this case they have been such as to deserve the greatest praise,) has no sufficient means of executing such an office. * * * * * * *

" Visitors are unreservedly admitted to the Garden daily, except on Sundays, and Mr. Aiton deserves credit for having exercised his power, as Director-General, in order to secure this privilege to the public. It is, however, not easy to discover what advantage, except that of a pleasant walk, has been derived from the privilege in the past state of the Garden." * * * *

Dr. Lindley " recommends that the Lord Steward be relieved from the burthen of this Garden, unless it should be Her Majesty's pleasure to retain it." If the Botanical Garden of Kew is relinquished by the Lord Steward, it should either be at once taken for public purposes, gradually made worthy of the country, and converted into a powerful means of promoting national science, or it should be abandoned. It is little better than a waste of money to maintain it in its present state, if it fulfil no intelligible purpose, except that of sheltering a large quantity of rare and valuable plants.

" The importance of public Botanical Gardens has for centuries been recognised by the Government of civilized states, and at this time there is no European nation without such an establishment, except England. The most wealthy and most civilized kingdom in Europe offers the only European example of the want of one of the first proofs of wealth and civilization. France, Prussia, Austria, Bavaria, Russia, Hanover, Holland, not to mention smaller Governments, have all Botanical Gardens, liberally maintained with public funds; and what is more curious, Dublin and Edinburgh have similar establishments to which grants of public money have been liberally furnished, but London has nothing, except a small Garden at Chelsea, maintained by the funds of a private corporation. Now that a great number of students are annually collected in London for the purpose of study, it has become indispensable that such means of instruction as a Botanical Garden affords, should be provided. It appears, from returns obtained from the Society of Apothecaries, that annually, on an average of the last three years, as many as 433 medical students have been registered as attending lectures on Botany in London. They are compelled to attend these lectures, not only by the Apothecaries' Society and the College of Surgeons, but by the regulations of the army and navy; and yet this large number of young men studying the most important of professions, is practically deprived of the advantages of referring to a Botanical Garden, without which it is impossible that their studies can be prosecuted efficiently. It is true that there is a Botanical Garden at Chelsea, belonging to the Apothecaries' Society, but it is not to be expected that the funds of such a corporation, however liberally disposed it may be, should suffice for the maintenance of such a Botanical Garden as the wants of students render necessary.

"But this is only one out of many reasons why a national Botanical Garden should be maintained by Government near London.

"There are many Gardens in the British colonies and dependencies; such establishments exist in Calcutta, Bombay, Saharunpore, in the Isle of France, at Sydney, and in Trinidad, costing many thousands a-year. Their utility is very much diminished by the want of some system under which they can all be regulated and controlled. They are in a similar condition to the Royal Foreign and Kitchen Gardens, already disposed of. There is no unity of purpose among them; their objects are unsettled; their powers wasted, from not receiving a proper direction; they afford no aid or assistance to each other, and it is to be feared, in some cases, but little to the countries in which they are established; and yet they are capable of conferring very important benefits upon commerce, and of conducing essentially to colonial prosperity.

"A national Botanical Garden would be the centre around which all those minor establishments should be arranged; they should be all under the controul of the chief of that Garden, acting in concert with him, and through him, with each other, reporting constantly their proceedings, explaining their wants, receiving their supplies, and aiding the mother country in every thing that is useful in the vegetable kingdom. Medicine, Commerce, Agriculture, Horticulture, and many valuable branches of Manufacture, would derive considerable advantages from the establishment of such a system."—*Lancet, June* 13th, 1840.

*The London, Edinburgh, and Dublin Philosophical Magazine, and Journal of Science. London, 8vo. Nos.* 114, 115, *for January and February* 1841.

The eminent scientific acquirements, and well-known literary celebrity of its conductors, are a fair earnest of the interest and value of the matters discussed in its pages. These are as various and extended as the title of the Journal suggests, and would lead us to expect. The greater number of its pages are devoted to mathematical and chemical investigations; some on new and interesting discoveries, others on subjects which have long occupied the attention of the cientific world, and by progressive links in the chain of inductive reasoning, founded on experimental research, are gradually developing fresh objects of inquiry, and extending the boundaries of positive and practical knowledge. It would obviously be impossible then, consistently with the limits of our time and space, to afford our readers more than a cursory and general view of their contents.

The two first papers are by Professor Airey, the Astronomer Royal, and Mr. Potter, on points connected with the undulatory theory of light, and its capability of explaining the varied phenomena produced by luminous bodies in different media, and under particular circumstances. The calculations contained in these communications are of an intricate and abstruse nature, requiring an extended knowledge of the higher branches of mathematical science, to follow out and understand them. There can be no doubt, that few subjects have been investigated of late years, with more skill and success, than that of light, and the curious analogies presented by it to heat, and the different departments of electrical science.

The high degree of mathematical and experimental information required to prosecute these inquiries with any degree of credit and hope of distinction, necessarily limits the number of labourers in its field, while at the same time, it enhances considerably the value of their exertions. Their application to the business of life, and improvement of the arts, are neither their least, nor their only merit.

The experience of centuries, and the daily progress of every branch of information in our own times have taught us, that however profound, and apparently visionary and incomprehensible such speculations may appear, they have led, (when united with industry, perseverence, and a cautious application of general principles to particular results,) to some of the most important and interesting triumphs of mechanical and physical science. The paper of Professor Airey is on the " Diffraction of an annular aperture," a point which he states has been " passed over too lightly by writers on the undulatory theory." The problem is enunciated, worked out, and proved, with the usual skill and acumen of that profound and accomplished mathematician.

In the numbers of the Journal under consideration, are contained no less than six communications from different observers, on the electrical phenomena connected with Steam. This, being a subject which has very recently been made known, and, we believe, accidentally discovered, has excited considerable attention in Europe and elsewhere, as well as directed many experimental inquirers to institute researches with a view to its elucidation. The value of steam, in every point of view, and the daily increasing interest and importance of the phenomena of electricity, as applied to practical purposes, render them well worthy of the labour bestowed upon their investigation.

In the first paper of *Dr. Schafhaeutl,* " On Steam considered as a conductor of electricity," he concludes from certain experiments detailed, that steam, pure and free from contact with water, is a non-conductor, resembling in this respect, the gases. He appears to ascribe the electricity of steam to its condensation, on the rapid expansion of which when issuing from a jet, its production in some measure depends. In the same number, Mr. Armstrong of Newcastle, details some interesting experiments on the same subject. He insulated the boiler, and then ascertained that a jet of high pressure steam contains little more electricity than one of low pressure, its apparent excess being caused by its being more readily collected. He infers, that, the electricity is in a neutral state while the steam is confined within the boiler, and that it is a tolerable conductor of electricity " even in its transparent state." The discrepancy in the results of these two observers, shews, that many more experiments are required before any definite conclusions on the subject can be arrived at.

Mr. Armstrong appears to have been the first person who noticed and attempted to explain these phenomena; one of their chief uses will be to enable us to understand many meteorological phenomena, concerning which our information is at present very indefinite and unsatisfactory.

The next subject of interest is a paper "On the Tornado which visited New Brunswick in 1835." The views of the author, Mr. Redfield, of New York, appear to be plausible and ingenious, on a phenomenon, with whose course and causes we have scarcely any acquaintance: much will doubtless be written, and many conjectures hazarded, before we reach an approximation to the truth. The admirable work of Colonel Reid, and the many simultaneous observations now carrying on by competent individuals in every quarter of the world, have given an impetus to this department of meteorology, which cannot fail, ere long, to clear away much of the mist in which it is at present involved. It would be useless and unphilosophical in the present state of our knowledge, or more correctly speaking, of its absence, to attempt to explain and lay down laws on these obscure facts, until accumulated observations shall enable us to arrive at satisfactory and conclusive results. The chief points ascertained by Mr. Redfield, are, that the course and action of these tornadoes are rotative, and their effects more violent on and near the line passed over by the axis, than in any other portions of the track.

The purely chemical papers are numerous, and on a great variety of subjects. A new crystalline compound of chlorine and cyanogen, resembling the bi-sulphate of quinine in external appearance, is described, together with the processes for obtaining it, by its discoverer Mr. Stenhouse. A translated paper of *Prof. Poggendorff's* from his *Annalen*, "On the surprising intensity of the Zinc-iron circuit," is published in the number for January. The discovery was made by Mr. Martin Roberts, who did not venture to offer any explanation of it. The German Professor has attempted an elucidation, which we do not consider perfectly satisfactory. In all these inquiries, however, the test of direct experiment is required to enable any one to coincide with or object to the views and conclusions of the original observer.

One of the most interesting documents in the January number, is the excellent anniversary address of the President of the Royal Society. It exhibits the ardour and zeal with which all branches of scientific inquiry are prosecuted and encouraged by a Society second to none in the world for the rank, wealth, intelligence, and celebrity of its members.

The award of its medals to Sir John Herschel, Professor Wheatstone, and MM. Biot, Sturm, and Liebig, likewise afford proof of the noble disinterestedness with which merit is acknowledged and appreciated, from whatever country or clime it may emanate. The task of drawing up summary accounts of deceased Members and Fellows, was delegated to Dr. Roget, by whom it has been executed with his accustomed taste and elegance.

The list is rather a long one, and unfortunately comprises some of the most distinguished ornaments of the present age. We regret much that our limited space will only permit us to transcribe the notices of Mr. James Prinsep, Mr. Vigors, and the venerable Professor Blumenbach. It cannot fail to be a source of the greatest gratification to the numerous relations, friends, and admirers of the late distinguished Secretary to the Asiatic Society, to find his merits thus prominently recorded by the Royal Society. The sketches of the German Professor and Mr. Vigors, we give to our readers, from their well-known connection with the science of Natural History.

"Mr. James Prinsep, whose brilliant career of research and discovery has been closed by a premature death in the flower of his age, was Principal Assay Master, first of the Mint at Benares, and secondly of that of Calcutta, where he succeeded Professor Wilson in 1833; he was a young man of great energy of character, of the most indefatigable industry, and of very extraordinary accomplishments; he was an excellent assayist and analytical chemist, and well acquainted with almost every department of physical science; a draughtsman, an engraver, an architect, and an engineer; a good Oriental scholar, and one of the most profound and learned Oriental medallists of his age.

In 1828 he communicated to our Society a paper "On the Measurement of High Temperatures," in which he described, amongst other ingenious contrivances for ascertaining the order, though not the degree, of high temperatures, an air-thermometer applicable for this purpose, and determined by means of it, probably much more accurately than heretofore, the temperature at which silver enters into fusion.*

His activity whilst resident at Benares has more the air of romance than reality. He designed and built a mint and other edifices; he

* See Phil. Mag. and Annals, N. S. vol. iii. p. 129, and vol. x. p. 356, note.—Edit.

repaired the minarets of the great mosque of Aurengzebe, which threatened destruction to the neighbouring houses; he drained the city, and made a statistical survey of it, and illustrated by his own beautiful drawings and lithographs the most remarkable objects which the city and its neighbourhood contains; he made a series of experimental researches on the depression of the wet-bulb hygrometer; he determined, from his own experiments, the values of the principal coins of the East, and formed tables of Indian meterology and numismatics, and of the chronology of the Indian systems, and of the genealogies of Indian dynasties, which possess the highest authority and value.

When transferred to Calcutta, he became the projector and editor of the "Journal of the Asiatic Society of Bengal," a very voluminous publication, to which he contributed more than one hundred articles on a vast variety of subjects, but more particularly on Indian coins and Indian Palæography. He first succeeded in deciphering the legends which appear on the reverses of the Greek Bactrian coins, on the ancient coins of Surat, and on those of the Hindoo princes of Lahore and their Mahomedan successors, and formed alphabets of them, by which they can now be readily perused. He traced the varieties of the Devanagari alphabet of Sanscrit on the temples and columns of Upper India to a date anterior to the third century before Christ, and was enabled to read on the rocks of Cuttack and Gujarat the names of Antiochus and Ptolemy, and the record of the intercourse of an Indian monarch with the neighbouring princes of Persia and Egypt; he ascertained that, at the period of Alexander's conquests, India was under the sway of Boudhist sovereigns and Boudhist institutions, and that the earliest monarchs of India are not associated with a Brahminical creed or dynasty. These discoveries, which throw a perfectly new and unexpected light upon Indian history and chronology, and which furnish, in fact, a satisfactory outline of the history of India, from the invasion of Alexander to that of Mahommed Ghizni, a period of fifteen centuries, are only second in interest and importance, and we may add likewise in difficulty, to those of Champollion with respect to the succession of dynasties in ancient Egypt.

These severe and incessant labours, in the enervating climate of India, though borne for many years with little apparent inconvenience or effect, finally undermined his constitution; and he was at last compelled to relinquish all his occupations, and to seek for the restoration of his health in rest and a change of scene. He arrived in England on the 9th of January last; but the powers both of his body and his mind seemed to have been altogether worn out and exhausted; and after lingering for a few months, he died on the 22nd of April last, in the forty-first year of his age. The cause of literature and archæology in the East could not have sustained a severer loss."

"Mr. Nicholas Aylward Vigors was born in 1787, at Old Leighlin, in the county of Carlow, where his family had long resided. After the usual preparatory education, he proceeded to the University of Oxford, where he became a very diligent and successful student. On quitting the University, he purchased a commission in the Guards, and distinguished himself highly at the battle of Barossa, by continuing to bear the colours of his regiment after he was severely wounded. On his return from the Peninsula, he was prevailed upon by the earnest entreaties of his family, to quit the army; and he devoted himself afterwards, with characteristic ardour, to scientific and literary pursuits.

Mr. Vigors was one of the founders, and the first, Secretary of the Zoological Society, to whose Museum he gave his very valuable collections of ornithology and entomology, which were the two branches of natural history he had most carefully studied. He was the author of a very elaborate paper in the Linnæan Transactions,* "On the Natural Affinities which connect the Orders and Families of Birds," in which he attempted to apply in detail the same principles of arrangement that Mr. MacLeay had previously sketched out in his *Horæ Entomologicæ,* in a more general way, as applicable to the whole animal kingdom. He afterwards published, in conjuction with Dr. Horsfield, another very valuable memoir† on the Birds of Australia, grounded upon a rich collection from that country, in the possession of the Linnæan Society, which they described and arranged according to their natural affinities. He was likewise the principal editor, during several years, of the "Zoological Journal," in which he wrote many memoirs, chiefly devoted to the further exposition of his views with respect to the affinities of

* Linnæan Transactions, vol. xiv.

† Linnæan Transactions, vol. xv.

birds, but some of them descriptive of new or rare Mammalia, or new forms of exotic insects or birds.*

Mr. Vigors was a man of very considerable attainments as a scholar as well as a naturalist,† and made a liberal use of an ample private fortune in the promotion of those sciences which he cultivated: he was the representative in Parliament, for some years before his death, first of the city, and lastly of the county, of Carlow."

"John Friedrich Blumenbach was born on the 11th of May, 1752, at Gotha, where his father was Protector of the Gymnasium. He was accustomed to attribute the formation of his taste for literary history and the study of the natural sciences to the instructions and encouragement of Menz and Christ, two professors of Leipsig, who were friends and fellow-townsmen of his father. After studying for sometime at Jena, he removed to Göttingen, for the purpose of completing his medical course, where he was very favourably noticed by Heyne and Michælis, and more particularly by Büttner, Professor of Natural History, a great linguist, and a man of very extraordinary acquirements, whose museum of medals and natural history, when afterwards purchased by the University, he was employed to arrange. The skill and diligence which he shewed in this employment, and the reputation of his professional and other attainments, secured him the appointment of Extraordinary Professor of Medicine in 1776, and of Ordinary Professor in 1778, a situation which he continued to hold for nearly sixty years.

His lectures comprehended Natural History, Comparative Anatomy, Physiology, and Pathology, on all which subjects he published many valuable memoirs and other works, more particularly his admirable *Manuals*, which have long enjoyed an extraordinary popularity, and which have been translated into nearly every great European language.

The first of this series of publications was the "Handbuch der Naturgeschichte," which appeared in 1779. In his "Institutiones

* Mr. Vigors's name has very frequently appeared in our pages, from the time when he first became known as a naturalist to a very recent period. Abstracts of many papers by him occur in the Proceedings of the Zoological Society, beginning in Phil. Mag. and Annals, N. S. vol. ix. p. 54, and continued through that and the present series.—Edit.

† Mr. Vigors was the author of " An Inquiry into the Nature and Extent of the Poetic Licence," of which a second edition appeared in 1813, Lond. 8vo.—Edit.

Physiologicæ," a work equally remarkable for the orginality, precision, and clearness of its statements, which was published in 1787, he made known his views on the " Bildungs Trieb," or " Nisus formativus," which he had before announced in the Göttingen Transactions for 1785, and which he made the subject of a special work in 1789.* His " Specimens of the Physiology of Warm and Cold-blooded animals," appeared in 1789. In 1794 he published in our Transactions, " Observations on some Egyptian Mummies opened in London in 1792," with special reference to the three distinct varieties of national physiognomy which appear amongst them. His " Handbuch der vergleichenden Anatomie" appeared in 1805, and shewed how fully he already appreciated the important views of Cuvier, which elevated Comparative Anatomy from a merely descriptive science to one which was capable of the most instructive generalizations, and affording the means of distinguishing types and laws of formation, as well for different organs as for different classes of animals.

The term *nisus formativus* was employed by Blumenbach to denote that *vital power* which is innate in all living organized bodies, and in active operation during the whole period of their vital existence, by which they are controlled and modified with reference to a specified end; it is that power by which the organizable matter of every individual being assumes at its conception, its allotted form; which form is also capable of successive modifications by nutrition, according to the purpose for which it is destined by the Author of Nature, as well as of the reparation (within prescribed limits) of the injuries which it may have received. The announcement of this principle was received with extraordinary favour by physiologists, though it differed in little more than in name from the *vis essentialis* of the celebrated Wolff. It will be found to have formed the basis of some of his important speculations.

Blumenbach's well-known collection of the crania of the different races of mankind was made with a view to their more accurate classification, and gave rise to some of his more celebrated publications.† According to his ultimate views, he would make the Caucasian race the primary stem, from which all the others have degenerated to the

* Ubber den Bildungs Trieb.

† Collectio Decad. vi. craniorum diversarum gentium tabulis 60 æneis illustrata: 1790—1820. De generis humani varietate nativâ: 1795.

Mongol at one extremity, and the Æthiopic at the other, interposing the American variety between the Caucasian and the Mongol, and the Malay between the Caucusian and the Æthiopic: it is difficult, however, to arrive at very correct general conclusions on this very interesting subject, without reference to those which are founded on the analogies of language, as has been done by Cuvier and Prichard.

It is quite impossible, within the short compass to which this notice is necessarily confined, to convey more than a very general impression of the vast variety of the labours of this distinguished philosopher. We find him applying his knowledge of natural history in illustration of the arts and poetry of antiquity;* he was also one of the first naturalists who appreciated the importance of a knowledge of fossils in determining the relative ages of the strata of the earth†. He had cultivated archæology and literary history‡ from his earliest years with more than common interest and zeal. There were, in fact, few departments of knowledge and literature, however remotely connected with the natural sciences, which he has not illustrated by his writings; it was when thus travelling into provinces of knowledge which were somewhat foreign to his own, that he was accustomed to quote the adage of Seneca: "*Soleo et in aliena castra transire, non tanquam transfuga, sed tanquam explorator.*"

Blumenbach had long been considered as the patriarch of the University of Göttingen, and was allowed the full privileges attached to his distinguished reputation, to the memory of his long services, and to the respect due to his venerable old age; he retained his usual cheerfulness, his memory, and much of his ancient activity, until nearly the close of his life. He died on the 22nd January last, in the 88th year of his age, a memorable proof that the tranquil pursuits of science, and the gentle stimulus of constant, though not laborious

* Specimen Historiæ Naturalis, Antiquæ artis operibus illustratæ eaque vicissim illustrantis 1803. Com. Acad. Gott., tom xvi.

Specimen Historiæ Naturalis ex auctoribus Classicis, præsertim poetis, illustratæ eosque vicissim illustrantis: 1815. Com. recent. Acad. Gott., tom. cxi.

† Beiträge zur Naturgeschichte der Vorwelt: 1790. Specimen Archæologice telluris tarrarum. que imprimis Hannoveranarum: 1801. Also Comment. Acad. Gott., tom. xv. p. 132—156. Com. recent. Acad. Gott., tom. cxi. pp.3—24.

‡ His "Introductio in Historiam Medicinæ Literariam," published in 1786, is a most in structive specimen of scientific bibliography.

employments, are equally favourable to contentment of mind and length of days."

Dr. Lyon Playfair, a distinguished young chemist, has communicated a paper, " On a new fat Acid in the butter of nutmegs." It commences with a brief summary of what had previously been made known on the subject, followed by a detail of experiments to determine more accurately its composition and products. From these investigations it would appear, that it contains a principle, which Dr. Playfair has termed *sericine,* by the saponification of which, he produced an acid called *sericic.* This acid is snow-white in colour, of crystalline appearance, very soluble in hot alcohol, partially so in hot æther, and capable of uniting with bases. The *sericates* obtained were those of *barytes, silver, potash, soda,* and *lead,* the peculiarities and mode obtaining each of which are succinctly detailed.

The remaining chemical papers in this number are,

"On the combination of hydrated sulphuric acid with nitric oxide," by *M. Rose.* An abstract of recent researches on the constitution of fatty substances translated from the *Annalen der Pharmacie.* Mineralogical notices from Foreign Journals. On artificial oil of ants; and, On Irish tin ore, all possessing facts worthy the attention of those who take an interest in the progress of chemical science. Mr. Latham, Fellow of King's College, Cambridge, has communicated some ingenious facts and observations on what he denominates the *Science of Phonetics.* This he considers to be a department of Acoustics, which " determines how two given articulated sounds are related; and teaches that between two articulations an immutable and essential relation exists." The object of the paper is to shew, that " the real aspirates of K and G are not the sounds that are generally considered as such; in other words, that they are not the powers of the German *ch,* and Scotch *gh,* but that they are sounds perfectly distinct from either the one or the other of those articulations." This is an obscure and difficult department of Physiology, on which much ingenious speculation exists, but little positive knowledge is possessed.

The proceedings of the Royal Astronomical Society, with the address of Sir John Herschel on the award of the medal to *Signor Plana,* conclude the matters of importance in the February number. The medal granted to *M. Plana* was for his works, " *On the lunar theory, and on the perturbation of the Planets, particularly of Jupiter and*

*Saturn.*" The President of the Society entered into a long learned analytical justification of the reasons which led to the present disposal of the medal for works, which had been published and known for some length of time.

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*The Annals and Magazine of Natural History.*

The Annals of Natural History, formerly conducted by Sir W. Jardine, Sir W. J. Hooker, Dr. Johnston, and Mr. Selby, now incorporates the Magazine of Natural History, formerly conducted successively by Messrs. Loudon and Charlesworth, and is becoming in England what the Annales des Sciences Naturelle has long been in France, an index of the active occupations and results of the observations of the Zoologists, Botanists, and Geologists of the country. The volume for 1840 commences with a paper by the Rev. Dr. Hincks on the Flora of Ireland, which some consider to have been undeservedly neglected. He pays a just tribute to Mr. Mackay for his *Flora Hibernica,* as well as to that gentleman's general attention to the subject. The Flora of a country should however do more, he thinks, than give generic and specific characters; it should discriminate between those plants which are really indigenous and those which appear to have been introduced, whether at an early or a later period; it should mark the situation in which the plant is found, and the different parts of the country; whether abundant or scarce; and on what kind of soil, as limestone, basalt, &c. It should be an object to record the earliest notice of each plant, and the name of the person who first described it; to which should be added, remarks on its nature and uses. In a country like Ireland, which has its own peculiar language still in use, the name of the plant in that language should also be recorded when known, as well as the common English names. Mr. Mackay remarks, that it has been a matter of complaint that the natural productions of Ireland have not been sufficiently attended to, and another author observes that while England and France have their local Floras, the botany of Ireland remained as much unknown as that of an island in the Pacific; and a reviewer of Mr. Mackay's book in the Dublin University Magazine, speaks of every thing relating to the Natural History of Ireland as just beginning to excite notice. In England and Scotland, he remarks, every town of any magnitude has its Museum or Botanic Garden; Dublin was the only city in Ireland that possessed similar establishments until very lately, when the spirited people of Belfast established both a Garden and Museum. This is ascribed by Dr. Hincks to the general progress of science, and cannot be construed into any reproach of former times; and to shew the error of comparing the state of botanical science in Ireland, with that of an island in the Pacific, as some have done, Dr. Hincks refers to the catalogues of Irish plants by Molyneux, Ray, Slhwyd, Smith, Wade, Drummond, and others, to shew, that considerable information has been communicated on this subject prior to the time of Mr. Mackay,

Dr. Hincks then enters into an analysis of what had been done in Irish botany up to 1804, the period at which Mr. Mackay commenced his labours, and does justice to many distinguished persons, whose services would appear to have either been overlooked or forgotten by Mr. Mackay himself, and most of those who have recently turned their attention to this subject; to render this part of the paper as complete as possible, Dr. Hincks gives a numerical list of the species belonging to each natural order noticed at three different periods, namely, 1760, 1804, and 1838, including those noticed in Mr. Mackay's Flora Hibernica.

The second paper by S. Von Buch,* is on *Sphæronites,* or large round spherical Fossils, like oranges with two poles at their extremities. They are formed of numerous perforated polyhedral plates, generally hexagonal, perhaps of two hundred plates in each specimen. Above opens the mouth which is covered by a number of very moveable shields. Below, a petiole of thin pentagonal articulations fixes the body to the soil. The plates are perforated, and in some species the small perforations or pores are connected by furrows somewhat like those represented on the surface of *Ischadites Koenigii* (Murch. Sil. Syst. t. 26, f. 11.) which is in fact *Sphæronites Aurantium,* upon which an outline has been given to the grooves not belonging to them.

It would be difficult to comprehend the character of these fossils without the assistance of plates, which are not given in the annals. These curious organic bodies whose remains are found only in

* Read before the Royal Academy of Sciences of Berlin, March 16, 1840.

the oldest transition rocks, are supposed by Von Buch to have been another of the numerous forms of Encrinites or Crinoides.

The third paper is a catalogue of the land and fresh water Mollusca of Ireland, by Mr. Thompson, who affords a bright example to his countrymen in all that relates to Natural History.

The next paper is entitled "Observations on the spiral formations in the cells of Plants," by Dr. J. Schleiden, Professor of Botany in the University of Jena, succeeded by several botanical papers, by Professor Nees Von Esenbeck, Professor Lindley, Messrs. Babington, Henderson, Leighton, and others.

Professor Von. Esenbeck's paper affords the characters of above 30 species and two new genera of New Holland, *Cyperaceæ, Restiaceæ*, and *Guncaceæ*. Mr. Henderson's paper relates to the structure of the stigma in *Mimulus* and *Diplacus*, and its excitable property. The latter is remarked by the Editor to have been long known, but the elongated cylindric cells of the inner surface of the stigma terminating in tapering jointed glandular hairs, have not it is said, been before noticed. Professor Lindley in a note upon the genus *Decaisnia* of M. A. Brougniart, points out its identity with *Prescottia*. Mr. J. O. Westwood on the genus *Typhlopone*, with the description of several species from India, Java, and South America. A paper by Dr. Philippi, from which it appears he has made the curious discovery that the genus *Zoë*, discovered by Base, and placed by Latreille between *Polyphemus* and *Cyclopsa*, is nothing more than the young *Pagurus Hungarus*. A paper on the generation of *Entozoa*, by Dr. Drummond, a subject closely connected with medicine, and regarding which there is little or nothing known. Of the other Zoological papers of great interest, we can only notice that of Mr. Gray, keeper of the Zoological collection in the British Museum, entitled a Synopsis of the genera and species of *Starfish*. Mr. Gray remarks very truly that few persons have hitherto attempted to divide the *Starfishes* into natural groups, and that the attempts of Nardo and M. Agassiz have been little more than merely to change the names of the divisions previously formed by Linck, who divides the true starfishes, *Asterias*, Linn. into two great divisions, *stellis fissis*, and *stellis integris*, according to the presence or absence of ambulacra on the under-surface of the arms.

Of the latter, Mr. Gray seems to form a new class, Hypostoma, which will probably embrace about one-fiftieth part of this division of radiata, *(Echinodemata)*. How many other *classes* it may therefore be necessary to construct in order to include the whole, it would be difficult to say. Mr. Gray's attempt to make us acquainted with the numerous undescribed forms of these animals is, however, highly creditable to his zeal, as well as to his talents, and it is to be hoped that in this difficult task, he will avoid the errors he has so justly condemned in Agassiz and others, of multiplying names unnecessarily, where nomenclature is already so burdensome.

There is also a short paper by Milne Edwards on the Affinities of the *Lepidosiren*. This animal which belongs to America, was described by Mr. Owen, after the most careful investigation as a *fish*, was subsequently considered after an equally minute inquiry by M. Bischoff, to be a reptile. M. M Edwards, after a careful investigation of a specimen in the Jardin du Roi, Paris, inclines to the view adopted by M. Bischoff, as well from the presence of two auricles to the heart, as from other points of structure too minute to detail in this place. Several species of this curious form appear to be known, but we still require to discover some intermediate species, presenting a more decided character, which may reveal the true relations of the group.

The geological papers are less numerous than those of the departments we have noticed; they consist of two papers by Mr. Bowerman on the natural terraces of the Eildon Hills, the rocks composing the acclivities of which are hollowed out into terraces of from 100 to 120 yards broad, ascribed to the effects of glaciers, according to the views of Professor Agassiz. These views are fully entered into in a communication from M. Agassiz himself in another part of the volume extracted from the Proceedings of the Geological Society, November 1840. M. Agassiz does not suppose that his views on this subject will at once meet with the general concurrence of geologists, and admits, that the phenomena of glaciers in different latitudes and altitudes will differ in their effects. Having devoted several years to the study of these effects in Switzerland, M. Agassiz then directed his inquiries to the investigation of appearances resembling the effects of glaciers in countries in which such phenomena are now unknown. The upper surface of glaciers approaches nearest to the character of snow, and the lower surface to that of ice. Above a certain elevation, the temperature is never high enough to melt snow, and as all ice has previously been water, it is clear there can be little of it in a solid form at great elevations. The blocks and masses of rock that are detached from surrounding precipices above, consequently sink through the mass to the bottom of the snow. At lower elevations, the melting process during summer is more active on the surface of the glacier, and the water percolates through the porous mass till it reaches the rocks on which it rests. Here it is converted into ice, which by its expansive property tends to detach and burst fragments from the rocky bed, the ice, still acting as a wedge, thickens imperceptibly and forces up the superincumbent mass, and with it the stones and gravel which it had entangled at the bottom. When the heat of the sun during the summer melts the upper layers of ice; the masses thus detached are precipitated from the glacier, forming what are called *morains*, or accumulations of loose stones which skirt the glaciers below.

Thus glaciers have been found to produce certain remarkable effects, not only on the acclivities which they occupy, but also on the character of the plains below, and these effects in both cases are so peculiar as scarcely to be mistaken. Besides horizontal terraces and *morains*, glaciers during their gradual descent occasionally produce polished grooves in the rocks over which they slide. These are described by M. Agassiz as highly polished lines passing in the direction in which the glacier moves, and are produced by grains of quartz and fragments of rocks moved by the action of the ice down the surface of the rocks. These grooves are fresh and sharp beneath existing glaciers, but less distinct on surfaces that have been left for some time exposed to atmospheric action. Having thus established the peculiar modifications of the surface produced by glaciers, M. Agassiz was surprised to find traces of their existence in climates and altitudes where such causes could little be expected to have operated. Thus in several parts of Scotland, Ireland, England, and Wales, M. Agassiz has discovered effects which can only be referred to these causes, and which it is expected will clear up much of the mystery connected with erratic blocks. The subject is one of much interest, and as we think it is capable of being elucidated and matured by observations in the Himalaya, we shall probably quote M. Agassiz's views in detail, on some future occasion, when we are less pressed for space than at present. We have observed detached low irregular hills and knolls of boulders, and rounded masses in various situations at the foot of the Himalaya, for which we were quite unable to account. These low ranges at the pass where the Gogra enter the plains of Hindustan, extend parallel to the main chain at a distance probably of half a mile or more from the precipitous face of the mountain, and from which they are separated by a low valley. It is therefore probable, that these and similar piles of boulders, which will be found in many instances to skirt the mountains of India, may be owing to the causes referred to by M. Agassiz.

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## *Official papers on Isinglass, received from the Government.*

The following are the names of the fish procurable here, the sounds of which are used as an article of trade:—

*Ka-tha, Ka-ku-yan,* No. (4), *Ka-tha-bam,* No. (1), *Ka-pa-yin, Ka-kun,* No. (2), *Nat-ka-dan.* No. (3*) The whole of the above produce isinglass, but the largest kind is procured from the *Ka-pa-yin;* this fish measures from four to six feet in length, and produces a sound from one to one and a half viss in weight; the next largest is the *Ka-ku-yan,* a larger species of the *Ka-tha,* or "*Polynemus Sele,*" probably *Polynemus ploteus.* The fishermen state, that the whole of the above mentioned fish have no particular season for shoaling, with the exception of the *Ka-ku-yan,* which is procurable in larger quantities during the dry season than at any other portion of the year; this statement, however, is purely gratuitous, as the following remarks will shew.

The whole of the above mentioned fish are caught the whole year round, the smaller kinds by means of the common fishing stakes, and the larger with a description of trap, called by the natives *tsan-dah,* which are usually made in deeper water than the fishing stakes, generally with a depth of 10 or 12 feet at low water spring tides, with a rise of 18 to 22 feet; they are so formed that the fish on

* Nos. corresponding with those attached to the specimens.

entering cannot return; the fisherman being seated above the trap, is made aware of the fish entering, by its striking against a string which he holds, and which is fastened in the narrowest part of the bamboo trap; the bottom part is furnished with a moveable platform attached to a lever which the fisherman controls, and on elevating the lower end of the lever to which the outer end of the moveable platform is attached, the fish is thus brought within reach of the fisherman and secured. These fish frequent the mouths of rivers, preferring the brackish water to the sea; they are considered wholesome food, the *Ka-tha-bouce* especially being much esteemed.

During the rains the sound is seldom procured sufficiently dried, owing to the humid state of the atmosphere, and many are lost in consequence of breeding worms and becoming perfectly black ere it has had time to harden.

From the circumstance of the article never having been noticed before, it is difficult to say, what quantity could be procured during the year; my proposition to the head fisherman of advancing funds for the purpose of inducing people to erect a number of stakes or traps, appeared to meet with his concurrence, and he states about 500 viss as the probable amount which might be thus secured during the dry season, (November to May inclusive). I suggested the opposite shore of *Beloo Kyioun*, as being a more likely haunt of the larger kinds of fish, owing to the numerous sands and shoals in its vicinity, besides being more centrally situated in the estuary formed by the rivers Salween and Sitang, to which he assented, and purposes commencing operations there. This effected, it may reasonably be expected that 2,000 lbs. will be the minimum quantity procured.

The Burmese do not use the sound, either in its raw state, or when dried; and the few procured from the fish casually obtained by the fishermen, are dried and sold to the resident Chinese, the price ranging from 1 rupee to 1½ rupees per viss, according to its scarcity or otherwise. By adopting the method I have proposed of advancing, the cured sound may be procured at 1 rupee per viss, (or 27 rupees per maund,) and there is little doubt, but a very few seasons would have the effect of reducing this rate considerably, owing to the simple process, and the absence of all difficulty in the curing; merely extracting from the fish, removing the outer skin, and drying in the sun. The sound is used by the Chinese as an article of diet, and is prepared as follows:—After a thorough cleaning with cold water, and being perfectly free from the thin skin and other extraneous matter which adheres to it in its dry state, it is allowed to dry; after which it is placed in a baker's oven, and heated until it becomes brittle and expanded to about four times its original size, in this state it is soaked in water, and when soft, cut into small pieces and boiled with any description of animal food; composing one of the various dishes in which gluten is contained as shark's fins, edible bird's nests, and Bech de mar, or sea slug, it forms an indispensible article of Chinese "*cousine*." There appears to be some tact required in the process of baking the sound. The Chinese affirm that if unskilfully managed in this process, it becomes tough and incapable of being reduced to a soft state, thereby rendering it useless as an article of diet. Little can be said on the habits of any of the fish forming the subject of these remarks; inquiries on this head are rendered abortive by the apathetic manner in which the Burmese treat such subjects; they know the fish from the circumstance of its being caught, nor do they trouble themselves further in the matter; and as few will give themselves the trouble of extending their operations when a certain quantity will suffice for their present necessities, it is therefore not be expected that information of moment can be obtained from them. The approaching dry season will afford an opportunity of advancing the interest already taken in this matter, and it shall be my object to prosecute an enquiry, which may tend to develope the particular details, so desirable on a subject of so much importance.

I have endeavoured to collect specimens of all the fish possessing the sound of any available size, but as yet, have only been able to procure four, which have a number attached to their mouths, corresponding with that opposite their names. It was my intention to send them all whole, but *No. 3, Nat-ka-dan* (the spirit's wife) had so different an appearance to the others, that I suspected the party wished merely to dispose of the fish without knowing whether it possessed the sound; I was thus induced to open it, and to my surprise found its sound to be extraordinarily large for the size of the fish. I have cleaned it, and after soaking it in alum water a day, have dried it, as much as the limited time for the departure of the *Ganges* would permit. I forward it, together with a specimen of the large sound procured from the *Ka-ku-yan*, (Polys. ploteus); the latter, owing to its being cured during the monsoon, has a discolored part, which may be prejudicial to its quality. The specimens are packed in arrack, but should this be objectionable, I shall feel obliged for information as to the best method of packing any future specimens I may forward.* On inspecting the sound of the fish *No. 3*, I was struck with the circumstance of its not possessing the long stringy fibre, which I presume is essential to its being converted into the Isinglass of commerce, and on removing the outer skin, a very slight pressure separated a part of the sound which came away, of the consistency of a thick curd, without any appearance of fibre or stringy particles in it; the steeping in the alum solution has somewhat remedied this, and given the sound a stronger feel, with a horizontal fibrous appearance; however should

* The best way of preserving large fish is to preserve the skins merely with the head and fins attached. In this way they become perfectly dry and hard, the skin assuming of itself the natural form of the fish, and when varnished looks quite fresh.

my surmise be correct, that all sounds are not in substance the same, and that only particular kinds possess the property of Isinglass, an examination of the specimens now sent, and to be sent hereafter, may afford the means of directing me as to the particular kinds available, which will obviate much inconvenience that would otherwise accrue from an indiscriminate collection of sounds, part of which might subsequently be found useless for the purpose to which they were intended. The fish of this part of the province are, I believe, common to the whole coast of Tenasserim, farther than which I have no opportunity of ascertaining at present. It will be a subject of interest to ascertain whether they are also common to the coral formation of the Straits and Java sea, and this I intend making a subject of inquiry. I have frequently observed both in the Straits and Java, that the Chinese have the dried sounds exposed for sale in their shops, but at this date I am incapable of saying whether procurable on the spot, or by importation; and cannot say with certainty, whether the fish of this coast be also common to those waters.

E. O'Reily.

Amherst, 20th August, 1841.

*Memorandum on Mr.* O'Reily's *Paper.*

The four kinds of fish forwarded from the Tenasserim Coast are common in Calcutta,* but the size of the specimens appears to be greater than they attain here.

Having been merely placed in a wooden box with spirits, which soon escaped, the specimens arrived in a putrid state, but having sprinkled a little of the solution of chloride of lime over them I was enabled to examine them, and to make the annexed rough sketches, which may render Mr. O'Reily's remarks more easily understood.

Of the several kinds of Bola Isinglass has been made, and samples of it are contained in one of the packages sent home by the Government to the Honourable Court. The Bola are fine fishes, peculiar to India, and supposed to resemble the whiting in flavour and appearance.

* No. 1. Bacti of Bengal, or *Cois vacti,* Buchanan.—No. 2. The *Nuria,* or Bola chaptis of Buchanan.—No. 3. The *Coi Bola* of the natives, or Bola coitor, Buchanan.—No. 4. Polynemus sele, or Suleah of the Bengal fishermen.

They are caught at all seasons, and never at any time form, as far as I have seen, any very exclusive feature in the fish market, such as migratory fishes do when in season. For this reason their isinglass, though good, is never likely to become very important.

With regard to No. 4, or Suleah, it seems to be procurable in unlimited numbers on all parts of the coasts of India, and if cured, as it might be, would afford a great stock of provisions, but from the size of the fish, each being from 50 to 100 lbs. weight, it is too much for the natives to manage. It may fairly be expected, however, that the value of the isinglass afforded by this species, will lead to some general arrangements for taking as well as curing it.

Two specimens of isinglass accompanied the specimens of the fish; one specimen weighing about a pound taken from one of the Bolæ, the other weighing 2 lb. and 3½ ounce, taken from the Polynemus, or Suleah, and is worth from 3 to 4 shillings, the produce of a single fish.

The Government by way of encouraging the arrangements suggested by Mr. O'Reily, might instruct Mr. Blundell perhaps to receive the fish sounds at 27 rupees or 30 rupees per maund, the rate at which Mr. O'Reily thinks they might be collected for. In 1839-40, I collected about 30 maunds from the fishermen here, at 40 rupees per maund. The following year 1840-41, they rose in Calcutta to above 50 rupees, so that the rate proposed by Mr. O'Reily appears to be under the value of the article, but until it becomes known, and a market formed for it, private persons will not enter into the trade.

Mr. O'Reily complains of the fish sounds spoiling during the rains, and inquires how they are to be preserved. On being removed from the fish, they ought to be opened and the inner fleshy membrane removed, as well as a similar membrane from the outside. The sound should then be powdered over with dry lime, and hung up in a shed protected from rain, but exposed to free air. The lime will only adhere as long as the substance is soft; when it hardens and dries, it will fall off. Whenever the sun shines, if necessary, the sounds should be removed into it for a short time. Sounds prepared in this way will keep any length of time in any climate, and will fetch in this rough state from 1*s.* 4*d.* to 1*s.* 7*d.* per lb. in the London market. If prepared in the manner of fine Isinglass, (which from the cheapness of the kind of labour required, may be done more profitably in India than any where else,) the value of the article will be greatly enhanced; but the exact value is not yet known.

Encouragement might be afforded to the fishermen on the Coast to cure the fish with salt. A coarse salt, well adapted to this purpose (I should think) used to be formed at Hidgelee, I am told, merely by placing a little straw beneath the baskets from which the bittern dripped; the salt required for such purposes should be coarse-grained, but pure, and if procurable by so simple a means, would cost little, and might be supplied to fishermen under certain stipulations.

The specimens of fish I have been obliged to throw away, had they been skinned, they would have arrived perfectly safe and pure; instructions to do this might be sent to Mr. Blundell, from whom valuable specimens for the Honorable Court's Museum might be obtained.

*1st September*, 1841. J. M'Clelland.

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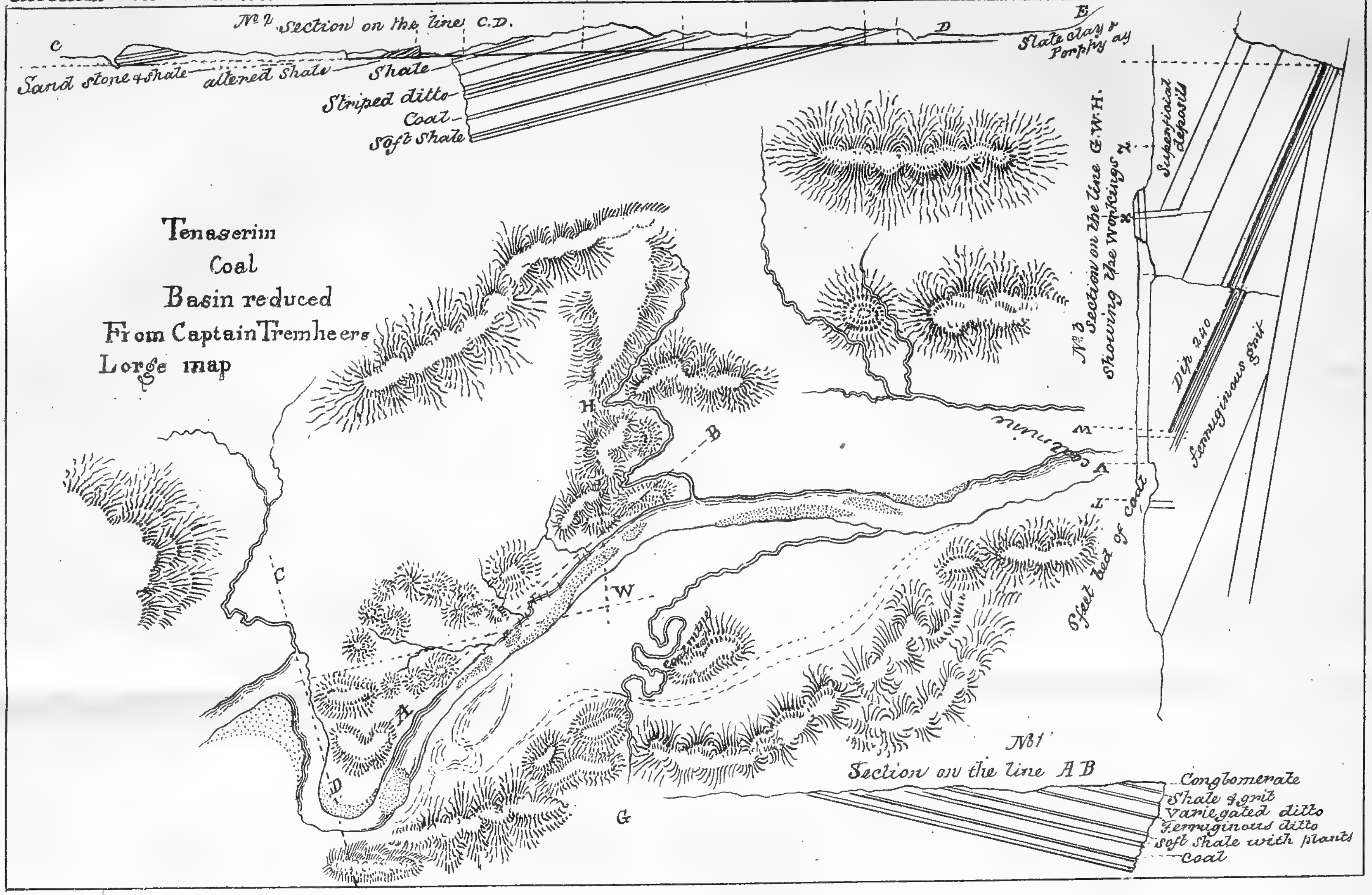
## *On Collections.*

We have been favoured by Captain McLeod, Assistant Commissioner, Tenasserim Provinces, with an inspection of a small collection of Animals from Moulmein, intended to be presented to Lord Auckland.

The first of these animals, the *Pwe*, is a species of Bamboo Rat, belonging to the genus *Rhizomys* of Mr. Gray, which may be distinguished as follows :—*Rhizomys Cinereus*. Dark grey above, silvery grey below; cheeks greyish or reddish yellow. Length about 20 in. from the snout to the extremity of the tail; circumference of the body about $9\frac{1}{2}$ inches; body entirely clothed with a scanty coarse grey hair. Yellowish grey on the face; throat and lower parts of the body silvery grey, back dark grey, which colour is extended over the top and crown of the head to a point between the eyes. Tail naked, and equal to about half the length of the body. The limbs are short, the feet are equal to half the length of the limbs, the toes long, and armed with strong nails. There are four toes to each fore-foot, and five to each hind-foot.

Mr. Gray gives the following characters of this curious genus :—"Incisors $\frac{2}{2}$ long and exposed, molar $\frac{3}{3}$ $\frac{3}{3}$, subcylindric, with oblique transverse ridges on the crown, head large with small eyes and small naked ears, body heavy, with short limbs, five toes to each foot, tail naked, of medium size."—Capt. McLeod remarks, that "the *Pwe* is an animal rarely



No. 2 Section on the line C.D.
C
D
E
Sand stone & shale
altered Shale
Shale
Striped ditto
Coal
Soft Shale
Slate clay & Porphyry
Tenaserim
Coal
Basin reduced
From Captain Tremheers
Lorge map
H
B
W
A
C
D
G
No. 3 Section on the line G.W.H.
Showing the Workings
Superficial deposits
Dip 24°
Ferruginous grit
6 feet bed of coal
No. 1
Section on the line A B
Conglomerate
Shale & grit
Variegated ditto
Ferruginous ditto
Soft Shale with plants
Coal

seen, and is found in the more hilly parts of the country. I do not know whether Helfer had one in his collection. I saw one at Zummi in 1837, exactly like the present specimen, it was perfectly tame. There are two species, the other is smaller, its fur like that of a mole; both burrow very rapidly. The Burmans eat the animal when they can catch it. It spends the day time in holes, and lives on the roots of the bamboo generally, but towards night-fall comes out and amuses itself by cutting the bamboo down, which it does very expeditiously. It does not take to the water at all."

Sir Stamford Raffles describes a species of Bamboo Rat found in Sumatra by Colonel Farquhar as follows:—"The body is about seventeen inches in length, ten inches in circumference, and the height at the shoulder about five. The tail is six inches long, tapering to a blunt point, naked and scaly. The body is covered with rough greyish hair, brownish on the back. The head round and lighter coloured. Incisors large, two in each jaw. Eyes small, ears naked, fore-feet four toed, hind-feet with a short fifth toe." It may be doubted whether this be the animal described by Mr. Gray as *R. Sumatrensis;* particularly as he refers to a specimen in the Museum at Leyden, as well as to a drawing in the Museum of the Asiatic Society, presented by Colonel Farquhar. The drawing in question appears to have been mislaid, a circumstance the more to be regretted, as several species of this genus now appear to belong to continental India, and it would be desirable to have the means of comparing these with such information as may have been previously collected on the subject. A species has recently been characterised by Mr. Hodgson, as an inhabitant of Nepal,* and two if not three, are contained in a Zoological collection of much interest, recently made in Assam by Mr. H. Walker, and which is now under that gentleman's investigation.

Another animal contained in this collection, is the *Bentu-*

* *Rhizomys Badius,* Hodgson. Cal. Jour. of Nat. History, 1841.

*rong*, or *Ictides ater* of Temminck. The Burmese name of this animal is stated by Captain McLeod to be *Myoŭk-kya*, or Monkey Tiger; it is described as living in the jungles, and very seldom seen.

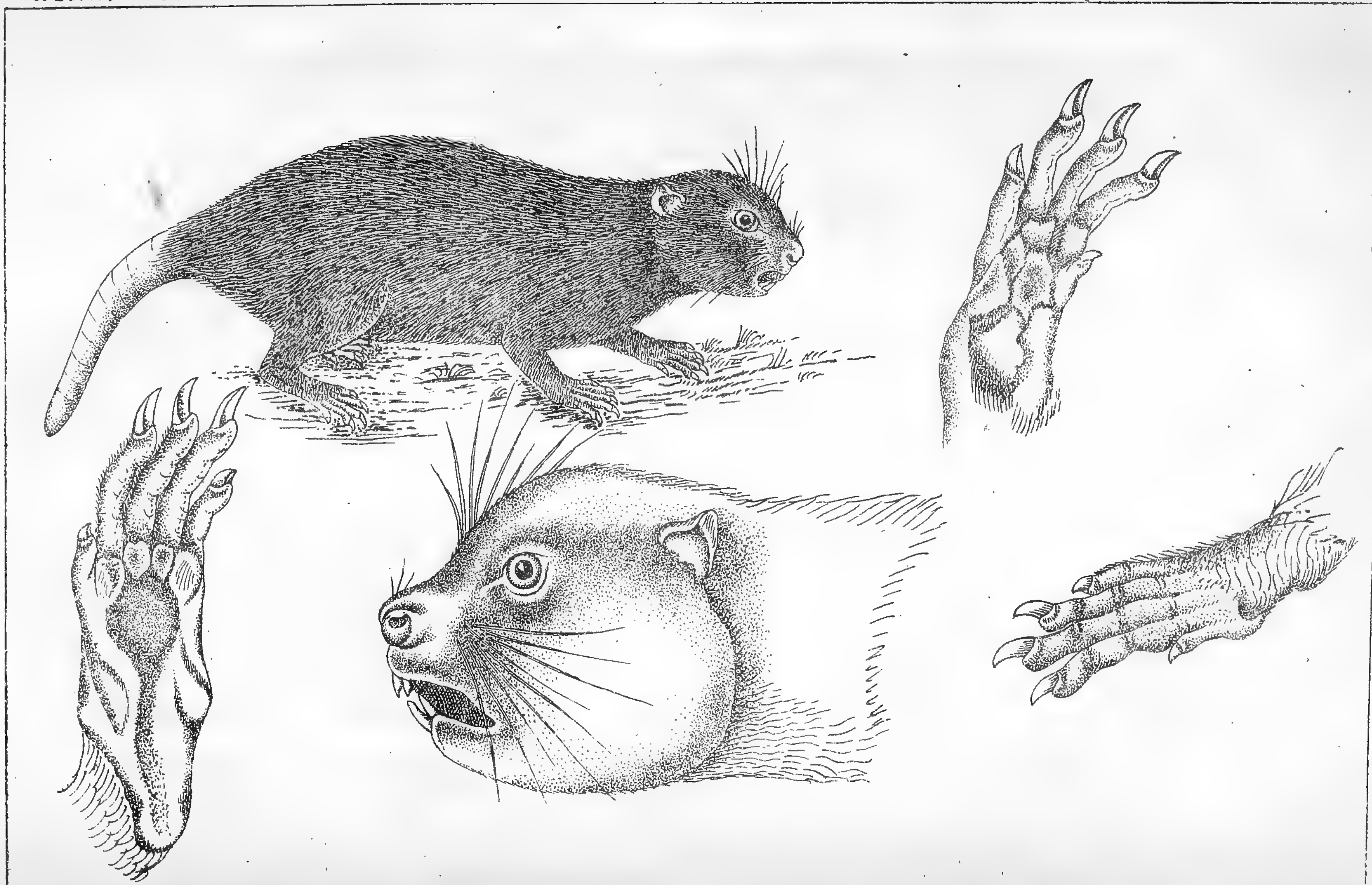
"The present specimen," says Capt. McLeod, "was shot at the summit of a tree; the natives say, it is generally seen on trees; that it twists its tail round a branch to give impetus to its spring, and then throws itself on its prey, generally monkeys, (whence its name,) and with it falls to the ground. Its head is said to be particularly hard, and that it cannot be killed by blows inflicted on it. The present specimen had several blows inflicted on it with a heavy bamboo, but not apparently to its injury." A third animal in this collection is also of much interest, the *Gulo Urva* of Mr. Hodgson; its presence in the Tenasserim Provinces, indicates a more wide and extensive habitat than that at first ascribed to it. This animal was noticed by Mr. Hodgson in 1835, as an inhabitant of the middle region of Nepal; in 1837 it became one of Mr. Hodgson's new genera of Nepal animals, to which perhaps other species of *Herpestes*, having bushy tails, might also be added.

I should here mention, that searching for Col. Farquhar's drawing of *Rhizomys Sumatrensis*, already referred to,* I found in the Society a drawing of a bushy tailed *Herpestes*, differing merely from Mr. Hodgson's *Gulo Urva*, in having the tail of one uniform colour with the body, without the yellow tip. There is no name or letter on the drawing to shew from whence it came, and to prevent its following the fate of Colonel Farquhar's *Rhizomys*, we here (plate xiii½ f. 1;) afford a copy of it.†

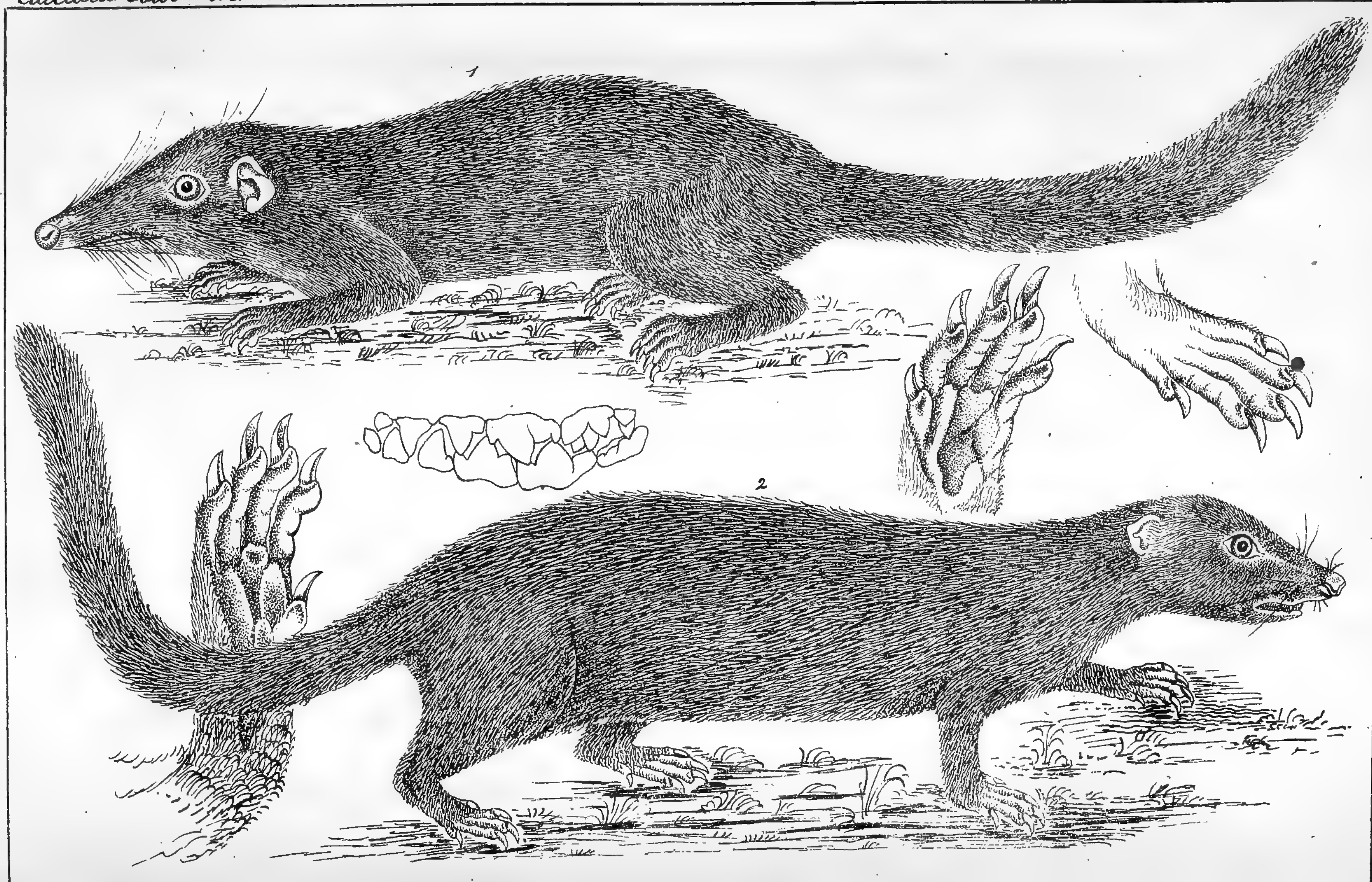
In our last we had merely time to acknowledge our obligation to Lieutenant Hopkinson, Junior Assistant to the Com-

* Vide Lin. Transactions, vol. xiii. p. 25-6. Proc. Zool. Soc. 1830, p. 96.

† References to Plates. Fig. 1, Pl. xiii½. *drawing of Herpestes* in the Asiatic Society. Fig. 2, *Gulo Urva, Hodgs.* specimen from Moulmein, with the feet of the same. Pl. xiv. *Rhizomys cinereus,* J. M. from Moulmein.



Rhizmys cinereus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2

missioner of Arrakan for a collection of specimens which he has kindly placed at our disposal, and of which the following is a list :—

*Mammalia.*—*Felis bengalensis, Paradoxurus typus, Sciurus giganteus,* and *a Pteromys* to be noticed in a future number.

*Birds.*—*Polyplectron Hardwickii,* 2 specimens, *Phasianus fasciatus,* 2 specimens, *Centropus Nigrornfus, Anastomus pondicerinus. Buceros Homrai* 2 specimens, *Buceros Malabaricus, Buceros bengalensis, Plotus Levalantii* and a *Vinago, Phœnicophœus tristis,* a *Perdix,* and *Strix flammea.* We have also to acknowledge our obligation to Mr. Laidlay of Surdah for an interesting specimen of *Entozoa,* and for his remarks on the subject, which with the specimen we reserve for future notice in an early number.

The receipt of a more perfect collection of the Fossils of Seedrapett will probably render it necessary to cancel that portion of our notes on the subject (from page 238 to page 240 inclusive) in which we referred the corals or zoophytes of Messrs. Kaye and Cunliffe to the teeth of Saurions; some of the specimens recently received have portions of the surface entire, leaving no doubt as to their real character, and the accuracy of their discoverers in regarding them as corals.

*Meteorological Register, kept at the Surveyor General's Office, Calcutta, for the Months of August and September,* 1840.

| August. Day of the Month | Moon's Phases. | 9 H. 50 M. Barometer. | 9 H. 50 M. Temperature. Of the Mercury. | 9 H. 50 M. Temperature. Of the Air. | 9 H. 50 M. Temperature. Of an Evapg. Surface. | 9 H. 50 M. Wind. Direction. | 4 P. M. Barometer. | 4 P. M. Temperature. Of the Mercury. | 4 P. M. Temperature. Of the Air. | 4 P. M. Temperature. Of an Evapg. Surface. | 4 P. M. Wind. Direction. | Rain Gauge. Upper. | Rain Gauge. Lower. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 29,572 | 81,0 | 80,3 | 80,0 | S. W. | ,522 | 83,2 | 83,0 | 81,9 | S. .. | 0,78 | 0,87 |
| 2 | | ,594 | 84,3 | 85,3 | 84,2 | W. .. | ,522 | 83,0 | 83,6 | 82,0 | S. W. | | |
| 3 | | ,544 | 84,0 | 87,0 | 85,9 | w. b.s. | ,462 | 85,5 | 87,5 | 85,0 | w. b. s. | 0,17 | 0,22 |
| 4 | | ,510 | 83,9 | 88,0 | 84,3 | S. .. | ,461 | 83,0 | 81,7 | 82,0 | S. .. | 1,20 | 1,34 |
| 5 | ☽ | ,522 | 83,3 | 85,5 | 82,0 | E. .. | ,440 | 85,0 | 85,1 | 82,1 | W. .. | | |
| 6 | | ,490 | 84,0 | 85,1 | 83,7 | E. .. | ,392 | 84,1 | 84,9 | 81,8 | S. .. | 0, 41 | 0,46 |
| 7 | | ,499 | 80,2 | 80,1 | 78,8 | S. .. | ,452 | 83,0 | 84,0 | 80,1 | S. .. | 0, 20 | 0,24 |
| 8 | | ,636 | 82,0 | 83,0 | 78,9 | S. W. | ,590 | 83,2 | 84,2 | 80,0 | S. .. | 0,09 | 0,10 |
| 9 | | ,674 | 82,5 | 84,0 | 81,0 | S. .. | ,608 | 84,2 | 85,0 | 81,1 | S. .. | | |
| 10 | | ,670 | 83,4 | 87,0 | 82,1 | S. .. | ,608 | 83,0 | 83,6 | 81,9 | S. b.e. | | |
| 11 | | ,689 | 83,3 | 86,9 | 83,0 | S. .. | ,636 | 84,0 | 86,7 | 83,5 | S. .. | 0,09 | 0,11 |
| 12 | | ,720 | 83,2 | 25,5 | 81,0 | S. .. | ,668 | 84,5 | 86,0 | 82,7 | S. .. | 0,07 | 0,08 |
| 13 | ○ | ,724 | 84,4 | 87,9 | 84,0 | S. W. | ,660 | 86,5 | 88,0 | 84,1 | S. .. | | |
| 14 | | ,680 | 83,8 | 83,9 | 83,1 | Calm. | ,590 | 83,0 | 80,9 | 79,1 | S. W. | 1,15 | 1,29 |
| 15 | | ,699 | 84,4 | 87,0 | 84,0 | S. E. | ,620 | 85,0 | 87,0 | 84,2 | Calm. | | |
| 16 | | ,740 | 85,0 | 88,0 | 85,5 | S. .. | ,690 | 87,0 | 88,1 | 85,0 | S. .. | 0,48 | 0,51 |
| 17 | | ,720 | 88,8 | 86,4 | 83,7 | w. b. s. | ,624 | 86,1 | 89,8 | 85,5 | S. .. | | |
| 18 | | ,642 | 85,5 | 87,9 | 84,6 | W. .. | ,572 | 85,0 | 84,0 | 81,1 | w. b.n. | | |
| 19 | | ,640 | 84,5 | 86,1 | 83,8 | N. W. | ,576 | 82,0 | 79,5 | 79,3 | N. E. | 0,52 | 0,59 |
| 20 | ☾ | ,620 | 82,0 | 79,0 | 79,0 | W. .. | ,544 | 81,0 | 79,4 | 79,0 | S. W. | 1,37 | 1,42 |
| 21 | | ,542 | 80,1 | 78,2 | 78,2 | W. .. | ,500 | 79,5 | 76,9 | 77,9 | S. W. | 5,05 | 5,65 |
| 22 | | ,670 | 80,0 | 80,0 | 89,5 | S. .. | ,620 | 83,8 | 85,0 | 82,2 | S. .. | 4,59 | 5,15 |
| 23 | | ,764 | 83,0 | 86,0 | 83,0 | s. b. e. | ,704 | 82,5 | 83,8 | 81,5 | Calm. | | |
| 24 | | ,790 | 82,7 | 86,8 | 84,0 | S. E. | ,717 | 84,0 | 85,7 | 82,5 | S. .. | 0,34 | 0,39 |
| 25 | | ,763 | 83,0 | 84,9 | 82,9 | S. E. | ,686 | 83,0 | 84,2 | 82,9 | S. .. | | |
| 26 | | ,720 | 83,2 | 83,9 | 81,8 | W. .. | ,652 | 81,9 | 81,5 | 80,0 | S. .. | | |
| 27 | ● | ,756 | 82,0 | 83,0 | 81,1 | S. .. | ,670 | 83,0 | 84,2 | 81,1 | S. .. | 0,22 | 0,24 |
| 28 | | ,754 | 82,3 | 83,9 | 81,2 | S. W. | ,683 | 82,9 | 83,8 | 82,7 | S. .. | 0,13 | 0,15 |
| 29 | | ,750 | 83,2 | 86,2 | 81,6 | S. .. | ,660 | 85,5 | 87,7 | 83.8 | S. .. | | |
| 30 | | ,712 | 85,0 | 85,2 | 83,0 | S. .. | ,601 | 84,0 | 80,0 | 80,0 | S. .. | 0,06 | 0,07 |
| 31 | | ,718 | 82,6 | 82,7 | 41,0 | S. .. | ,670 | 81,9 | 82,5 | 80,9 | S. .. | 2,20 | 2,43 |
| Mean. | | ,663 | 83,1 | 84,7 | 82,3 | | ,594 | 83,7 | 84,1 | 81,8 | | 1912 | 2141 |

| September. Day of the Month. | Moon's Phases. | 9 H. 50 M. Barometer. | 9 H. 50 M. Temperature. At the Mercury. | 9 H. 50 M. Temperature. Of the Air. | 9 H. 50 M. Temperature. Of an Evapg. Surface. | 9 H. 50 M. Wind. Direction. | 4 P. M. Barometer. | 4 P. M. Temperature. Of the Mercury. | 4 P. M. Temperature. Of the Air. | 4 P. M. Temperature. Of an Evapg. Surface. | 4 P. M. Wind. Direction. | Rain Gauge. Upper. | Rain Gauge. Lower. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 29,742 | 79,4 | 78,9 | 79,0 | S. .. | ,690 | 80,2 | 79,5 | 79,2 | S. .. | 06,0 | 0,67 |
| 2 | | ,764 | 81,5 | 85,0 | 82,3 | E. .. | ,700 | 81,2 | 81,0 | 80,0 | S. E. | 00,6 | 0,07 |
| 3 | | ,761 | 81,5 | 85,9 | 82,8 | S. E. | ,690 | 82,7 | 81,5 | 80,8 | E. .. | | |
| 4 | | ,749 | 82,2 | 86,0 | 83,0 | E. .. | ,677 | 82,3 | 83,9 | 82,2 | S. E. | 0,41 | 0,46 |
| 5 | ☽ | ,722 | 82,8 | 83,5 | 81,0 | E. .. | ,625 | 81,9 | 84,0 | 81,8 | E. .. | 0,81 | 0,85 |
| 6 | | ,718 | 83,9 | 84,2 | 82,1 | S. .. | ,626 | 80,8 | 80,0 | 79,0 | E. .. | 0,24 | 0,26 |
| 7 | | ,674 | 81,0 | 81,9 | 80,5 | S.b.E. | ,642 | 83,9 | 85,0 | 82,1 | S. .. | 0,44 | 0,46 |
| 8 | | ,730 | 82,1 | 86,0 | 83,1 | S. E. | ,652 | 86,5 | 90,0 | 83,8 | S. .. | | |
| 9 | | ,719 | 83,0 | 35,2 | 82,8 | S. W. | ,649 | 88,2 | 91,0 | 84,9 | S. .. | 0,06 | 0,07 |
| 10 | | ,752 | 83,7 | 87,8 | 83,2 | E. .. | ,688 | 84,0 | 86,1 | 83,5 | E. .. | | |
| 11 | | ,800 | 84,0 | 88,0 | 82,0 | E. .. | ,743 | 82,9 | 82,8 | 81,0 | S. E. | 0,18 | 0,20 |
| 12 | | ,822 | 83,2 | 85,9 | 83,0 | S. .. | ,730 | 82,0 | 81,9 | 81,5 | Calm.. | 0,50 | 0,54 |
| 13 | ☉ | ,780 | 84,0 | 87,0 | 82,5 | S. .. | ,720 | 86,0 | 88,5 | 84,3 | S. .. | 0,30 | 0,32 |
| 14 | | ,776 | 83,8 | 85,0 | 82,3 | S.b.E. | ,720 | 84,9 | 88,9 | 84,8 | S. E. | 0,05 | 0,05 |
| 15 | | ,794 | 82,3 | 81,8 | 79,5 | S. .. | ,734 | 82,8 | 84,2 | 82,0 | S. .. | 0,45 | 0,47 |
| 16 | | .... | .... | .... | .... | ...... | ,672 | 85,5 | 88,0 | 84,1 | S. .. | 0,06 | 0,09 |
| 17 | | ,750 | 84,3 | 87,0 | 83,2 | S. .. | ,670 | 85,1 | 85,9 | 82,1 | S. .. | 0,05 | 0,05 |
| 18 | | ,780 | 84,2 | 88,2 | 84,2 | S. .. | ,716 | 82,8 | 81,5 | 80,0 | S. .. | | |
| 19 | | ,802 | 84,0 | 86,0 | 83,8 | S. .. | ,732 | 85,8 | 85,0 | 82,1 | S. .. | 0,23 | 0,25 |
| 20 | ☾ | ,850 | 84,8 | 89,5 | 83,5 | S. .. | ,766 | 83,0 | 82,8 | 80,6 | S. .. | | |
| 21 | | ,840 | 83,7 | 88,8 | 83,5 | S. .. | ,748 | 86,0 | 89,2 | 82,5 | W.b s. | 0,12 | 0,13 |
| 22 | | ,782 | 84,0 | 37,8 | 83,0 | W.bS. | ,702 | 85,8 | 88,7 | 83,0 | W.b s. | | |
| 23 | | ,780 | 85,1 | 88,0 | 82,6 | S.b.w. | ,690 | 87,0 | 91,3 | 84,1 | S. .. | | |
| 24 | | ,772 | 85,3 | 88,7 | 83,2 | S. W. | ,692 | 86,8 | 92,3 | 85,2 | W.b s. | | |
| 25 | | ,745 | 85,4 | 89,8 | 85,0 | S. W. | ,686 | 87,2 | 91,5 | 83,6 | N. .. | | |
| 26 | | ,736 | 85,4 | 89,0 | 83,1 | S. W. | ,630 | 87,3 | 93,5 | 84,1 | W. .. | | |
| 27 | ● | ,696 | 86,0 | 92,2 | 83,3 | W.b s. | ,639 | 86,8 | 91,5 | 81,6 | W. .. | | |
| 28 | | .... | .... | ... | .... | ...... | ,624 | 87,5 | 90,1 | 83,8 | W. .. | | |
| 29 | | ,750 | 85,5 | 90,8 | 83,1 | S. .. | ,666 | 87,3 | 91,8 | 83,5 | S. .. | | |
| 30 | | ,770 | 85,5 | 89,5 | 83,3 | W. .. | ,680 | 86,3 | 88,0 | 84,1 | E.b.S. | | |
| Mean. | | ,763 | 83,6 | 86,3 | 82,6 | | ,687 | 84,7 | 86,6 | 82,5 | | 4,56 | 4,94 |

# Comparative Statistical Tables of Admissions into Hospital,—Total Sick Treated,—and Mortality from Disease, among the Royal Troops in the three Presidencies of India, for the Second Quarter of the Year 1840.

*Abstract of the General Quarterly Return of Sick of Her Majesty's Troops in the* Bengal *Presidency, from* 1st *April to* 30th *June,* 1840.

| Regiments and Stations. | Length of time present in the Command during the Quarter. | Average Strength during the Quarter. | Average Daily Sick. | No. of Admissions. | Total Treated. | No. of Deaths. | Ratio per Cent. of Daily Sick to Strength. | Ratio per Cent. per Quarter of Admissions to Strength. | Ratio per Cent. per Quarter of Deaths to Strength. | Ratio per Cent. of Deaths to Admissions. | Ratio per Cent. of Deaths to No. Treated. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3rd Light Dragoons—Cawnpore. | The whole period. | 631 | 63 | 282 | 327 | 3 | 9·98 | 44·69 | 0·47 | 1·06 | 0·91 | |
| 16th Lancers—Meerut. | Do. | 548 | 49 | 260 | 306 | 5 | 8·94 | 47·47 | 0·91 | 1·92 | 1·63 | |
| 3rd Buffs—Meerut. | Do. | 810 | 64 | 333 | 384 | 2 | 7·90 | 41·11 | 0·24 | 0·60 | 0·52 | |
| 9th Foot—Agra. | Do. | 776 | 64 | 369 | 414 | 7 | 8·24 | 47·55 | 0·90 | 1·89 | 1·69 | |
| 13th Light Infantry—Cabul. | Do. | 458 | 28 | 128 | 158 | 3 | 6·11 | 27·94 | 0·65 | 2·34 | 1·89 | No Regiment in the Bengal Command has had such a high "ratio of Mortality to strength" as the 94th in the Madras Presidency, and the 2nd and 17th in the Bombay Presidency. |
| 16th Foot—Dinapore. | Do. | 495 | 62 | 373 | 415 | 8 | 12·52 | 75·35 | 1·61 | 2·12 | 1·92 | |
| 18th Royal Irish—at Sea going to China. | Do. | 476 | 13 | 76 | 76 | 3 | 2·73 | 16·03 | 0·63 | 3·94 | 3·94 | |
| 21st Fusiliers—Fort William. | Do. | 670 | 77 | 619 | 686 | 15 | 11·49 | 92·38 | 2·24 | 2·42 | 2·18 | |
| 26th Foot—at Sea going to China, | Do. | 895 | 20 | 127 | 155 | 6 | 2·23 | 14·19 | 0·67 | 4·72 | 3·87 | |
| 31st Foot—Ghazeepore. | Do. | 700 | 53 | 235 | 282 | 14 | 7·57 | 33·57 | 2·0 | 5·95 | 4·96 | |
| 44th Foot—Kurnaul. | Do. | 746 | 61 | 327 | 366 | 5 | 8·17 | 43·83 | 0·67 | 1·53 | 1·37 | |
| 49th Foot—at Sea going to China, | Do. | 658 | 36 | 187 | 230 | 10 | 5·47 | 28·42 | 1·52 | 5·34 | 4·34 | |
| Detachments at Berhampore, Chinsurah, Landour, Presidency General Hospital, &c. | Do. | 598 | 62 | 384 | 443 | 14 | 10·36 | 64·21 | 2.34 | 3·64 | 3·16 | |
| General Quarterly Averages. | | 8,461 | 652 | 3,700 | 4,242 | 95 | 7·70 | 43·73 | 1·12 | 2·56 | 2.23 | |

*Abstract of the General Quarterly Return of Sick of Her Majesty's Troops in the* Madras *Presidency, from* 1st *April to* 30th *June,* 1840.

| Regiments and Stations. | Length of time present in the Command during the Quarter. | Average Strength during the Quarter. | Average Daily Sick. | No. of Admissions. | Total Treated. | No. of Deaths. | Ratio per Cent. of Daily Sick to Strength. | Ratio per Cent. per Quarter of Admissions to Strength. | Ratio per Cent. per Quarter of Deaths to Strength. | Ratio per Cent. of Deaths to Admissions. | Ratio per Cent. of Deaths to No. Treated. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15th (King's) Hussars—Bangalore. | The whole period. | 619 | 91 | 423 | 472 | 10 | 14·70 | 68·33 | 1.61 | 2·36 | 2·11 | |
| 4th Foot—Bellary. | Do. | 907 | 133 | 826 | 974 | 5 | 14·66 | 91·06 | 0 55 | 0·60 | 0·51 | |
| 39th Foot—Kamptee. | Do. | 727 | 68 | 572 | 623 | 8 | 9·35 | 78·67 | 1·11 | 1·39 | 1·28 | |
| 41st Foot—Belgaum. | Do. | 738 | 39 | 279 | 301 | 5 | 5·28 | 37·80 | 0·67 | 1·79 | 1·63 | This does not include a small detachment of the 41st Regt. at Poonah, (Bombay Presidency), in which 1 death occurred in Hospital. |
| 55th Foot—Fort St. George. | Do. | 711 | 65 | 349 | 398 | 8 | 9·14 | 49·08 | 1·12 | 2·29 | 2·01 | |
| 57th Foot (Right Wing) Trichinopoly. | Do. | 498 | 58 | 373 | 409 | 3 | 11·64 | 74·89 | 0·60 | 0·80 | 0·73 | |
| Do. (Left Wing)—Bangalore | Do. | 325 | 31 | 175 | 194 | 1 | 9·53 | 53·84 | 0·30 | 0·57 | 0·51 | |
| 62nd Foot—Moulmein. | Do. | 775 | 76 | 480 | 525 | 5 | 9·80 | 61·93 | 0·64 | 1·04 | 0·95 | |
| 63rd Foot—Moulmein. | Do. | 815 | 41 | 316 | 341 | 4 | 5·03 | 38·77 | 0·49 | 1·26 | 1.17 | |
| 94th Foot—Cannanore. | Do. | 665 | 85 | 402 | 469 | 23 | 12·78 | 60·45 | 3·46 | 5·72 | 4·69 | |
| Depôt of Recruits and Invalids—Poonamallee. | Do. | 53 | 7 | 20 | 36 | 2 | 13·20 | 37·73 | 3·77 | 10·00 | 5·55 | |
| General Quarterly Averages. | | 6,833 | 694 | 4,215 | 4,742 | 74 | 10·15 | 61·68 | 1·08 | 1·75 | 1·56 | |

*Abstract of the General Quarterly Return of Sick of Her Majesty's Troops in the* Bombay *Presidency, from* 1st *April to* 30th *June,* 1840.

| Stations and Regiments. | Length of time present in the Command during the Quarter. | Average Strength during the Quarter. | Average Daily Sick. | No. of Admissions. | Total Treated. | No. of Deaths. | Ratio per Cent. of Daily Sick to strength. | Ratio per Cent. per Quarter of Admissions to Strength. | Ratio per Cent. per Quarter of Deaths to Strength. | Ratio per Cent. of Deaths to Admissions. | Ratio per Cent. of Deaths to No. Treated. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4th Light Dragoons—Kirkee | The whole period. | 689 | 65 | 550 | 579 | 4 | 9·43 | 79·82 | 0·58 | 0·72 | 0 69 | In the Returns of the Bombay Presidency, I find that the Strength on the last day of the period is given, instead of the average, which would give erroneous ratios. I have corrected this, however, in the present Table as far as I could, by taking the mean strength of the 3 Monthly Returns. |
| 2nd Foot—Deesa. | Do. | 803 | 74 | 540 | 612 | 25 | 9·21 | 67·24 | 3·11 | 4·63 | 4·08 | |
| 6th Foot—Poonah. | Do. | 761 | 70 | 472 | 542 | 16 | 9·19 | 62·02 | 2·10 | 3·39 | 2·95 | |
| 17th Foot—Panwell on the march and Poonah. | Do. | 813 | 80 | 672 | 738 | 22 | 9·84 | 82·65 | 2·70 | 3·27 | 2·98 | |
| 40th Foot—Kurratchee. | Do. | 781 | 62 | 521 | 553 | 12 | 7·93 | 66·71 | 1·53 | 2·30 | 2·17 | |
| 41st Detachment—Poonah. | Do. | 6 | 2 | 3 | 9 | 1 | 33.33 | 50·00 | 16 66 | 33·33 | 11·11 | |
| General Quarterly Averages. | | 3,853 | 353 | 2,758 | 3,033 | 80 | 9·16 | 71·50 | 2·07 | 2·90 | 2·64 | |

*Comparative View of the Sickness and Mortality (Health) during the Second Quarter of* 1840, *at the respective Stations, occupied by Her Majesty's Troops in the* Bengal *Presidency.*

| | Stations. | Corps. | Average Strength. | From Fevers. Admitted. | From Fevers. Total Treated. | From Fevers. Died. | Pneumonia. Admitted. | Pneumonia. Total Treated. | Pneumonia. Died. | Hepatitis. Admitted. | Hepatitis. Total Treated. | Hepatitis. Died. | Dysentery. Admitted. | Dysentery. Total Treated. | Dysentery. Died. | Cholera. Admitted. | Cholera. Total Treated. | Cholera. Died. | Rheumatism & Lumbago. Admitted. | Rheumatism & Lumbago. Total Died. | Rheumatism & Lumbago. Died. | Scorbutus. Admitted. | Scorbutus. Total Treated. | Scorbutus. Died. | Venereal. Admitted. | Venereal. Total Treated. | Venereal. Died. | Other Diseases. Admitted. | Other Diseases. Total Treated. | Other Diseases. Died. | Total Admitted. | Total Treated. | Total Died. | Ratio per Cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. | Do. of Deaths to No. Treated. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cawnpore, ... | 3rd Light Dragoons, ... | 631 | 37 | 42 | 2 | 1 | 1 | ... | 3 | 3 | ... | 29 | 30 | ... | 12 | 12 | ... | 6 | 9 | ... | ... | ... | ... | 71 | 92 | ... | 122 | 138 | 1 | 282 | 327 | 3 | 44·69 | 0·47 | 1·06 | 0·91 |
| 2 | Meerut,* ... | 16th Lancers, 548; 3rd Buffs, 810 | 1,358 | 113 | 128 | ... | 12 | 12 | ... | 33 | 37 | ... | 27 | 32 | 2 | 1 | 3 | 1 | 40 | 50 | 1 | ... | ... | ... | 78 | 102 | ... | 289 | 326 | 3 | 593 | 690 | 7 | 43·66 | 0·51 | 1·18 | 1.01 |
| 3 | Agra,... ... | 9th Foot, ... ... | 776 | 123 | 129 | 2 | 2 | 3 | ... | 15 | 19 | 1 | 9 | 12 | 1 | 1 | 1 | ... | 16 | 20 | ... | ... | ... | ... | 33 | 42 | ... | 170 | 186 | 3 | 369 | 414 | 7 | 47·55 | 0·90 | 1·89 | 1·69 |
| 4 | Cabul, ... | 13th Light Infantry, ... | 458 | 23 | 23 | ... | 2 | 15 | ... | 4 | 7 | ... | 4 | 4 | ... | 1 | 1 | ... | 4 | 6 | ... | ... | ... | ... | 20 | 23 | ... | 70 | 88 | 3 | 128 | 158 | 3 | 27·94 | 0·65 | 2·34 | 1·89 |
| 5 | Dinapore,... | 16th Foot, ... ... | 495 | 65 | 72 | ... | 5 | 7 | ... | 11 | 13 | ... | 64 | 69 | 3 | 5 | 5 | 1 | 32 | 34 | ... | ... | ... | ... | 55 | 63 | ... | 136 | 152 | 4 | 373 | 415 | 8 | 75·35 | 1·61 | 2·14 | 1·92 |
| 6 | Chinsurah, | Detachments, ... ... | 481 | 59 | 62 | ... | 3 | 3 | ... | 3 | 3 | ... | 72 | 74 | 2 | 10 | 10 | 5 | 18 | 18 | ... | ... | ... | ... | 60 | 76 | ... | 101 | 110 | ... | 326 | 356 | 7 | 67·77 | 1·45 | 2·14 | 1·96 |
| 7 | Fort William, | 21st Foot, ... ... | 670 | 151 | 155 | 2 | ... | ... | ... | 1 | 2 | ... | 33 | 36 | 6 | 13 | 14 | 5 | 38 | 41 | ... | ... | ... | ... | 61 | 86 | ... | 322 | 352 | 2 | 619 | 686 | 15 | 92·38 | 2·23 | 2·42 | 2·18 |
| 8 | Ghazeepore, | 31st Foot, ... ... | 700 | 65 | 76 | 1 | 9 | 10 | 1 | 18 | 19 | 3 | 15 | 18 | ... | 25 | 25 | 6 | 15 | 28 | ... | ... | ... | ... | 18 | 25 | ... | 70 | 81 | 3 | 235 | 282 | 14 | 33·57 | 2·00 | 5·95 | 4·96 |
| 9 | Kurnaul, ... | 44th Foot, ... ... | 746 | 135 | 146 | 2 | ... | ... | ... | 8 | 11 | ... | 5 | 10 | 1 | ... | ... | ... | 6 | 10 | ... | 1 | 1 | ... | 22 | 32 | 1 | 150 | 160 | 1 | 327 | 366 | 5 | 43·83 | 0·67 | 1·53 | 1·37 |
| 10 | Hazareebaugh,† ... | ... ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

* The Returns of these 2 Corps have been added together, as there is very little difference in their Ratios of Sickness and Mortality.—† Not occupied by any Regiment during the Quarter.

Remarks.

1. These Tables are a little more extended than the last.
2. The comparison of the ratios of Sickness and Mortality, between the present and former Quarter, in the different Corps, and at the different Stations, can easily be made.
3. The value of a series of such Tables will be appreciated by those who understand their object.
4. I have retained the column for Scorbutus, with a view to attract the attention of Medical Officers to its causes, and means of prevention among those under their charge.

*Comparative View of the Sickness and Mortality (Health) during the Second Quarter of* 1840, *at the respective Stations occupied by Her Majesty's Troops in the* Madras *Presidency.*

| | Stations. | Corps. | Average Strength. | From Fevers. Admitted. | From Fevers. Total Treated. | From Fevers. Died. | Pneumonia. Admitted. | Pneumonia. Total Treated. | Pneumonia. Died. | Hepatitis. Admitted. | Hepatitis. Total Treated. | Hepatitis. Died. | Dysentery. Admitted. | Dysentery. Total Treated. | Dysentery. Died. | Cholera. Admitted. | Cholera. Total Treated. | Cholera. Died. | Rheumatism & Lumbago. Admitted. | Rheumatism & Lumbago. Total Treated. | Rheumatism & Lumbago. Died. | Scorbutus. Admitted. | Scorbutus. Total Treated. | Scorbutus. Died. | Venereal. Admitted. | Venereal. Total Treated. | Venereal. Died. | Other Diseases. Admitted. | Other Diseases. Total Treated. | Other Diseases. Died. | Total Admitted. | Total Treated. | Total Died. | Ratio per Cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. | Do. of Deaths to No. Treated. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bangalore, ... | 15th Hussars, 619 | 944 | 42 | 46 | 1 | ... | ... | ... | 36 | 44 | 3 | 57 | 62 | 2 | 5 | 5 | 1 | 20 | 21 | ... | ... | ... | ... | 139 | 151 | ... | 124 | 143 | 3 | 423 | 472 | 10 | 68·33 | 1·61 | 2·36 | 2·11 |
| | | 57th Ft. Rt. Wg. 325 | | 24 | 24 | ... | ... | ... | ... | 5 | 5 | ... | 12 | 14 | ... | 1 | 1 | ... | 12 | 13 | ... | ... | ... | ... | 72 | 81 | ... | 49 | 68 | 1 | 175 | 206 | 1 | 53·84 | 0·30 | 0·57 | 0·48 |
| | Total at Bangalore, | ... ... ... ... ... | ... | 66 | 70 | 1 | ... | ... | ... | 41 | 49 | 3 | 69 | 76 | 2 | 6 | 6 | 1 | 32 | 34 | ... | ... | ... | ... | 211 | 232 | ... | 173 | 211 | 4 | 598 | 676 | 11 | 61·22 | 0·16 | 1·83 | 1·25 |
| 2 | Fort St. George, | 55th Foot, ... ... | 711 | 74 | 83 | 1 | 1 | 1 | ... | 14 | 22 | ... | 57 | 59 | 3 | 1 | 1 | ... | 33 | 38 | ... | ... | ... | ... | 38 | 47 | ... | 131 | 147 | 4 | 349 | 398 | 8 | 49·09 | 1·12 | 2.29 | 2·01 |
| 3 | Trichinopoly, ... | 57th Foot, Rt. Wing, | 498 | 119 | 124 | ... | 2 | 2 | ... | 9 | 11 | ... | 57 | 59 | 1 | ... | ... | ... | 4 | 6 | ... | ... | ... | ... | 99 | 116 | ... | 83 | 91 | 2 | 373 | 409 | 3 | 74·89 | 0·60 | 0·80 | 0·73 |
| 4 | Belgaum, ... | 41st Foot, ... ... | 738 | 15 | 15 | ... | 8 | 10 | ... | 28 | 34 | 1 | 45 | 47 | 2 | ... | ... | ... | 19 | 23 | ... | 1 | 1 | ... | 78 | 80 | 1 | 83 | 89 | 1 | 276 | 298 | 5 | 37·39 | 0 67 | 1·81 | 1·67 |
| 5 | Cannanore, ... | 94th Foot, ... ... | 665 | 40 | 44 | 1 | ... | ... | ... | 39 | 50 | 3 | 130 | 145 | 19 | ... | ... | ... | 19 | 23 | ... | ... | ... | ... | 25 | 33 | ... | 148 | 173 | ... | 402 | 469 | 23 | 60·04 | 3·45 | 5·72 | 4·90 |
| 6 | Bellary, ... | 4th Foot, ... ... | 907 | 342 | 398 | 1 | 4 | 4 | ... | 22 | 28 | 2 | 31 | 36 | 2 | ... | ... | ... | 41 | 57 | ... | ... | ... | ... | 185 | 232 | ... | 199 | 219 | ... | 826 | 974 | 5 | 91·06 | 0·55 | 0·60 | 0·51 |
| 7 | Kamptee, ... | 39th Foot, ... ... | 727 | 281 | 285 | 3 | 2 | 3 | ... | 11 | 14 | 1 | 8 | 17 | 1 | ... | ... | ... | 25 | 27 | ... | ... | ... | ... | 59 | 68 | ... | 186 | 207 | 3 | 572 | 623 | 8 | 78·67 | 1·10 | 1.39 | 1·28 |
| 8 | Moulmein, ... | ‡62nd Foot, 775 | 1590 | 89 | 98 | ... | 1 | 1 | ... | 47 | 54 | 2 | 81 | 82 | 2 | ... | ... | ... | 32 | 39 | ... | ... | ... | ... | 51 | 62 | ... | 179 | 189 | 1 | 480 | 525 | 5 | 61·93 | 0·64 | 1.04 | 0·95 |
| | | 63rd Foot, 815 | | 83 | 85 | ... | 3 | 6 | ... | 19 | 24 | 2 | 18 | 18 | ... | ... | ... | ... | 18 | 18 | ... | ... | ... | ... | 24 | 27 | ... | 151 | 163 | 2 | 316 | 341 | 4 | 38·77 | 0·49 | 1·26 | 1·17 |
| | Total at Moulmein, | ... ... ... ... ... | ... | 172 | 183 | ... | 4 | 7 | ... | 66 | 78 | 4 | 99 | 100 | 2 | ... | ... | ... | 50 | 57 | ... | ... | ... | ... | 75 | 89 | ... | 330 | 352 | 3 | 796 | 886 | 9 | 50·06 | 0·56 | 1·13 | 1·01 |

‡ I have given the Returns of these 2 Regiments separately to shew the extraordinary difference between their Ratios, though similarly Quartered at the same Station. The 62d has been a conspicuously unfortunate Corps in regard to Sickness and Mortality since its arrival in India. The cause of this deserves a minute investigation; as does also that of comparative immunity of a Corps;—as of the 26th Cameronians while in India, for instance.

*Comparative View of the Sickness and Mortality, (Health,) during the Second Quarter of* 1840, *at the respective Stations occupied by Her Majesty's Troops in the* Bombay *Presidency.*

| | Stations. | Corps. | Average Strength. | From Fevers. Admitted. | From Fevers. Total Treated. | From Fevers. Died. | Pneumonia. Admitted. | Pneumonia. Total Treated. | Pneumonia. Died. | Hepatitis. Admitted. | Hepatitis. Total Treated. | Hepatitis. Died. | Dysentery. Admitted. | Dysentery. Total Treated. | Dysentery. Died. | Cholera. Admitted. | Cholera. Total Treated. | Cholera. Died. | Rheumatism & Lumbago. Admitted. | Rheumatism & Lumbago. Total Treated. | Rheumatism & Lumbago. Died. | Scorbutus. Admitted. | Scorbutus. Total Treated. | Scorbutus. Died. | Venereal. Admitted. | Venereal. Total Treated. | Venereal. Died. | Other Diseases. Admitted. | Other Diseases. Total Treated. | Other Diseases. Died. | Total Admitted. | Total Treated. | Total Died. | Ratio per Cent. of Admissions to Strength in the Quarter. | Do. of Deaths to Strength. | Do. of Deaths to Admissions. | Do. of Deaths to No. Treated. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Kirkee, ... ... | 4th Light Dragoons, | 689 | 176 | 181 | ... | 3 | 3 | ... | 4 | 4 | ... | 21 | 24 | 3 | 9 | 9 | 1 | 22 | 22 | ... | ... | ... | ... | 50 | 53 | ... | 265 | 283 | ... | 550 | 579 | 4 | 79·82 | 0·58 | 0·72 | 0·68 |
| 2 | Deesa, ... ... | 2nd Foot, ... ... | 803 | 306 | 323 | 12 | 3 | 3 | ... | 7 | 8 | ... | 21 | 29 | 5 | 2 | ... | ... | 21 | 28 | ... | ... | ... | ... | 9 | 11 | ... | 171 | 208 | 8 | 540 | 612 | 25 | 67·24 | 3·11 | 4·62 | 4·08 |
| 3 | Poonah,... ... | 6th Foot, 671 | 767 | 147 | 149 | 2 | 1 | 1 | ... | 24 | 30 | 3 | 30 | 37 | 2 | 14 | 14 | 9 | 7 | 7 | ... | 1 | 2 | ... | 80 | 90 | ... | 167 | 200 | ... | 472 | 542 | 16 | 62·02 | 2·10 | 3·38 | 2·95 |
| | | 41st Detachment, 6 | | ... | ... | ... | 1 | 3 | †1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 4 | ... | ... | ... | ... | ... | 1 | ... | ... | 1 | ... | 3 | 9 | 1 | 50·00 | 16·66 | 33·33 | 11·11 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 475 | 551 | 17 | | | | |
| 4 | Colabah,‡ ... | ... ... ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5 | Kurratchee, ... | 40th Foot, ... ... | 781 | 314 | 329 | 8 | ... | ... | ... | 19 | 21 | 2 | 28 | 29 | ... | ... | ... | ... | 28 | 29 | ... | 4 | 5 | ... | 21 | 24 | ... | 107 | 117 | 2 | 521 | 553 | 12 | 66·70 | 1·53 | 2·30 | 2·16 |

† This death is omitted in the Bombay Quarterly Return, though it appears in the Monthly of that Presidency for April. Note. The 17th Regiment changed its station during this Quarter.

‡ By the Return it does not appear that there were any Troops of Her Majesty's Service at this Station during the Quarter.

*Return, shewing the Comparative Ratio of Admissions and Deaths from the most prevalent and fatal Diseases among Her Majesty's Troops in the three Presidencies, during the Quarter, from 1st April to 30th June,* 1840.

| Presidencies. | | No. Admitted. | Total Treated. | No. Died. | Ratio per Cent. of Admissions to strength for the Quarter. | Ratio per Cent. of Deaths to strength for the Quarter. | Ratio per Cent. of Deaths to Admissions. | Ratio per Cent. of Deaths to No. Treated. |
|---|---|---|---|---|---|---|---|---|
| | | | | | *1st Table—of Fevers.* | | | |
| Bengal, .. .. .. | Intermittens, | 73 | 75 | 0 | 0·86 | 0·00 | 0·00 | 0·00 |
| | Remittens, .. | 53 | 57 | 2 | 0·62 | 0 02 | 3 77 | 3·51 |
| | Continued, .. | 738 | 798 | 8 | 8 72 | 0.09 | 1·08 | 1·00 |
| Total, .. | | 864 | 930 | 10 | 10·21 | 0·11 | 1·15 | 1 07 |
| Madras, .. .. .. | Intermittens, | 224 | 236 | 1 | 3·27 | 0·01 | 0·44 | 0·42 |
| | Remittens, .. | 43 | 48 | 1 | 0 63 | 0·01 | 2·32 | 2·08 |
| | Continued, .. | 845 | 922 | 6 | 12·36 | 0 09 | 0·71 | 0 45 |
| Total, .. | | 1112 | 1206 | 8 | 16·27 | 0·11 | 0·71 | 0·66 |
| Bombay, .. .. .. | Intermittens, | 48 | 58 | 0 | 1·27 | 0·00 | 0·00 | 0·00 |
| | Remittens, .. | 378 | 402 | 13 | 9·83 | 0.34 | 3·43 | 3·23 |
| | Continued, .. | 733 | 762 | 12 | 1·90 | 0·31 | 1·63 | 1 56 |
| Total, .. | | 1159 | 1212 | 25 | 30·0 | 0·64 | 2·15 | 2·00 |
| | | | | | *Summary of Fevers.* | | | |
| Summary of each type of Fever in the three Presidencies, .. .. | Intermittens, | 345 | 369 | 1 | 1·80 | 0·00 | 0·29 | 0·27 |
| | Remittens, .. | 474 | 507 | 16 | 2 47 | 0·07 | 3·36 | 3·15 |
| | Continued, .. | 2316 | 2482 | 26 | 12·09 | 0·13 | 1·12 | 1·04 |
| General Total and Ratios of Fevers, .. .. .. | | 3135 | 3558 | 43 | 11·15 | 0·22 | 1·37 | 1·28 |
| | | | | | *2nd Table—of Pneumonia.* | | | |
| Bengal, .. .. .. .. | | 36 | 55 | 2 | 0·42 | 0·02 | 5·55 | 3.63 |
| Madras, .. .. .. .. | | 21 | 26 | 0 | 0·30 | 0·00 | 9·30 | 0·00 |
| Bombay, .. .. .. .. | | 14 | 15 | 1 | 3·36 | 0·02 | 7.14 | 6·66 |
| General Total and Ratios of Pneumonia, .. .. | | 71 | 96 | 3 | 0·37 | 0·01 | 4·22 | 3·12 |
| | | | | | *3rd Table—of Hepatitis.* | | | |
| Bengal, .. .. .. .. | | 115 | 135 | 7 | 1·35 | 0·08 | 6·08 | 5·18 |
| Madras, .. .. .. .. | | 231 | 287 | 14 | 3·38 | 0·20 | 6·06 | 4·88 |
| Bombay, .. .. .. .. | | 69 | 78 | 5 | 1·79 | 0·13 | 7·24 | 6 41 |
| General Total and Ratios of Hepatitis, .. .. | | 415 | 500 | 26 | 2·11 | 0·13 | 6·26 | 5·20 |
| | | | | | *4th Table—of Dysentery.* | | | |
| Bengal, .. .. : .. | | 336 | 388 | 25 | 3·97 | 0·29 | 7·44 | 6·44 |
| Madras, .. .. .. .. | | 499 | 545 | 32 | 5·89 | 0·47 | 6·41 | 5·87 |
| Bombay, .. .. .. .. | | 166 | 197 | 12 | 4·31 | 0·31 | 7·23 | 6·09 |
| General Total and Ratios of Dysentery, .. .. | | 1001 | 1130 | 69 | 5·22 | 0·35 | 6·89 | 6 06 |
| | | | | | *5th Table—of Cholera.* | | | |
| Bengal, .. .. .. | Biliosa, .. | 71 | 75 | 20 | 0·83 | 0·23 | 28·16 | 26·66 |
| | Maligna, .. | 3 | 3 | 2 | 0·03 | 0·02 | 66 66 | 66 66 |
| Total, .. | | 74 | 78 | 22 | 0·87 | 0·26 | 29·72 | 28 20 |
| Madras. .. .. .. | Biliosa, .. | 5 | 5 | 0 | 0 07 | 0·00 | 0·00 | 0·00 |
| | Maligna, .. | 2 | 3 | 1 | 0·02 | 0·01 | 50.00 | 33·33 |
| Total, .. | | 7 | 8 | 1 | 0·10 | 0·01 | 14·28 | 12 50 |
| Bombay, .... .. .. | Biliosa, .. | 16 | 17 | 6 | 0·41 | 0·15 | 37·50 | 35·29 |
| | Maligna, .. | 35 | 35 | 14 | 0·90 | 0·36 | 40·00 | 40·00 |
| Total, .. | | 51 | 52 | 20 | 1·32 | 0·51 | 39·21 | 38·46 |
| Summary of each type of Cholera in the three Presidencies, .. .. | Biliosa, .. | 92 | 97 | 26 | 0·48 | 0·13 | 28·26 | 26·80 |
| | Maligna, .. | 40 | 41 | 17 | 0·20 | 0·08 | 42·50 | 41·46 |
| General Total and Ratios of Cholera, .. .. .. | | 132 | 138 | 43 | 0·68 | 0·22 | 32·57 | 31·15 |
| | | | | | *6th Table—of Rheumatism.* | | | |
| Bengal, .. ... .. .. | | 192 | 237 | 1 | 2·27 | 0·01 | 0·52 | 0·42 |
| Madras, .. .. .. .. | | 226 | 257 | 0 | 3 30 | 0·00 | 0·00 | 0·00 |
| Bombay, .. .. .. .. | | 90 | 101 | 0 | 1·32 | 0·00 | 0·00 | 0·00 |
| General Total and Ratios of Rheumatism, .. .. | | 508 | 595 | 1 | 2·65 | 0·00 | 0·00 | 0·00 |
| | | | | | *7th Table—of Venereal.* | | | |
| Bengal, .. .. .. .. | | 468 | 614 | 1 | 5·53 | 0·01 | 0·21 | 0·16 |
| Madras, .. .. .. .. | | 773 | 896 | 2 | 11·31 | 0·02 | 0·25 | 0·22 |
| Bombay, .. .. .. .. | | 216 | 239 | 2 | 5·60 | 0·05 | 0·92 | 0·83 |
| General Total and Ratios of Venereal, .. .. .. | | 1457 | 2256 | 5 | 7·60 | 0·02 | 0·34 | 0·22 |
| | | | | | *8th Table—of Other Diseases.* | | | |
| Bengal, .. .. .. .. | | 1615 | 1805 | 27 | 19·08 | 0·31 | 1·67 | 1·40 |
| Madras, .. .. .. .. | | 1346 | 1517 | 17 | 19·69 | 0·24 | 1·26 | 1·12 |
| Bombay, .. .. .. .. | | 993 | 1139 | 15 | 25·77 | 0·38 | 1·51 | 1·31 |
| General Total and Ratios of other Diseases, .. | | 3954 | 4461 | 59 | 20·65 | 0·30 | 1·48 | 1·32 |

Remarks

1. I should have added a Table to shew the effects of exposure of our Soldiers to the strong rays of the Sun, and to the influence of high atmospheric temperature, from which it appears a great mortality occurred during this Quarter. Several died suddenly from this cause, not entered at all in the Hospital Returns, and several deaths from it are returned under the head of Fever. Those denominated "Apoplexy" were all from this cause, and six deaths appear under this head.
I wish to call the attention of Medical Officers to the very dangerous effects of exposure to the Sun and to oppressive heat, and at the same time to remind them of one of the most efficacious remedies for its cure *in the first stage*, viz. "the pouring of a stream of cold water on the head," which appears to be in little use here.

2. The Tables of Pneumonia and Rheumatism, shew that Soldiers require to be particularly guarded against "*checked perspiration*," which is by far the most prolific cause of disease and death among H. M.'s Troops in India.

3. I have given double columns for Cholera, as in the Regimental Returns it is divided into Cholera Biliosa, and Cholera Spasmodica; although it is evident from the ratios of Mortality, that the distinction was often confounded. No doubt the Diagnosis of the Malignant disease in its commencement is often most difficult, if not impossible. Moreover, the name "Cholera" is itself a stambling block, involving the question whether it be derived from χολὴ *bile*, and ῥέω *to flow*; or from χολέρα a *Waterspout.*

4. As usual, the greatest quantum and ratio of Mortality occurred from Dysentery; and as by these Comparative Tables we shall soon be enabled to shew the localities where it is most prevalent and fatal, so will they facilitate the investigation of its causes, and means of prevention.

*Concluding Summary (Comparative) Table of the Quarterly Returns of Sickness and Mortality among Her Majesty's Troops in the three Presidencies of India, from 1st April to 30th June, 1840.*

| Presidencies. | Average Strength. | Average Daily Sick. | No. of Admissions. | Total Treated. | No. of Deaths. | Ratio per Cent. of Daily Sick to Strength. | Ratio per cent. of Admissions to Strength for the Quarter. | Ratio per Cent. of Deaths to Strength for the Quarter. | Ratio per Cent. of Deaths to Admissions. | Ratio per Cent. of Deaths to No. Treated. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bengal. .. | 8461 | 652 | 3700 | 4242 | 95 | 7·70 | 43·73 | 1·12 | 2·62 | 2·23 | 1. The Ratio of Admissions is higher in each Presidency this 2nd Quarter of the year, than in the former.<br>2. The Ratio of deaths to Strength is higher in Madras and Bombay, but somewhat lower in the Bengal Presidency.<br>3. The Ratio of Deaths to Admissions is lower in each Presidency.<br>4. The highest Ratios of Admissions and Deaths are on the Bombay side. |
| Madras, .. | 6833 | 694 | 4215 | 4742 | 74 | 10·15 | 61·68 | 1·08 | 1·75 | 1·56 | |
| Bombay, .. | 3853 | 353 | 2758 | 3033 | 80 | 9·16 | 71·58 | 2·07 | 2·90 | 2·64 | |
| Summary, | 19147 | 1699 | 10673 | 12017 | 249 | 8·87 | 55·72 | 1·30 | 2·33 | 2·07 | |
| This would give Average Ratios *per Annum*. . . . | | | | | | | 222·90 | 5·20 | Considerably higher than last Quarter. | | |

JOHN MURRAY, M. D.
*Inspector General, H. M's. Hospitals.*

THE

# CALCUTTA JOURNAL

OF

# NATURAL HISTORY.

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*Muscologia Itineris Assamici; or, a Description of Mosses, collected during the Journey of the Assam Deputation, in the years* 1835 *and* 1836. *By* WILLIAM GRIFFITH, ESQ. *Assistant Surgeon, Madras Establishment. Read before the Linnæan Society of London, March* 6*th,* 1838.*

The accompanying collection forms part of the large collections made during the journey of the late Deputation from Calcutta into Upper Assam. By far the greater portion was collected on the Khasiya Hills, an elevated

* This paper, which was written in 1836, was read before the Linnæan Society in March, 1838. I fear that it may not appear to be altogether in good taste to publish in India, what was not published in England, for I have implicit confidence in the soundness of the judgment which suggested that the paper should stand over.

Still I wish to place on record the only connected botanical examinations which have resulted from the Assam Deputation, the more particularly because most of the species are undescribed, and almost all the specimens, from which the descriptions were drawn up, have been destroyed.

With the feelings of an author, those of a botanist are mingled. Priority is the bone of contention for which the great majority of botanists are always wrangling. It appears to me evident that if a botanist were to come to India, visit the places I have, and publish his materials, tract of country, forming portion of the Eastern frontier of British India. The extreme distance from Terya Ghat, at

I should be exposed to the loss of so many undescribed species. And it is well known that most botanists, even many who are considered great, cannot put up with the loss of a single species, even though their claims to its botanical authorship may be founded on any thing but justice. The loss therefore to me would be insupportable.

The publication of MSS. which I knew from the disadvantages attendant on their preparation would contain an unusual number of mistakes, and which I know to do so, does not admit of such easy explanation: it is however not very far from being in accordance with modern practice. I myself would rather have reserved the MSS. until I could have worked out to the best of my ability the very extensive materials in Muscology now in my possession. But the daily increasing extent of my Indian Herbarium, the duty I have to perform with regard to the Affghan Collections, the probability of my residing for several years in an unexplored and highly botanical country, all induce me to suspect that any adjournment would become a postponement sine die.

For those who take an interest in Indian Muscology, it may not be amiss to add, that in vol xi. of Sir Wm. J. Hooker's Journal of Botany, the Mosses in the Herbarium distributed by Dr. Wallich, and those collected by Dr. Royle, are enumerated; the former by the Hon'ble W. Harvey, the latter by Dr. Hooker, botanist to the Antarctic expedition. And of these, many I believe are figured in Hooker's Icones, tab. XVII to XXIV.

This paper, like most others, is written for the European Muscologist, in as much as it gives only the means of determining the previously undescribed species.

This deficiency is shared by my paper.

Those, who consider it indispensable to understand structure before they venture to describe form, I would refer to the works of Hedwig, to a paper by Mr. Robert Brown, in the 12th vol. of the Linnæan Transactions, and to a paper by Mr. Valentine in the xvii. vol. of the same excellent collection. Mr. Valentine's paper is accurate and original, and with the exception perhaps of the physiological conclusions, worthy of being studied. The article on Mosses in Dr. Lindley's Introduction to Botany, 2nd Ed. is certainly inaccurate with regard to one of the most peculiar points of structure, and presumptively so in all the points regarding function.

the foot of the Hills on the southern side, to Raneegaon on the northern side, does not exceed 60 miles; and that between Churra Punjee and Nunklow, both of which may be said to be on the edge of the higher portion of the plateau, 35 miles.

The heights of the places situated on the route between the above places, are as follows; they are taken from Capt. Pemberton's "Report on the Eastern Frontier of British India:"

| | *feet.* |
|---|---|
| Churra Punjee, ... ... ... ... | 4,349 |
| Surureem, ... ... ... ... ... | 5,600 |
| Moflong, ... ... ... ... ... | 5,942 |
| Myrung, ... ... ... ... ... | 5,940 |
| Nunklow, ... ... ... ... ... | 4,553 |

In addition to these places, I must mention Moosmai and Maamloo, near Churra Punjee; and at about the same elevation, Mumbree between Moflong and Myrung, one of the highest parts on the route; and the Bogapanee, a mountain stream rushing through a valley perhaps 1,500 feet below Moflong. The mean annual heat of these Hills, although it probably varies much relatively to the distance from the commencement of the descent on either side, may be estimated at 65° Fahrenheit, calculating the average height to be 5,100 feet, and adopting Baron Humboldt's ratio of a decrease of one degree for every 396 feet of vertical ascent. Very little is known about the climate of the central portions; but towards either descent, it becomes one of excessive dampness throughout the rains. The southern side receives the whole force of the S. W. monsoon, and the fall of rain at Churra Punjee, the only place where it has been estimated, is, if the accounts be correct, prodigious. Mr. Cracroft states, that the total rain that fell in four months, from June to September inclusive, and in two days of October, when

15,790 fell, was inches 225,789. But if we consider that this so far exceeds the maximum amount observed in other places, exposed more directly to the influence of the S. W. monsoon, we may reasonably question the correctness of Mr. Cracroft's observations.

So little attention has been hitherto paid to Indian Muscology, that no parallel can be drawn between the Muscology of the Khasiya Hills, and of other mountainous tracts of India. The present collection forms about one-eighth of the whole number, taking Bridel's total amount (1,324 species) to be nearly correct. And some idea may be formed of the probable great number of species that remain to be found, when I mention, that the whole of the Hill collection was formed between the 8th of October, and the 20th of November: and that the most interesting portions of the hills to the Eastward of the route mentioned were not visited.

I know no arrangements of the genera, except the artificial one employed by Dr. Hooker, and the artificial and natural ones of Bridel, as given in his Bryologia Universalis. Mr. Brown begins his account of the Melville Island Mosses with *Polytrichum.* No very satisfactory ordination of all the genera has, I believe, as yet been given; nor will it be, until additional characters have been discovered. At the same time, I think, that several types of organization exist, and that in the larger groups of these, every gradation of development, at least so far as the peristome is concerned, may be observed.

*Sphagnum* approaches, in some points, to *Hepaticæ,* but I doubt the correctness of its being stated to be evaginulate. I have not been able to examine its fruits at different periods, but it appears to me that the only difference between it and the usual form, exists in the cohesion of the true apex of the seta, with the interior of the vaginula.

*Polytrichum,* in the structure and origin of its peristome, has nothing in common with the usual form of mosses, in which both peristomes originate from the inner membrane. In the genus alluded to, and in one or two allied genera, it is an extension of the outer wall of the capsule, shews usually no indications of composition, and is probably analogous to the annulus of the more developed genera of the order. Its processes too are liable to vary in number, and they are in some species much increased beyond the number 32, which is the maximum number of a single peristome of the usual structure, in which likewise no instance occurs of less than 16; for although Tetraphis has only four, and one or two genera only eight teeth, the composition, as indicated by longitudinal lines, is in all such 32. The smallest number, 16, exists in some Weissiæ and Didymodons. I believe that Mr. Brown was the first to direct attention to the composition of the teeth of the peristome in the above instances. One of the most curious peculiarities in *Polytrichum* exists in the inflection of the inner membrane, forming, as it were, a ring opposite the *neck* of the capsule. This is quite distinct from the inflection that occurs in some other genera, in which the inflected portion is the termination of the membrane.

The outer peristome of *Buxbaumia* is obviously of analogous origin with the peristome of *Polytrichum;* neither do I see any reason for not adopting the opinion of Bridel, that the inner peristome of *Buxbaumia* and *Diphyscium* is analogous to the epiphragma of *Polytrichum.* Bridel in his generic characters of *Catharinea, Pogonatum* and *Polytrichum,* describes the teeth of the peristome as seizing, by their apices, the epiphragma. This is incorrect; the teeth are seized by the epiphragma, which, in the dry state alone by contraction, leaves the interstices open: in the wet state it expands, covering the whole of the teeth as well as their interstices.

I have referred a species, which, with almost every character of *Dicranum,* has the peristome of *Didymodon,* to the former genus. Schwaegrichen however refers a nearly allied species with a similarly anomalous peristome to *Didymodon:* this however appears to me to be sacrificing a number of characters to a solitary one. But if such views are correct, my Fissidens neckeroides must be incorporated with *Didymodon.*

*Fissidens* has, I think, without doubt, terminal setæ, for in those cases in which they are axillary, they frequently become elongated, which, so far as I know, is never the case with those which have truly lateral setæ. Judging from the first developed leaves both of the stem and perichætium, it would seem that the "duplicatura" of Hedwig is the true lamina, and that they differ only from highly carinate leaves in the excurrent vein being as it were alate, the dorsal ala being prolonged down the carina to its base. The only objection to this view is the frequent inequality of the two lamellæ.

In Trematadon longicollis, I had opportunities of ascertaining the correctness of the observations of Mr. Valentine on the development of the setæ. With these observations I am only however partially acquainted. The old and incorrect ideas appear nevertheless to still prevail, and are admitted into the second edition of Mr. Lindley's Introduction to Botany. The explanations too adopted in this excellent book as to the difference between a mitriform and dimidiate calyptra, and an outer and inner peristome, are likewise particularly erroneous.

With regard to the development of the setæ of Musci, I know of no analogous instances, excepting Jungermannia, which is undoubtedly vaginulate. The changes subsequent to fecundation are, in these, much more complicated than in Phænogamous plants, in which they are limited almost universally to the maturation of a pre-existing ovule; whereas in these, they are extended not only to the development of the sporula, but to the generally highly complex apparatus in which these are contained.

I am not aware whether any one has explained the opposition of the teeth of the peristomes in Funaria. But looking at the situation of the carinæ or plicæ that exist in the membrane of the inner peristome, which are invariably alternate with the teeth of the outer peristome, and at the allied genus *Bartramia*, it is evident that the anomaly arises from the cohesion of the component parts of different processes, each of which thus becomes strictly compound.

I have approximated *Pterogonium* to Neckera, on account of its habit, and the laterality of its setæ: in its capsule and peristome it approaches nearly to some Weissiæ.

*Daltonia* I have adopted in the sense of Bridel. Neckera heteromalla, which Dr. Hooker refers to *Daltonia*, agrees entirely with *Neckera* in its inner peristome, and must, if attention be paid to its mitriform calyptræ, be referred to *Pilotrichum* of Bridel, or *Daltonia* of Mr. Arnott? I have no opportunity of examining *Anomodon*, which *can* only differ in the degree of development of the membrane of the inner peristome, and its adhesion to the base of the outer. As the authors of the Muscologia Brittanica state that their Daltonia agrees well in the inner peristome with Anomodon, there is some reason to doubt the accuracy of the generic characters of both these genera, as given in the book alluded to.

In *Neckera* I have included *Pilotrichum* and *Cryphæa* of Bridel, and *Daltonia* of Arnott. It is certainly a heterogeneous assemblage, particularly as regards habit. I have been guided in this by the existence of every gradation between the truly dimidiate calyptræ of the true Neckeræ and its mitriform state in *Pilotrichum*. The existence of the appendiculæ, which appear to have first excited attention in *Drepanophyllum*, is now, I believe, for the first time, pointed out as occurring in Neckera. Neither are they limited to one section, although three out of the four species in which they occur agree tolerably well in habit, and all are characterised by a great tendency to elongation in their branches, to the lower part of which elongation the appendiculæ are usually confined. Their structure is that of Paraphyses; their contents similar apparently to the contents of the ordinary form of anthers. As *Paraphyses* are perhaps, in all cases, abortive anthers, these appendages may be considered as anthers at the maximum of development. The objections to this exist in their having no especial protecting organs, and in their never appearing to dehisce. The question will be best set at rest, by examining whether they ever co-exist with male flowers of the ordinary form. If such is not the case, such species cannot remain grouped with those which have male flowers of the ordinary form. Neckera Hookeriana and Adiantum have leaves of two distinct forms, the lateral and distichous ones being alone oblique. This they possess, in common with some Hookeriæ, Leskiæ and Hypna. In all, this is only an instance of excess, as it were, of the difference perceptible in the obliquity of the lateral leaves, and the equilaterality of the anticous and posticous ones of many other mosses, and especially of the falcate section of Hypnum. With Stipulæ they have nothing in common, for independently of their being single organs,—even when they *may* be considered referable to, or as belonging to the lateral leaves, it is only to one series of these, and only to one point of these (the lower point of insertion), that they correspond.

I do not know whether the nature of the compound hairs existing on the vaginula or calyptræ of many mosses has been hinted at. In Neckera crinita they are obviously reduced perichætial leaves. Such is probably their nature in all cases. They are not to be confounded with the simple hairs existing in similar situations, such being referrible to Paraphyses.

*Anhymenium* I have ventured to propose as a new genus, remarkable for the proportionally very small teeth of the outer peristome, and for the great development of the processes of the inner peristome, considered relatively to the almost total absence of a basilar membrane. In this instance, the disparity between the membrane and the processes, in favour of the latter, is greater even than in Climacium.

*Pleuropus*, the second genus, which appears to me new, has the same relation to Leskia, etc. that Brachymenium has to Bryum. From the former genus it is alone distinguishable by the laterality of its setæ, and the accompanying difference in habit.

Almost the whole of the above descriptions were made from dried specimens. I trust that considerable indulgence will be shewn to the numerous errors that must exist, especially as regards the fabrication of new species. Advice in Muscology is not to be obtained in India; and my means of consultation are limited to Bridel's Bryologia Universalis, the Musci Exotici of Dr. Hooker, and the Muscologia Brittanica of Dr. Hooker and Taylor. In means of comparison with authentically named specimens, I am altogether deficient: owing to this, I have not ventured to meddle with either Leskia or Hypnum, under any circumstances a business of some difficulty, but one to me almost insuperable on account of the unnatural arrangement of Hypnum by Bridel.

*Sequence of the genera of the Muscologia Itineris Assamici.*

| | No. of species. | | No. of species. |
|---|---|---|---|
| 1. Sphagnum, ... ... ... | 1 | 10. Grimmia, ... ... ... ... | 3 |
| 2. Polytrichum, ... ... ... | 6 | 11. Trematodon, ... ... ... | 2 |
| 3. Diphyscium, ... ... ... | 1 | 12. Dicranum, ... ... ... ... | 13 |
| 4. Gymnostomum, ... ... | 7 | 13. Fissidens, ... ... ... ... | 10 |
| 5. Orthodon, ... ... ... ... | 1 | 14. Didymodon, ... ... ... | 4 |
| 6. Orthotrichum, ... ... ... | 5 | 15. Funaria, ... ... ... | 2 |
| 7. Schlotheimia, ... ... ... | 1 | 16. Bartramia, ... ... ... | 3 |
| 8. Weissia, ... ... ... ... | 3 | 17. Brachymenium, ... ... | 3 |
| 9. Barbula, ... ... ... ... | 3 | 18. Bryum, ... ... ... ... | 7 |

| | No. of species. | | No. of species. |
|---|---|---|---|
| 19. Pterogonium, ... ... ... | 4 | 24. Hookeria, ... ... ... ... | 4 |
| 20. Neckera, ... ... ... ... | 20 | 25. Leskia, ... ... ... ... | 7 |
| 21. Daltonia, ... ... ... ... | 1 | 26. Hypnum, ... ... ... ... | 28 |
| 22. Pleuropus, ... ... ... | 3 | | |
| 23. Anhymenium, ... ... ... | 1 | Total, ... ... ... ... | 143 |

## Sphagnum.

*Sphagnum obtusifolium.*

Hab: In humidis, circa Surureem et Moflong.

Var: *a.* S. cymbifolium Brid. Bryol. Univ, 1. p. 2?

Hab: In humidis ad margines rivulorum Moosmai.

Fructiferum nunquam reperimus.

## Polytrichum.

1. *Polytrichum (Catharinea) angustatum,* Hook. Musc. Exot. p. 5. t. 50. Brid. Bryol. Univ. 2. 105.

Hab: In collium Khasiyensium regionibus altioribus, vix inveniendum infra altitudinem 5,000 pedum.

Aggregatum: Caules simplices, semunciales, e basi foliosi. Folia siccatione marginibus involuta, valide crispata tortiliaque, celluloso-membranacea, ascendenti-incurvata, subcarinata, lanceolato-linearia, acuta vel obtusiuscula, undulata, a medio supra denticulata, dorso apicem versus aspera papillis in lineis oblique transversis dispositis; vena crassiuscula completa dorso apicem versus denticulata; lamellis rectiusculis subquinis basin folii fere attingentibus; marginibus subincrassulis sub lentem modice augentem fibrosis. Perichætialia consimilia, interiora minora.

Var: *a.* Atrovirens: Caules longissimi, setas excedentes, simplices vel subramosi, inferne foliorum venis persistentibus obsiti; folia longiora, magis repanda et incurva.

Hab: Sururreem in rupibus madidis.

Var: *b.* Majus: folia longissima, 4—linealia, magis incurvata.

2. *Polytrichum falcifolium*, Gr.

Caule simplici, foliis e basi lanceolata subulatis falcatim incurvis integris, capsula rotundato-ovata exapophysata inclinata.

Hab : In arenosis Boga Panee, Collium Khasiyensium.

Aggregatum: Caules breves vix lineas tres longitudine excedentes.

Folia siccatione tortilia et incurva, madore falcatim incurva, e basi lanceolata cauli adpressa longe subulatim acuminata, concava, obtusa, integra marginibus subinvolutis, percursa vena crassa completa, lamellis conspicuis subseptem instructa.

Perichætialia basi largiora magisque membranacea.

Seta stricta, longitudine unciam paullo excedens, rubrotincta, siccitate tortilis.

Vaginula mediocris, anguste cylindracea. Paraphyses subnullæ, pistilla pauca, styli longi apicibus solito dilatatiores. Capsula inclinata nutansve, siccatione interdum erecta, sæpius rotundato-ovata et inæqualis, interdum suburniformis, ore vix coarctato nunc obliquo, fuscobrunnea, inconspicue areolata; membrana interna libera, apicem versus capsulœ in annulum inflexa.

Peristomium e dentibus 27—33, sed sæpius ut videtur 32, basi connexis, brevibus, acutis, leviter inflexis, sublentem materie grumosa hinc illinc opaciusculis, inæqualibus, latioribus (ob cohesionem) pluribus apice subemarginatis medioque sulcatis.

Epiphragma demum liberum.

Columella inclusa, 4 angularis, fere 4-alata, apice planiusculo annulum membranæ interioris subattingens.

Cætera non visa.

3. *Polytrichum proliferum*, Gr.

Caule indiviso hinc apice innovatione prolifero, foliis falcato-incurvatis siccitate tortilibus e basi lanceolata longe linearibus argute dentatis carinatis carina medium supra denticulata, capsula erecta oblongo-ovata basi sub-apophysata, operculo conico breviter apiculato, calyptra villosissima.

Hab : Legi primum in umbrosis circa Churra Punjee sed absque fructificatione; serius fructiferum invenit D. Wallichius infra rupes in umbrosissimis prope Sururreem.

Cæspitosum, atrovirens: caules spithamæi, basi denudati. Folia siccitate marginibus involuta incurvata et tortilia, longissima fere semuncialia, angustia, acuta, vena completa ab initio partis linearis angustissime lamellata, infima innovationum oblongo-lanceolata, vena elamellosa. F. perichætialia conformia longiora.

Seta terminalis vel pseudolateralis, solitaris vel geminata, crassiuscula, basi rubra cæterum pallida, siccitate tortilis et flexuosa. Vaginula angusta. Paraphyses filiformes hyalinæ, inæqualiter septatæ, tenuissimæ. Pistilla subnulla.

Capsula æquilateralis, oblongo-ovata, interdum anguste urniformis, fuscoviridis, collo constricto.

Membrana interna libera ad collum capsulæ in annulum inflexa, annulo, operculo persistente, apice columellæ obturato.

Peristomium e dentibus 32 linearibus, æqualibus, æquidistantibus, inflexis, basi unitis, acutiusculis, pulchre coccineo-rubris, marginibus hyalinis.

Epiphragma tenue, hyalinum, centro opaciusculum.

Columella cylindracea, irregulariter alata, apice imo plana, longitudine fere capsulæ.

Sporula in acervulo sordide viridia, minuta, rotundata, lævia, inæqualia.

Operculum conicum breviter recteque subulatum. Calyptra dimidiata, fusca villis arcte implexis pallide ferrugineis.

### 4. *Polytrichum urnigerum?* Menz? Hook et Tayl. Musc. Britt. 49. t. 11.

Var: Simplicicaule.

Hab: In ripis in Pinetis circa Moflong.

Habitus fere P. juniperini. Medium videtur inter P. urnigerum et aloides, illi statura majore, colore, foliisque accedens, huic caule simplici. Dentes peristomii pallidi, inæquales, sub—32. Calyptræ villi fulvi.

### 5. *Polytrichum aloides.* Hedwig.

Hab: In collibus Khasiyensibus vulgatim; in ripis arenosis rivuli Deboro apud Kujoodoo et Rangagurrah, regionis Assamicæ altæ. Nuperius vidi allatum e collibus Aborensibus.

Variat magnopere statura, capsula læviuscula vel papulosa, operculique longitudine.

6. *Polytrichum?*

Hab: In collibus Aborensibus in solo arenoso.

Efructiferum tantum vidi. Caules elongati simplices basi nudiusculi. Folia undique imbricata, e basi latiuscula membranacea longissime lineari-subulata, concavo-canaliculata, apices versus tenuiter denticulata, percursa vena crassa anguste lamellosa, dorso apicem versus denticulata, madore incurva summa subsecunda, siccitate tortilia marginibus involutis.

P. prolifero valde affine. Habitu et foliatione Lyelliæ crispæ proximum, differt tantum foliis magis incurvis, tenuiter et apices versus tantum denticulatis.

## Diphyscium. Web: et Mohr.

1. *Diphyscium longifolium*, Gr.

Caulescens, foliis (maximis) ligulatis acutis integris vel crenulatis, perichætialibus vena excurrenti longe aristatis laciniis saepidus dentiformibus, capsula semi-exserta, calyptra dimidiata.

Hab: In saxis rupibusque rorantibus ad Moosmai et Surureem, etiam in rupibus in sylvis umbrosis Myrung.

Dense cæspitosum, sæpe pulvinatum: e locis madidis proveniens atrovirens. Caules longitudine variantes a lineis duabus usque ad semunciam, inferne denudati. Folia siccatione incurvata crispataque marginibus involutis, madore subrosaceim patentia, repanda, sæpius irregulariter crenata, prædita vena crassiuscula completa inferiora minora, reliqua bilinealia: areolæ minimæ.

Perichætialia plurima, erecta; exteriora foliis caulinis similia sed vena excurrente longe aristata, reliqua intus gradatim magis magisque membranacea, apice bifida sinu longe aristigero, laciniis integris vel breviter laciniatis, intima minima fere omnino membranacea.

Seta subnulla. Vaginula brevis conica, albida. Paraphyses paucæ vel subnullæ. Pistilla 3—5 breviter stipitata stylis longissimis.

Capsula alba, magna, oris margine irregulari. Membrana interna discreta, insidens stipite brevi conico, capsulæ ope filamentorum cellulosorum adhærens, ore constricto irregulariter lacero. Peristomium sub-16-plicatum, niveum. Columella inclusa, plana, latissima. Sporula globosa, lævia, valde irregularia, in acervulo læte viridia.

Operculum conicum, obtusum, vel acute rostratum, cum columellæ apice secedens.

Calyptra subulata ad apicem usque fere fissa, operculi longitudine.

D. folioso proximum.

## GYMNOSTOMUM. HEDW. BRIDEL EX PARTIM.

### SECT. I.—GYMNOSTOMA VERA.

1. *Gymnostomum repandum*, Gr.

Caule simplici, foliis congestis ascendenti-patentibus spathulato-lanceolatis acuminatis repandis apices versus serratis vena intra apicem evanida, capsula turbinato-hæmisphærica, operculo convexiusculo mammillato.

Hab: In terram circa Suddya vulgatim occurrit. Per menses frigidos fructificat.

Pusillum, semunciam vix metiens. Folia marginibus simplicia; areolis magnis irregulariter parallelogrammicis: vena crassiuscula fere completa. Perichætialia magis ovata.

Seta brunnea, vix bilinealis.

Vaginula subcylindracea; paraphyses pistillaque subnulla.

Capsula brunnea hæmisphœrica, sed ob apophysin spuriam basilarem turbinato-hæmisphærica. Sporula brunnescentia sphærica, sub lentem modice augentem echinata. Calyptra basi ventricosa 3-4-fissa.

Species forsan vix distincta, intermedium videtur inter G. sphæricum et G. pyriforme.

2. *Gymnostomum pulchellum*, Gr.

Caule simplici, foliis congestis ascendenti-patentibus spathulato-lanceolatis apiculatis repandis marginatis subintegris vena in apiculum excurrente, capsula turbinato-pyriformi, operculo planiusculo umbonato.

Hab : In terram circa Suddiya.

Præcedente cum quo mixtum occurrit duplo triplove majus. Folia conspicue areolata, areolis parallelogrammicis angulatisve. Perichætialia majora magisque ovata. Seta 3-4 linealis erecta, pallida. Capsula erecta, brunnea, membrana interna inter os hujus in annulum brevem inflexa. Sporula rotundata, sub lentem acre augentem minutissime scabrella. Calyptra basi ventricosa fissa.

Verisimiliter intermedium inter G. pyriforme et fasciculare. Præcedenti valde affine.

3. *Gymnostomum atro-viride*, Gr.

Caule fastigiatim ramoso, foliis lineari-lanceolatis acutis carinatis integris patentibus siccitate incurvis vena subcontinua inferioribus subtrifariis, perichætialibus convolutis longe aristato-acuminatis, capsula erecta ovata vel rotundato-ovata, operculo oblique rostrato capsulam æquante.

Hab : In saxis Maamloo, in rupibus madidis Moosmai.

Dense cæspitosum, siccatione fuscoviride. Caules dense conferti, fastigiatim ramosi, vel dichotomi vel hinc innovatione tantum prædití, vix semunciales. Foliorum carina scabrella (an semper ?), areolæ parvæ sæpius rotundatæ, perichætialium vena infra apicem evanida.

Seta trilinealis sanguineo-brunnea. Vagina subfusiformis. Paraphyses paucissimæ. Pistilla subnulla.

Capsula rubro-brunnea ore paullo constricto, exannulata. Membrana interna libera, stipitata, paullo infra os capsulæ inflexa, marginibus laceris. Sporula in acervulo fusco-brunnescentia, rotundata, lævia, subuniformia. Columella clavata, apice truncata et membrana obsolete marginata. Operculum basi convexiusculum. Calyptra dimidiata parva.

Var. *a*. Foliis duplo angustioribus, perichætialibus acumina tissimis sed vix aristatis.

G. xanthocarpo propinquum. An satis distinctum a G. curvirostro ?

4. *Gymnostomum inconspicuum*, Gr.

Caule simplici vel apicem versus ramoso, foliis siccitate tortilibus carinatis madore planiusculis patenti-ascendentibus oblongo-lanceolatis rigidis acutis integris, perichætialibus conformibus, capsula erecta cum apophyse cylindraceo obovata.

Hab: Inveni mixtum parcissime cum Dicranis quibusdam in rupibus madidis, Churra Punjee.

Dense cæspitosum. Caules unciales vel breviores, basi decumbentes, simplices vel apices versus innovationibus fastigiatim ramosi. Folia undique patentia raro recurvata, superiora conferta lanceolato-linearia, marginibus basin versus recurvis, inferiora oblongo-lanceolata subintegerrima, læte lutescenti-viridia, percursa vena intra apicem evanida, areolis densis opaciusculis punctiformibus. Perichætialia carinata, intima minora.

Vaginula brevis cylindraceo-ovata. Paraphyses plures hyalinae subfiliformes, brevissimæ. Pistilla pauca.

Seta pallida lineas duas longitudine vix excedens.

Capsula sub-inæqui-lateralis, ovato-cylindracea, apophysin obconicam terminans, ore parum angustato. Membrana interna basi discreta, stipitata, ad collum capsulæ breviter introflexa. Columella subcylindracea apice paullo dilatata, planiuscula. Sporula globosa lævia, immersa diaphana.

G. longirostro, Gr. affine, diversum præcipue setis omnibus terminalibus, foliorum marginibus nullo modo involutis, formaque capsulæ.

## Sect. II.—Hymenostylium.

Capsulæ os clausum columellæ apice dilatato et membrana interna introflexa. Operculum cum columellæ apice secedens.

5. *Gymnostomum longirostrum*, Gr.

Caule innovationibus prolifero vel simplici, foliis lanceolato-linearibus acutis solidiveniis integerrimis marginibus involutis, capsula erecta oblongovata, operculo longe et recte rostrato capsulam excedente.

Hab : In collibus Khasiyensibus sed locus mihi incognitus.

Cæspitosum. Caules decumbentes sæpe unciales, radiculis brunneis villosi, proliferi, et sæpe parce ramosi. Folia siccitate insigniter involuta et incurvata, madore ascendenti-patentia, inferiora oblongo-lanceolata, superiora lineari-lanceolata, luride viridia, subcarinata, marginibus flexuosis involutis, areolis minutissimis, percursa vena fuscescente completa.

Perichætialia conformia, interiora minima.

Seta brevis vix bilinealis lutescens, terminalis si solitaria, si plures terminales lateralesque, siccitate tortilis.

Vaginula cylindracea. Paraphyses filiformes hyalinæ. Pistilla pauca. Capsula exannulata, oblongo-ovata vel cylindraceo-oblonga, lutescens, parietibus tenuibus diaphanis collo contrictiusculo, ore irregulariter denticulato rubro.

Columella clavata, inclusa, breviter stipitata basi reliquiis membranæ internæ cincta.

Sporula rotundata, lævia, immersa subdiaphana.

Operculum e basi conica rubra longe rostratum, capsulam paullo excedens, rostro lutescenti acuto, basi conica columellæ apice adhærenti obtrusa. Calyptram non vidi.

Affinis G. xanthocarpo. Hook. Musc. Exot p. 2 t. 153 præsertim capsulæ structura. Habitus, ut videtur, quodammodo Calymperes Gardneri.

Of this very distinct species, I have only seen one capsule before the fall of the operculum. The inner membrane is totally distinct from the capsule, and is connected only with the margin of the much dilated apex of the columella. It subsequently seems to become irregularly ruptured ; the base alone remaining, and surrounding the lower portion of the columella.

## Sect. III.—Diastoma.

Capsula annulata, collo insigniter constricto. Operculum cum columellæ apice secedens.

Huic sectioni primo D. Hookero propositæ pertinent Gymnostomum julaceum et involutum ejusdem auctoris. A Gymnostomo differt omnino habitu, et statione geographica, illo nempe boreali, hoc tropicali. Locus naturalis Barbulam prope.? A Gymnostomis veris posterum certe segregandum.

6. *Gymnostomum denticulatum*, Gr.

Caule sub-simplici, foliis lingulato-oblongis acutis apices versus denticulatis vena sub-completa, perichætialibus intimis convolutis obtusissimis integris, capsula anguste cylindracea, operculo subulato.

Hab: In rupibus inter Syung et Myrung, et in terram circa Moflong. Nuperius legi in collibus Naga dictis altitudine circiter 1,000 pedum.

Cæspitosum. Caulis erectus, vix semuncialis. Folia siccatione incurvata marginibus insigniter involutis, madore patenti-recurvata, leviter repanda marginibus vix incurvis imo sæpa leviter recurvis, percursa vena crassa sursum valde attenuata et vix completa; areolis minutis.

Perichætialia exteriora conformia, marginibus superne involutis, interiora minora integerrima vena infra apicem evanida. Seta ob innovationes interdum pseudo-lateralis, filiformis, rubescens, siccitate tortilis. Vaginula obclavata, basi paraphysibus pistillisque paucis obsita.

Capsula leviter inclinata, subinæquilateralis brunnea, sub lentem modice augentem areolatim striata. Annulus insignis, initio horizontalis, operculo detruso erectus. Membrana interna libera, subsessilis.

Columella filiformis, longitudine fere thecæ.

Sporula minuta, rotundata, lævia, in acervulo fusco-viridia, immersa diaphana, subuniformia.

Operculum subulatum, capsula subquadruplo brevius, rostro sæpius declinato.

Calyptra dimidiata lævis, semel bisve torta.

Variat statura, foliis madore etiam margine involutis, et obsolete denticulatis. An ideo posterum cum G. involuto. Hook. Musc. Exot. p. 2 t 154, conjungendum?

7. *Gymnostomum recurvum*, Gr.

Caule ramoso, foliis ascendentibus lanceolatis acuminatis integerrimis marginibus recurvis vena crassa in mucronem excurrente, capsula ovato-cylindracea, operculo subulato.

Hab: In arenosis Bogapanee.

Cæspitosum, totum rufescens. Caules sæpius pluries ramosi, ramis subfastigiatis, inferne nudiusculi.

Folia caulis primarii dense, ramorum laxiuscule imbricati, siccitate adpressa, rigida, marginibus subincrassatis, areolis distinctis subparallelogrammicis.

Flos fæmincus terminalis, discoidius, cinctus foliis perichaetialibus ascendenti-patentibus, concavis, cæterum caulinis subsimilibus. Paraphysespaucissimæ. Pistilla plura sub-octena.

Vaginula cylindracea. Seta vix semuncialis, rubescens, ob innovationem pseudolateralis, sicca tortilis. Capsula erecta, utrinque attenuata, rubro-brunnea. Annulus ut in præcedente.

Membrana interna libera.

Sporula in acervulo fusco-viridescentia, inæqualia, rotundata, immersa diaphana.

Operculum subulatum, rectum vel obliquum, obtusum, capsula subtriplo brevius.

Calyptra subulata, dimidiata, ad medium fere fissa.

Variat statura et acumine imo foliorum sæpe diaphano.

## Orthodon. Bory.

1. *Orthodon subglaber*, Gr.

Caule erecto simplici, foliis oblongo lanceolatis acuminatis apice piliferis argute serratis, calyptra basi glabra apice papilloso scabra.

Hab: In arboribus vigentibus mortuisve in sylvis Mumbree, in arboribus et rupibus in sylvis Myrung; in utroque loco satis copiosus.

Habitus foliatioque fere omnino O. serrati, sed folia dorso lævia, apice in pilum integrum diaphanum breviusculum exeuntia.

Capsula erecta, oblongo-ovata, apophysin brevem obconicam terminans, siccitate subcylindracea, collum infra angustata.

Membrana interna arcte adnata.

Peristomii dentes madore incumbenti-conniventes, siccitate erectiusculi apicibus inflexis, distantes, latiusculi, crassi, coriacei, lineis tribus, quarum centralis conspicuosior exarati, lineisque transversis plurimis; etrabeculati, sub lente acre augentem minute punctulati.

Columella cylindracea, inclusa.

Sporula in acervulo sordide lutescentia, irregularia, lævia, sæpius extremitate una alterave attenuata.

Operculum ut in O. serrato, sæpius cum calyptra secedens.

Calyptra mitræformis, basi ventricosa, et profunde 4-partita, laciniis abrupte inflexis, fundum vel os calyptræ claudentibus, apice subulato sub lentem papillis scabra, cæterum glabra.

## ORTHOTRICHUM, HEDW.

1. *Osthortichum concavifolium*, Gr.

Caule fastigiatim ramoso squarroso, foliis cordatis vel cordato-ovatis concavissimis breviter apiculatis evanidivenüs perichætialibus marginibus insigniter revolutis vena excurrenti cuspidatis, capsula oblongo-urceolata immersa, peristomio simplice, operculo conico.

Hab: Inveni specimen unicum fructiferum mixtum cum Neckera aurea e Mumbree.

Caulis erectus, sapius fastigiatim ramosus, uncialis. Folia undique imbricata, siccitate arcte adpressa, madore patentissima, convoluto-concava, integerrima, marginibus leviter revolutis, vena medium ultra evanida prædita, areolis minutis oblongis vel rotundatis, summa minora, cordata, brevissime acuminata obtusa.

Perichætialia subconformia paullo majora a medio supra reflexo-patentia, valde acuminata, marginibus insigniter revolutis, vena sursum ampliata excurrenti ibidemque scabrella percursa.

Vaginula (saltem nuda) brevissima rubrobrunnea. Paraphyses Pistillaque pauca.

Seta brevissima, exserta et vaginula subnulla.

Capsula sublœvis, ore valide constricto, fuscoviridescens. Membrana interna adnata.

Peristomium e dentibus 16, brevibus, erectis, fragilibus, albis, punctulato-opaciusculis, marginibus scabrellis, lineis transversis conspicuis, centrali longitudinali subobsoleta.

Columella cylindracca, apiculata, inclusa. Sporula majuscula, uniformia, globosa, laevia, immersa opaciuscula. Operculum conicum breve, rubrum. Calyptra deerat.

Solum est inter Orthotricha Khasiyensia forma boreali gaudens.

2. *Orthotrichum Moorcroftii*, Hook et. Grev. in Edinb. Journal of Science, 1824, 1 p. 116 e. Bridelio. Leiotheca Moorcroftii, Brid. Bryol. Univ. vol. I. App. p. 727.

Hab : In rupibus arboribusque per totos colles Khasiyanos inter Churra Punjee et Nunklow.

Variat colore fuscescente foliisque madore minus patentibus. Folia siccitate incurvatim tortilia. Perichætialia exteriora conformia, interiora oblongo-lanceolata cuspidato-acuminata. Vaginula cylindracea angusta, ubique paraphysibus plurimis hyalinis, summis longissimis, basinque versus pistillis pluribus obsita. Capsulæ os incrassatum, lucidum, sulcatum. Dentes peristomii pallidi, albidi, vix per paria approximati, lineis compositionis inconspicuis.

Sporula magnitudine summopere varia, opaciuscula.

3. *Orthotrichum assamicum*, Gr.

Caule repente, foliis lanceolato-linearibus subcarinatis ascendentibus siccitate incurvatis contortisque, capsula anguste cylindracea, peristomio simplice, calyptra villosa.

Hab: In arboribus versus Negrogam et in agro " Muttack" dicto, regionis Assamicæ altæ; atitudine supra mare circiter 600 pedum.

Cæspitosum, ramosum, rami breves ascendentes. Folia rectiuscula, integerrima, marginibus leviter recurvis, prædita vena crassiuscula in apiculum brevem mucroniformem excurrente, inconspicue areolata.

Perichætialia interiora, fere membranacea, subconvoluta, cuspidato-acuminata, solidivenia.

Seta ob innovationes lateralis, vix semuncialis, brunnea, sicca spiraliter torta. Vaginula cylindracea. Paraphyses plurimæ, summæ longissimæ. Pistilla pauca longiuscule pedicellata.

Capsula erecta; juniorem tantum vidi.

Peristomium simplex, e dentibus 16 binatim compositis, obtusis, sæpius emarginatis, punctulato-opacis, notatis linea longitudinali semi-diaphana, lineis transversis ægre distinctis.

Sporula fuscescenti-viridia, irregularia. Operculum e basi convexa recte rostratum capsula triplo brevius.

Calyptra campanulata, pilis luteis compositis ascendenti-adpressis villosa, basi 3-5 fida, fissuris irregularibus, una alterave medium fereattingente.

Præcedenti proximum; capsulaque matura non observata an jure separavi ob folia breviora, ascendentia, siccitate contorta, capsula mqne anguste cylindraceam?

4. *Orthotrichum squarrosum.* Hook et Grev. loc citat. p 128 (e Bridelio) Schlotheimia squarrosa. Brid. Bryol. Univ. 1. *324*.

Hab: In terram in sylvis, Myrung.

Bridelio) Schlothimia Squarrosa. Brid. Bryol. Univ. 1. 324.

Hab: In terram in sylvis, Myrung.

Planta Khasyana cum descriptione Brideliana bene convenit; differt tantum statura minore, ramis sæpe apice tantum ob innovationes ramosis et peristomio interiore?

Peristomii utriusque descriptionem subjungo.

Peristomium exterius madore connivens, siccitate semi-reflexile, e dentibus 16 binatim compositis, subulato-planis, obtusis, emarginatis, rigidis, opacis, solidis, rufobadiis, linea longitudinali subdiaphana transversisque crebris minus conspicuis notatis.

Interius e ciliis totidem alternantibus, ad basin usque fere bipartitis, rarius indivisis, (ciliolis inæqualibus) peristomium exterius longitudine æquantibus vel sæpius brevioribus, opaciusculis, sublentem centies augentem conspicue sed irregulariter striatis, peristomio exteriori præcipue basin versus plus minus cohærentibus.

Structura peristomii interioris affine O. perichætiali Hook. et Grev.

5. *Orthotrichum? bryoides*, Gr.

Caule repente ramoso, ramis sterilibus repentibus fertilibus erectis, foliis coriaceis obovatis-subulato apiculatis margine fibrosis, capsula erecta oblongo-elliptica ore coarctato, calyptra villosa.

Hab : In arboribus in locis humidis Surureem.

Cæspitosum. Rami fertiles unciales inferne dense radiculis ferrugineis vestiti.

Folia subconformia, siccatione crispata tortiliaque, madore oblique patenti-ascendentia, interdum recurva,* apices versus ramorum fertilium conferta, obovata, vel obvato-oblonga, repanda, apicibus rotundata, subulato-apiculata, vena crassa subulata in apiculum excurrente vel sæpius infra apicem evanida donata; marginibus fibrosis, integerrimis; areolis pro genere maximis, angulatis, oblongis vel parallelogrammicis. Folia perichætialia pauca, subconformia, basi concava, exteriora majora, interiora multo minora.

Seta terminalis, viridescens, crassiuscula, sicca tortilis.

Vaginula ovato-oblonga, pistilla plurima præsertim basin versus gerens. Paraphyses plurimæ, summis longissimis, inferne e cellularum seriebus duabus conflatis, pilis paucis compositis immixtis ascendentibus circa setæ basin.

Capsula magna, longitudine fere bilinealis, latitudine semi-linealis, brunnea, sub lentem modice augentem conspicue celluloso-areolata, ore lævi valde angustato.

Peristomium utrumque imperfectum tantum vidi. Exterius e dentibus 16 ? conniventibus, albidis, angustis, binatim compositis, obtusis, infra opacis, supra punctulatis subhyalinis, linea longitudinali indistincta, transversis pluribus distinctioribus notatis, fragilibus, leviter semet cohærentibus.

Interius membrana areolata brevissima p. exteriori 4-plo brevius, apice irregulariter dentata, alba, obsolete plicata.

Operculum (immaturum) conico subulatum obtusiusculum.

Calyptra (immatura) anguste companulata, basi subintegra, pilis compositis longis, ascendentibus patentibusque, flexuosis villosa.

Species perpulchra distinctissima, habitu omnino bryoideo, areolatione marginationeque foliorum in tribum insolita insignis.

* Maxima, longitudine 2½ lineas, latitudine 1 lineam metientia.

Verisimiliter Schlotheimiæ, peristomio interiore perfecto investigato, in posterum adjungendum. Per. exterius p. exteriori Schlotheimiæ sulcatæ simillimum.

## Schlotheimia Bridel.

1. *S. sulcata.* Hook. Musc. Exot. 2. 14. t. 156.

Macromitrion sulcatum. Bird. Bryol. Unin. 1. 319.

Hab : In rupibus et arboribus Churra Punjee et Moosmai.

Rami hinc apice fere semper innovantes,

Capsula 8-sulcata. Membrana interna adnata. Peristomium exterius e dentibus 16 binatim compositis, minime evolutis, obtusis, fragilibus, fuscescentibus.

P. interius longitudine exterioris, e membrana cellulosa areolata, margine irregulariter denticulata, quamvis conspicere licet formatum esse videtur e dentibus ciliisve totidem alternantibus, binatim compositis et firme cohærentibus.

Columella inclusa apice truncata.

Sporula in acervulo viridia, lævia, magnitudine valde varia, minora immersa diaphana, majora opaca.

## Weissia. Hedw. Bridel exparte.

1. *Weissia Templetoni.* Hook.

Hab : In terram circa Moflong.

Flos masculus cinctus foliis perigonialibus rosaceim patentibus ovato-oblongis. Antheræ plurimæ, cum stipite longo clavatæ, constantes e sacculo simplici subrotundo oblongove, hyalino, transversim dehiscente, stipitem oblique terminante, immixtæ paraphysibus setaceis vel clavatis.

Vaginulæ superficies celluloso-areolata.

Variat statura, foliorum serrulatione et acuminatione, capslau interdum subglobosa et peristomii fugacitate et structura, varietate una peristomio multo magis evoluto minusque fugace gandentc, dentibus simplicibus vel binatim compositis.

Folia magis acuminata et operculum magis planum quam in figura, Hook. et Tayl Musc. Britt. t. 14.

Planta a Weissia proculdubio segreganda.

Habitus omnino Gymnostomi, a quo ob peristomii dentes operculo detruso fugacissimos caute distinguendum.

Vix Eremodon longicollis, Brid. Bryol. univ. 1. 234. ob venam evanidam.

2. *Weisia bartramioïdes*, Griff.

Caule fasciculatim? fastigiatim ramoso, foliis (siccitate rectis) adpressis lanceolatis acuminatissimis solidiveniis perichœtialibus aristatis, capsulœ erectœ globosœ vel ovato-globosœ ore valide constricto.

Heb: Rupes arenosæ ad Churra Punjee, Sururеem, et Bogapanee.

Cœspitosa. Caulis ascendens, apice fastigiatim ramosus, vix semuncialis.

Rami subclavati, extrorsum curvati.

Folia caulis subdistantia, ramorum densissime imbricata acuminatissima, fere pilifera, acuminibus denticulatis, interdum apice diaphanis, percursa vena crassa breviter excurrente, marginibus leviter revolutis, areolis oblongis parallelogrammicis.

Flos hermaphroditus, terminalis, gemmiformis, foliis perichœtialibus conformibus in cuspidem piliformem acuminatis, vena longe excurrente. Antherœ paucœ, pallide lutescentes, oblongœ, breviter stipitatœ, apice dehiscentes, cellulis irregularibus areolatœ. Paraphyses subnullœ. Pistilla antheris numerosiora, longiuscule stipitata.

Seta terminalis, subsemuncialis, fuscescens, sicca tortilis.

Vaginula mediocris.

Capsula siccatione sulcata, brunnea, ore lævi rubro-brunneo.

Membrana interna discreta.

Peristomium, quod imperfectum solum vidimus, fugacius, e dentibus 16 siccatione erectis, humore fere horizontaliter connivientibus, brevibus, latiusculis, binatim compositis (ciliolis interdum facile solubilibus) rarius simplicibus, solidis vel longitudinaliter perforatis, apice emarginatis, aliquand oper paria appro ximatis diaphanis, pallide fusco-lutescentibus.

Columella cylindracea, inclusa, apiculata.

Sporula fusco-ochroleuca, oblonga, lævia, immersa opaca,

Operculum non visum.

Calyptra dimidiata, per totam fere longitudinem fissa.

Affinis præsertim forma capsulæ, W. pomiformi, Hook. Musc. exot. p. 7 t. 131.

3. *Weisia Maclellandii*, Griff.

Caule simplice, foliis siccitate tortilibus e basi lanceolata longe-linearibus carinatis sursum argute serrulatis carina apicem versus serrulata, capsula erecta anguste cylindracea.

Hab: In arbore lapsa prope Myrung parcissime invenit D. McClelland.

Caules erecti, vix unciales. Folia siccitate involuta et tortilia, humore oblique patentia, acuta vel obtusa, percursa vena solida, dorso inferne scabrella superne serrulata, marginibus leviter incrassatis, areolis inconspicuis.

F. Perichætialia conformia longiora.

Capsula fuscescens, ore rubro lucido.

Peristomium e dentibus 16, minutis, simplicibus, infra os capsulæ exsertis, horizontaliter conniventibus, aurantiaceis.

Sporula majuscula, lævia, fusco-viridescentia, immersa opaciuscula.

Columella inclusa, apice truncata.

Operculum, calyptra saltemquoad.

A Calympera Gardneri, saltemquoad iconem Hook. Musc. cxot. t. 146. vix distinguenda, nisi carina foliorum serrulata et peristomio.

## Barbula, Hedw. Tortula, Hook. et Greville.

1. *Barbula indica, Brid. Bryol, univ.* 1.544. *Tortula Indica, Hook. Musc. exot. p.*'7. 135.

Hab : Ripæ prope Jumalpore, Bengaliæ inferioris.

Caules simplices. Folia siccitate valde involuta et incurvata vix crispata, marginibus superiorum et præsertim perichaetialium involutis. Peristomii capsulam fere æquantis dentium articuli opacitate obscurati.

2. *Barbula longifolia*, Griff.

Caule simplice brevissimo, foliis erecto-patentibus linearibus concavo-carinatis acutiusculis muticis siccitate incurvtis marginibus valde involutis, capsula cylindraciuscula, operculo subulato obliquo capsula duplo breviore.

Hab: Ad Moflong parce legit D. McClelland.

Caulis vix lineas quatuor metiens.

Folia siccitate etiam subtortilia, humore patentia, inferiora sæpe recurva, integra vel apicem versus minute denticulata, percursa vena subulata in mucronem brevem excurrente.

Perichætialia conformia, majora.

Seta terminalis, subuncialis, gracilis, fere capillacea, flexuosa, rubro tincta, siccitate tortilis.

Vaginula cylindracea, angusta, paraphyses pistillaque pauca gerens.

Capsula æquilateralis, subfusiformis, os versus gradatim angustata, brunnea, ore incrassato rubro, annulo completo siccitate inflexo cincto.

Membrana interna basi libera, breviter stipitata.

Peristomium caspula triplo-brevius; dentes 32, an semper? basi per paria approximati, capillacei, obliquiusculi, vel ut in var: A semel tortiles, rubri, scabrelli, opaci, apicibus pallidi.

Columella filiformis, apice truncata, inclusa.

Sporula uniformia, lutescentia, lævia, immersa diaphana.

Operculum conico-subulatum. Calyptra dimidiata, apice longe stylifera.

Affinis videtur Barbulæ recurvatæ, Hook. Musc. exot 7. t. 130.

Var. A. Peristomio semel torto.

Hab. Ad Bogapanee.

### 3. *Barbula arcuata,* Griff.

Caule simplice longiusculo, foliis lanceolato-acuminatis carinatis vena excurrente breviter apiculatis margine recurvis perichætialibus longissimis canaliculatis, capsula cylindracca arcuata.

Hab: Legimus specimina 2-3 fructifera in arenosis "Bogapanee."

Caulis erectus, basi denudatus, subsemuncialis. Folia siccatione adpressa, obsolete falcatim secunda, summa apice flexuosa patentia, humore ascendentia, rigida, integra, e basi lanceolata valde acuminata, perichœtialia margine involouta, acuminibus limbum æquantibus, sursum denticulatis.

Seta terminalis, vix uncialis, capillacea. Vaginula angusta, cylindracea. Paraphyses pistillaque pauca.

Capsula erecta, angusta, brunnea. Peristomii dentes sub-32, obliqui, rigidi, opaci, scabrelli. Columella truncata, inclusa.

Cætera desunt. Peristomium exparte destructum solum vidimus.

Ex charactere videtur proxima B. domesticæ, Brid. Bryol. univ 1. 536. An vere differt?

## Grimmia, Hedw.—Hooker. Bridel ex parte.

1. *Grimmia flexuosa,* Griff.

Caule simplice elongato flexuoso, foliis adpressis lanceolatis acuminatis carinatis vena excurrente cuspidatis perichætialibus longe aristatis, capsula immersa oblongo-ovata, operculo breviter et recte rostrato.

Hab. Ripæ arenosæ fluminis Soorma prope Chattuc agri Sylhetensis. Ripæ Maamloo collium Khasiyanorum; rivulique Deboro prope Rangagurrah. Nuperius vidimus e collibus Aborensibus allatam.

Caules sæpius simplicissimi, filiformi-clavati, unciam vix excedentes. Folia sursum gradatim majora, integra, e base lanceolata valde acuminata. Perichætialia majora vena longius excurrente cuspidato-aristata.

Seta terminalis, brevissima.

Capsula brunnea, complete annulata. Peristomii dentes erecti, vel subconniventes, rigidi, plano-subutati, basi diaphani lineisque transversis conspicue notati, cœterum opaco-punctulati, sæpe varie perforati, lutescentes.

Sporula in acervulo ochroleuca, rotundata, lævia, immersa opaca.

Columella brevis, inclusa.

Operculum e base conica subulatum, rostro recto acuto.

Calyptra mitriformis, integra vel fissa.

2. *Grimmia ovata, Mohr.* Hook et Taylor Musc. Brit. 71. t. 13. Drypodon ovatus, Bridel Bryol univ. 1. 202.

Hab: Rupes et monumenta circa Moflong, ubi abundat.

Foliorum margo unus tantum recurvus.

## EFFRUCTIFERÆ.

3. *Grimmia.*—

Hab: Rupes roratæ ad cataractam Moosmai, ubi dense cæspitosa.

Prostrato-dependens. Caules ramosi; rami subsimplices, clavati. Folia siccitate adpressa, subsecunda, madida ascendentia, lanceolato-acuminata, carinata, minute denticulata, vena in mucronem brevem excurrente prædita, marginibus subincrassatis opacis, areolis oblongis laxiusculis.

Var *a*. Caules filiformes, foliaque minora.

Hab: Ibidem.

## TREMATODON, RICH.

1. *Trematodon sabulosus*, Griff.

Caule simplice brevissimo, foliis conniventibus ovato-lanceolatis acuminatis, capsula subovata nutante apophyse clavata ecerviculata duplo breviore, operculi conico-subulati rostro curvato.

Hab: Ripæ arenosæ fluminis Burrumpootur, tractusque sabulosi huic vicini. Humida cujusque regionis Assamorum editæ, ubi frequentisimus Fructus Aprili Majoque maturi.

Caulis lineam, vix excedens.

Folia tenera, imbricata, obtusiuscula, concava, prædita vena completa crassa, integerrima, areolis conspicuis, acuminum marginibus basin versus revolutis.

Perichætialia sub 3-plo majora, conformia. Seta sicca flexuosa subtortilisque, gracilis, stramineo-nitens, linealis.

Vaginula arcta, rubra; paraphyses pistillaque pauca.

Capsula conspicue annulata, matura sulcata, sub lente modice augente areolata. Apophysis antice struma minuta instructa. Membrana interna adnata, sed facile solubilis.

Peristomium connivens, e dentibus 16 binatim compositis, (ciliolis irregularibus) rigidis, medio perforatis, trabeculatis, striatis rubris, apicibus pallide aurantiaceis punctulato-scabrellis.

Columella inclusa.

Sporula in acervulo lutescentia, rotundata, lævia.

Operculum e basi conica curvato-rostratum, capsula paullo brevius. Calyptra dimidiata, lævis.

Quoad characterem affinis T. brevicolli, Hornsch. Brid. Bryol. univ. 1. 385. a quo vix differt nisi statura minore, vena excurrente longitudine que apophysis.

2. *Trematodom longicollis,* Rich. Bridel Bryol. Univ, 1. 388.

Hab : Ripæ arenosæ fluminum Noa Dehing et Deboro regionis editæ Assamicæ. Fructus Aprili Maioque maturi.

Caulis simplex, brevis, lineas duas longitudine vix excedens.

Folia sicca flexuosa, etiam tortilia, madida subsecunda, inferiora multo breviora rectiuscula, superiora flexuosa, interdum subcrispata incurvataque, e basi lata longe subulato-acuminata, convoluto-canaliculata, integra, lutescentia, prædita vena completa ? plerumque indistincta.

F. Perichætialia maxima, convoluta, acumine limbum vix superante recto vel flexuoso, prædita vena distinctiore ; intima minora.

Vaginula rubro-aurantiacea, cylindracea. Paraphyses paucæ, breves. Pistilla subnulla.

Seta longissima, sesquiunciam excedens, capillacea, straminea, sicca flexuosa apiceque parce tortilis.

Capsula immatura cylindraceo-ovata, sicca sulcata, nutans. Apophysis longissima, capsulam 3-plo superans, clavata, apice subcerviculata, basi antice strumosa, arcuata. Peristomium (immaturum solum visum) præcedentis.

Operculum conico-subulatum, rostro obliquo, capsula dimidio brevius.

Calyptra dimidiata, lævis, pallide straminea.

## Dicranum, Hedw.

1 *Dicranum glaucum,* Hedw.

Hab : Sylvæ Churra Punjee et Maamloo collium Khasiyanorum. Regiones Assamorum editæ, ubi ad basin arborum frequens. Fructiferum non vidimus.

Var. A. Foliis magis deciduis.—Negrogam.

B. Foliis longioribus, magis acuminatis.

Rupes humidæ, Churra Punjee, ubi Hypni specie mixtum. —Hypno subbasilari, Hook. proximum.

C. Foliis brevioribus et latioribus.

Negrogam versus.

D. Macrophyllum; vix non distinctum.

Churra Punjee, versusque Negrogam.

E. Marginatum; foliis siccatione ascendenti-subsecundis, dorso transverse undulatis, humore falcatim subsecundis, spiraliter dispositis, marginibus hyalinis, latis.

Negrogam versus.

Verisimiliter species distincta.

Dispositio foliorum spiralis in facie ramorum aversa valde conspicua.

2 *Dicranum cuspidatum*, Griff.

Caule mediocri simplice parceve ramoso, foliis undique patentibus e basi lanceolata acuminatissimis carinatis marginibus acuminis carinaque argute denticulatis baseos incurvis, perichætialibus basi convolutis, capsula erecta clavato-cylindracea basi strumosa.

Hab. Pineta Moflong. Duo solum specimina fructifera vidimus.

Cæspitosum; caules sæpius ramosi radiculoso villosi, ramis ascendentibus, simplicibus.

Folia siccitate falcatim subsecunda, flexuosa, humore undique patentia; inferiora fere horizontatia, fragilia, seniora sæpius rupta, dense imbricata, amæne viridia.

F. Perichætialia conformia, interiora longissima, convoluta circa setam, abrupte acuminata.

Seta terminalis vel ob innovationes lateralis, crassiuscula, 3-4-linealis, viridescens, siccatione flexuosa.

Vaginula cylindracea, longa, brunnea, ore membranaceo. Paraphyses pistillaque pauca.

Capsula erecta, basi strumosa, sub-cylindracea, e basi sursum gradatim ampliata, (ore incrassato) pallide brunnnea.

Membrana interna, discreta, subsessilis.

Peristomium siccum madidumve connivens; dentes rubri, profunde bipartiti, diaphani, raro irregulares, laciniis pallidis, sœpe basin versus materie mucilaginosa coalitis.

Columella filiformis, capsula paullo brevior, apice truncata.

Sporula lævia, fusco-viridia, difformia.

Operculum calyptra que non visa.

Valde affinis D. fragili, Hook. Musc. exot. 2 p. 10. t. 134.

3 *Dicranum scoparium,* Hedw.?

Hab. Arenosa torrentis Bogapanee.

Folia innovationum sæpius undique patentia; folia basi planiuscula sursum carinata carinis denticulatis, perichætialia intima mutica, exteriora longe cuspidato-acuminata, acumine canaliculatato, apice denticulato, refracto; capsula erecta.

An ita distinctum mediumve inter D. scoparium, Hedw. and undulatum, Solrad?

4 *Dicranum subulatum,* Hedw.

Hab. Ripæ circa Moflong ubi sequente sæpius mixtum.

Folia sæpe vix falcatim secunda, sub-integerrima, siccitate flexuosa.

Capsula inclinata, subobliqua, oblongo-ovata, vacua demum fere cylindracea erecta et sulcata, annulo completo prædita. Peristomii dentes mediocres, infra medium bipartiti, rubri, laciniis pallidis. Operculum e basi conicâ longe et oblique rostratum, capsulam æquans. Calyptra non visa.

Sporula immersa opaciuscula, globosa, sublævia, in acervulo fusco-ochroleuca.

Sequenti proximum; vix discrepans seta erecta capsulaque demum cylindracea. Affine videtur D. longisetæ, Hook. Musc. exot. 2. 11. t. 139.

5 *Dicranum khasiyanum,* Griff.

Caule simplice brevi, foliis falcatim subsecundis e basi lata longissime subulato-acuminatis acuminibus infra medium obsolete canaliculatis vena crassiuscula, seta flexuosa, capsula inclinata cernuave ovato-elliptica siccatione sulcata, operculo conico subulato, calyptra ventricosa lævi.

Hab: Ripæ Moflong.

Cæspitosum; folia interdum undique patentia, e basi quadrata vel oblongo-quadrata concava axi adpressa subulato-acuminatissima, integra, luteo-viridia, acumine concolori, vena solida latiuscula percursa.

F. Perichætialia conformia.

Seta terminalis, sæpius solitaria, sicca vix tortilis, seduti madida valde flexuosa, pallida. Paraphyses paucissimæ. Pistilla 2-3.

Capsula directione varia, suberecta, inclinata, cernua vel interdum pendula, æqualis siccitate sulcata, brunnea, annulata; membrana interior adhæsens.

Peristomii dentes 16 (vidimus etiam 18,) per paria approximati (an semper?) breves, rigidi, fragiles, profunde bipartiti, basi sub lente centies augente striati, laciniis punctulato-opacius culis; lineis transversis conspicuis.

Columella inclusa, filiformi-clavata. Sporula in acervulo ochracea.

Operculum conico-subulatum capsula brevius, rostro obliquo acuto.

Sequenti affine; discrepans præsertim seta madida immutata calyptraque lævi.

Var A. majus; foliis saturatius coloratis, seta flexuosa vel subrecta.

Hab. Rupes madidiæ Churra Punjee—Dicrauum Khasiyanum *subulato* forsan jungeus.

6. *Dicranum* (*Campylopus*) *pinetorum*, Griff.

Caule brevissimo simplice, foliis falcatim subsecundis e basi lanceolata longissime subulato-acuminatis canaliculatis acuminum apicibus concoloribus scabrellis, seta flexuosa, capsula ovata pendula siccitate sulcata, operculo oblique rostrato, calyptra fimbriata.

Hab: Pineta prope Moflong, truncis pinorum adhæreus.

Dense cæspitosum, pallide lutescenti-viride. Caules sub-3-lineales, simplices vel ob innovationes parce ramosi. Folia inferiora et præcipue caulium sterilium, (qui magis elongati) falcatim subsecunda; superiora et perichætialia ascendentia, e bas lanceolata longissime subulato-acuminata, canaliculata, veli involuto-concava, flexuosula, apicibus minute denticulatis subtriquetris, vena latissima completa.

Perichætialia conformia, majora, convoluta.

Seta vix bilinealis, sicca erecta flexuosa, madida decurva, pallida.

Vaginula mediocris. Paraphyses paucissimæ. Pistilla 2-3.

Capsula humore pendula, siccitate erecta, ovata, basi solida, annulata, sicca sub-8-sulcata, pallida, parietibus tenuibus. Membrana interna libera, subsessilis.

Peris tomium madore erectiusculum, siccatione inflexile, cum membrana interna facillime separabile, e dentibus 16 æqualiter approximatis ad medium circiter bipartitis, basi rubro-aurantiaceis et sub lente fortiter augente conspicue striatis, laciniis pallidis punctulatis.

Columella inclusa.

Sporula minuta, lævia, uniformia, in acervulo fusco-ochroleuca.

Operculum e basi conica oblique subulatum, thecâ paullo brevius, sæpe cum calyptra secedens, sed huic netiquam adhærens.

Calyptra dimidiata, per totam fere longitudinem fissa, basi hinc illinc breviter fissa, subinflexa et pilis simplicibus, colore calyptræ, brevibus fimbriata.*

Var. A. Villis calyptræ magis evolutis hyalinis.

Hab. Myrung, in arborum truncis.

A. D. flexuoso, cui proximum videtur, discrepat præcipue capsulis estriatis, operculoque oblique rostrato.

7. *Dicranum Didymodon,* Griff.

Caule simplice, foliis persistentibus longissimis subulato-setaceis falcatim secundis apicibus scabris, seta flexuosa, capsula cylindracea pendula, peristomii dentibus 32 per paria approxi matis, operculo conico subulato obliquo, calyptra glabra.

Hab. Pineta Moflong, truncis arborum adhærens.

Dense cæspitosum, amœne virens.

Caules vix trilineales, erectiusculi, radiculis villosi, basi nudiusculi.

* Note.—Bridel makes no mention of an annulus in his Campylopus flexuosus, but in his character of the genus, he says, " theca exannulata." C. concolor, Dicranum concolor of Dr. Hooker, he however describes as being annulate.

Folia infima minora, ascendentia, reliqua falcatim secunda, e basi lanceolata subulato-acuminatissima, concavo-canaliculata integra, percursa vena lata excurrente ? acuminum apicibus subtriquetis obsolete denticulatis.

Perichætialia conformia. Seta ob innovationes lateralis, pallida, sicca tortilis et flexuosa, raro geniculatim deflexa.

Vaginula cylindracea. Paraphyses pistillaque paucissima.

Capsula paullulum obliqua, utrinque attenuata, exannulata, sicca sæpius erecta.

Peristomii dentes 32, setacei, per paria approximati et infra medium trabeculis conspicue juncti, ibidem striati, cæterum punctulato-scabrelli, rubri apicibus pallidis, (omnino fere ut Didymodon purpureo.)

Sporula lutescentia, globosa, lævia, minuta, immersa hyalina.

Columella inclusa, truncata.

Operculum capsula duplo brevius. Calyptra dimidiata.

Omnia Dicrani, dentibus peristomii exceptis. Proximum D. pinetorum, a quo facile distinguitur calyptra glabra peristomioque.

Proximum videtur Didymodonti longirostri, Schwägr :—Brid. Bryol. univ 1.512, a quo differt foliis persistentibus conspicue secundis non fragilibus, operculoque capsula duplo breviore.

Var ? A. Caules elongati, hinc illinc ramosi, ramique apicem versus nudi incrassati, apicibus imis foliosis, partibus denudatis cicatricibus foliorum lapsis semi-annularibus notatis.

Invenimus efructiferum in sylvis Myrung.

### 8. *Dicranum* (*Campylopus) ericoïdes*, Griff.

Caule subsimplice apice prolifero, foliis rigidiusculis strictis ascendentibus e basi anguste lanceolata subulato-canaliculatis acuminatissimis perichætialibus longe aristatis apicem versus scabris semi-diaphanis, setis aggregatis flexuosis, capsula pendula subobovata basi obsolete strumosa siccitate profunde sulcata, operculi rostro obliquo, calyptra fimbriata.

Hab. Sylvæ Myrung.

Terrestre, cæspitosum, amæne-viridescens.

Caulis primarius terra sepultus, brevis simplex, foliis rigidis atroviridibus undique patentissimis, summis patenti-ascendentibus obsitus, apice prolifer. Caulis novellus fructifer conformis lineas tres vix excedens.

Folia siccatione adpressa, humore patenti-ascendentia, integra, acuminibus flexuosis, apice denticulato-scabris, subdiaphanis.

F. Perichætialia basi ampliata, membranacea concava, longius acuminata, et quasi aristata, arista subdiaphana apicem versus scabra.

Setæ aggregatæ, 1-3 sæpius 2, pallidæ vix semunciales, siccæ fere semper geniculatim deflexæ, calyptræ apice nempe foliis perichætialibus ope filamentorum confervoideorum firme adhærente, demum eruptæ erectæ flexuosæ, humore decurvæ.*

Vaginula cylindracea, angusta. Pistilla pauca, stylis longis Paraphyses subnullæ.

Capsula siccitate erecta, inclinata, subæqualis, dorso nempe convexior, lutescens ore rubro, humore lævis, annulata. Membrana interna discreta.

Sporula immersa hyalina, globosa, lævia, in acervulo sordide ochroleuca.

Peristomii dentes 16, ad medium vix bipartiti, pulchre rubri, laciniis albidis.

Operculum fere prioris, cum calyptræ apice arcte cohærens semperque hoc pileatum.

Calyptra profunde dimidiata, basi villis hyalinis pulchre fimbriata, apice semper lacera.

Præcedenti proximum, sed ob foliorum directionem, setas aggregatas, capsulam sub-obliquam que operculum cum calyptra cohærens sat distinctum.

A D. introflexo distinguitur præsertim foliorum apicibus nunquam hyalinis.

* Note.—Although the Setæ are aggregate, yet in this as well as in D. ericoides no more than the usual number of pistilla can be said to be fecundated, as from each seta being surrounded by a perichætium, it is obvious that each belongs to a distinct female flower. The case is different in some other instances of aggregation of setæ, in which, as in some Brya, it arises from the development of more than one pistillum of one flower.

9. *Dicranum (Campylopus) exasperatum*, Griff. Campylopus exasperatus. Brid. Bryol. Univ. 1, p. 473.

Hab: Rupes apricæ Churra Punjee.

Descriptio Bridelii loc. cit. plantæ nostræ apte fere convenit; hujus vers folia perichætialia pilo albo non termina a seta que apicem versus solum tantum scabrella.

Capsula annulata. Membrana interna discreta, breviter stipitata.

Peristomium pallide rubrum, e dentibus 16, vel per paria longitudine tota approximatis peristomium que 8-dentatum mentientibus, setaceis, opaciosirius, vel ad medium usque bipartitis, vel, ciliolis plus minus cohærentibus, solidis obsolete ve per foratis,—obliquuscule in spiram dispositis.

Columella inclusa, clavata, apice truncata.

Sporula in acervulo fusco-lutescentia, minuta, uniformia, lævia.

Operculum conico-subulatum, capsula vix triplo brevius, rubro-aurantiacum, rostro obliquo acuto cum apice calyptræ arctissime cohærente semperque hoc pileato.

Calyptra dimidiata, basi fimbriata, sæpe (villis deciduis ?) subglabra.

Flores fæminei aggregati, terminales, peripherici axillares? cincti foliis perichætialibus arcte convolutis, apicibus patulis.

Paraphyses subnullæ. Pistilla 2-5, stylis longissimis in sinu folii perichætialis intimi convoluti obtecta.*

## Dicrana ? efructifera.

10. *Dicranum?* Hab: Pini truncus, Nunklow. Proximum D. exasperato, discrepans statura majore, foliis distantibus, summis solum arcte imbricatis, magis convolutis, acuminum apicibus denticulato-scabris.

Muscus pulcher, dense cæspitosus, læte luteo-nitens.

11. *Dicranum?* Hab: Rupes husridæ, Churra Punjee, ubi rarum sæpius que aliorum muscorum comes.

* Note.—In the Musc. Britt. of Drs. Hooker and Taylor, page 92, it is said, that Dicranum glaucum has the nerveless reticulated leaves of a Sphagnum. This is not the case in the Indian specimens, so far at least as regards the reticulation, which is, I believe confined to Sphagnum.

Caules elongati, simplices, vel innovationibus parce ramosi. Folia inferiora secunda; brunnea summa vel novella patenti-ascendentia, luteo-nitentia, e basi anguste lanceolata subulato-acuminatissima, convoluto-canaliculata, integra, rigida, stricta, demum fragilia, acuminum opacorum apicibus diaphanis denticulatis vel scabrellis, rectiusculis, vel semel abrupte geniculatis, vena latiuscula indistincta.

An D. introflexum, Hedw? sed folia seniora certe secunda, Habitu propinquum D. exasperato sed præ aliis D. scopario et ericoïdi.

12. *Dicranum?* Hab: Rupes humidæ, Surureem.

Cæspitosum, luteo-nitens. Caules elongati, apice interdum proliferi, simplices parceve ramosi, unciales vel biunciales, per totam longitudinem radiculoso-villosi.

Folia distantia, sicca madidave falcatim secunda, e basi-lanceolata longissime subulato-acuminata, convoluto-canaliculata, integra, acuminibus sursum quasi aristatis, aristà minute scabrella concolore laminam subæquante, vena angusta indistincta.

An D. concolor. Hook. Musc. exot. 2 p. 10 t. 138? sed vena angusta, foliaque valde convoluto-concava.

13. *Dicranum?* Hab: Rupes torrenti "Burtapanee" collium Khasiyanorum vicinæ.

Cæspitosum, amæne virens. Caules subunciales, simplices vel rarius apice innovationibus ramosi, basi decumbentes, denudati, apice decurvati.

Folia semper falcatim secunda, tenera, e basi latiuscule lanceolatá acuminatissima, concavo-carinata, integra, marginibus leviter involutis, apicibus acuminum opacissimis teretibus scabrellis denticulatisve, prædita ven a angusta, inferne valde striata, infra apicem indistincta.

Aspectu præsertim siccoteneritate structuraque foliorum affine D. cuspidato. Species præsertim siceæ teneritate structuraque foliorum D. cuspidato affines.

## Fissidens. Hedw.

1. *Fissidens bryoides.* Hedw.

Var. A. Lamellarum margines tantum hyalini.

Hab: In ripis prope Jumalpore, Bengalæ inferioris.

B. Folia dense imbricata, obtusiuscula, rubro-tincta, vena sæpius intra apicem evanida, lamellæ obsolete marginatæ, capsula inclinata.

Hab : In arbore lapsa ad ripas fluminis, Noa Dihing copiose.

C. *F. tamarindifolius*. Brid. Bryol. Univ. 2, 684 ?

Folia læte viridia elongata, lamellarum margines sæpius conspicue fibrosis.

Specimina 2, 3, inveni mixta cum muscis aliis e Mumbree.

D. *arboreus*.

Hab : In arboribus Moflong : parcissime.

Habitus D. bryoidis, minimus. Caules sæpius ramosis. Foliorum margines simplices : seta lateralis terminalisve, brevis, folia perichætialia caulinis similia paullo excedens.

Capsula erecta urceolato-ovata.

Verisimiliter species distincta. seb ob materies mancas huic adjeci.*

## 2. *Fissidens longisetus,* Griff.

Caule simplici elongato, foliis lineari-scalpelliformibus integerrimis marginatis perichætialibus subsimilibus, seta laterali caulem subœquante, capsula inclinata cernuave oblongo-ovata-

Hab : In ripis Mumbree, mixtum cum. F. tamarindifolio.

Caules semunciales, cum foliis ambitu lineares. Folia valde acuta, amœne viridia, percursa vena medium supra flexuosa in mecronem excurrente.

Seta filiformis pallida, siccatione tortilis, caulem æquans vel excedens, in plantis novellis caule lineali præditis etiam longissima.

Capsula interdum urceolato-ovata, basi solida, pallida, ore brunneo. Peristomii dentes ultra medium bipartiti, crebre trabeculati, rubri, laciniis setaceis, pallidis, punctulatis.

Operculum e basi subhemisphœrica breviter et oblique rostratum, capsula brevius.

Calyptra breviter fissa.

* Note.—In referring the above to F. bryoides, my European specimens of which have a very distinct margin to the leaves, I have been guided by a remark of Dr. Hooker, (see Hook et Tayl. Musc. Britt. p 89,) from which it appears that though a general, it is not a universal character.

Proximus F. bryoide a quo differt tantum (an satis ?) setis lateralibus elongatis. A. F. adiantoide statura minore, foliis integerrimis, perichætialibus caulinis subsimilibus, operculique rostro brevi discrepat.

3. *F. Jungermannioides*, Griff.

Caule repente ramosissimo, foliis insigniter falcatim—secundi scalpelliformibus marginibus incrassatis subintegerrimis perichætialibus similibus, seta terminali leviter arcuata, capsuli cernua urceolato-ovata, calyptra conico-subulata.

Hab. In rupibus madidis Moosmai.

Dense cæspitosus, luride viridis. Rami semunciales, ascendentes. Folia præsertim sicca falcatim secunda, acutiuscula, percursa vena crassa in apiculum mucroniformem excurrente, marginibus valde incrassatis, (lamellarum exceptis qui simplices !) areolis subconspicuis rotundatis quadratisve diaphanis.

Flos femineus gemmiformis, paraphysibus fere orbata. Pistilla plura.

Seta suberecta, vel siccitate arcuata, vix bilinealis, pallide fusca.

Vaginula mediocris. Capsula æqualis, pallide fusco-brunnea. Membrana interna cohærens. Peristomium pulchre coccineo rubrum, dentes medium infra bipartiti, trabeculati, laciniis pallidis punctulato-opacis. Columella cylindracea, brevis, inclusa.

Operculum e basi conica sub-oblique rostratum, capsula paullo brevius. Calyptra conico subulata, hinc breviter fissa, basi denticulata, diu persistens.

Distinguitur a F. bryoide caule ramosissimo, foliorumque marginibus incrassatis opacis.

4. *Fissidens neckeroides*, Griff.

Caule repente ramoso, ramis erectis, foliis lineari-scalpelliformibus subfalcatis marginibus subincrassatis apice denticulatis, perichætialibus convolutis, setis (pluribus) lateralibus foliis breviribus, capsula ovata erecta, peristomii dentibus per paria approximatis indivisis perforatis.

Hab : In arbore semidestructa inter Moleem et Surureem.

Dense cæspitosus. Caules radiculis villosi, rami ascendentes, sæpius simplices vix unciales, complanati, apicibus subdeclinati.

Folia leviter falcata, præserstim superiora secunda, obsolete repanda, marginibus irregulariter et prœsertim apicem versus denticulatis, vena in mucronem excurrente prædita, inconspicue areolata. F. perichætialia convoluta, ensiformi-cuspidata, evanidivenia.

Setæ axillares, vix bilineales, curvatæ, pallidæ. Vaginula brevis subcylindracea. Paraphyses nullæ. Pistilla plura.

Capsula æqualis, ovata vel oblongo ovata, basi solida, fusco-viridis sub lentem areolis oblongis inconspicue notata.

Peristomuim e dentibus 16, madore conniventibus perparia sub approximatis, conspicue trabeculatis, basi pulchre rubris cæterum albidis, ciliolis inæqualibus, sursum hyalinis, per totam longitudinem et præcipue apices versus mediantibus trabeculis cohærentilres, ideoque dentes indivisi et crebre perforati videntur.

Sporula magna, in acervulo fusco-viridia, aliis minutis immixta, ideoque difformia, immersa globosa, opaciuscula, sublævia.

Columella cylindracea, inclusa, apice subcyathiformis.

Operculum e basi convexâ oblique rostratum, capsula subduplo brevius.

Calyptra dimidiata lævis, apice fusca, basi irregulariter fissa, marginibus leviter inflexis.

Species distinctissima prope D. adiantoidem locanda, habitu Neckeræ peristomioque didymodontis gaudens.

5. *Fissidens nobilis*, Griff.

Caule simplici, foliis lineari-scalpelliformibus basi decurrentibus marginibus incrassatis serrulatis setis lateralibus, folia excedentibus, capsula ovato—oblonga nutante, operculo longe et oblique rostrato.

Hab: In rupibus arenosis sylvarum umbrosarum Mumbree; etiam in ripis Agri Muttock dicti.

Aggregatus. Caules ascendentes, longitudine a semuncia ad uncias duas vel ultra metientes, cum foliis ambitu lineari—spathulatis. Folia maxima, longitudine 3·3½ linealia, latitudine sublineales, ensiformia, acuminata; marginibus conspicue incrassatis opacis denticulatis præsertim apices versus; vena crassa flexuosa in mucronem excurrente percursa; areolis inconspicuis.

Flores fæminei gemmiformes, numero indefiniti, sæpius plures cuique cauli, axillares, his apices caulium versus tantum evolutis (an semper?) in sinubus foliorum fulcientium reconditi, cinct foliis perichætialibus caulinis subsimilibus. Paraphyses nullæ vel paucissimæ; pistilla plura.

Seta pallida, apice paullo incrassata, subsemuncialis.

Capsula subinæqualis, dorso paullo convexior, ore obliqiusculo dilatato, fusco-brunnea, sicca sæpe erecta. Membrana interna cohærens, stipite crasso insidens.

Peristomii dentes madore apicibus tantum inflexi, rubro-coccinei, pulchre trabeculati, ad medium circiter bipartiti, sub lentem centies augentem leniter striati, ciliolis inæqualibus apicibus paullo pallidioribus.

Sporula inæqualia, immersa rotundata, lævia, diaphana.

Operculum e basi conico-hemisphærica longe et oblique rostratum, capsulam æquans vel paullo excedens, pallide rubro-brunneum.

Calyptra dimidiata, lævis, integra vel basi aliquoties fissa.

Species perpulchra sequenti valde affinis.

6. *Fissidens areolatus*, Griff.

Caule simplici, foliis ligulato-scalpelliformibus apice rotundatis marginibus simplicibus integerrimis perichætialibus conformibus, seta laterali curvata, capsula nutante ovato-oblonga, operculo subcampanulato rectiuscule rostrato.

Hab: In rupibus madidis umbrosis Mumbree.

Uncialis, vel sæpe digitalis; caules ascendentes. Folia longitudine sub-bilinealia, latitudine ½ linealia, percursa vena infra mucronulum brevem evanida, diaphana, areolis pro genere maximis rotundatis vel angulatis. Seta plerumque singula cuique cauli. Capsula etc præcedentis sed minor.

Species formosa, præcedenti affinissima, discrepans præsertim foliis apice rotundatis, marginibus simplicibus integerrimis et areolis conspicuis. Operculum etiam paululum forma differt.

7. *Fissidens sylvaticus,* Griff.

Caule simplici, foliis lineari-scalpelliformibus subintegerrimis marginibus simplicibus perichætialibus intimis subsimilibus, seta basilari caule duplo longiori, capsula cernua vel nutante ovato-oblonga, operculo longe recteque rostrato, calyptra subulata.

Hab. In ripis sylvarum Mumbre.

Caules ascendentes, bi-tri-lineales, basi interdum innovantes. Folia sub-8-juga, acuta, integra, vena in mucronem excurrenti prædita, inconspicue areolata. F. perichætialia, uti in omnibus aliis setis laterailbus vel basilaribus gaudentibus, diversiformia, exteriora convoluta fere mutica, interiora basi convoluta, cuspide ensiformi prædita, ideoque foliis caulinis subsimilia.

Seta erecta, solitaria necne, pallida, caulem duplo triplove superans, apice incrassata. Vaginula brevis. Paraphyses subnullæ Pistilla plura.

Capsula paullo inæqualis, dorso convexior, ore lato, collo constric. tiusculo. Membrana interna fere omnino libera, breviter stipitata.

Peristomium madore arcte inflexile, rubro-coccineum, dentes profunde bipartiti, ciliolis inæqualibus, asperulis.

Columella brevis inclusa, cylindracea, apice truncata.

Sporula fusco-brunnescentia, minuta, lævia.

Operculum e basi convexa longe recteque subulatum, capsulæ longitudine.

Calyptra subulata, rectiuscula, basi in unico exemplo maturato viso integerrima !

An satis distinctus a D. taxifolio.?

8. *F. taxifolius,* Hedw.

Ad marginem sylvæ Mumbree.

Var : A. Calyptra longissime subulata, demun breviter subdimidiata, apice curvata, stylo apiculata.

Hab : In terram Mumbree.

### Efructiferi.

9. *Fissidens.*

Hab : In rupibus rorantibus, Moflong.

Caules repentes ramosi. Rami subunciacis, ascendentes.

Folia leviter falcata, subsecunda, lineari scalpelliformia, obtusa, omnino mutica, inconspicue areolata, marginibus simplicibus integerrimis, vena intra apicem evanida.

Habitus F. areolati et nobilis, quibus ob ramificationem verisimiliter affinis. Prope F. jungermannioidem locandus. ?

10. *Fissidens.*

Hab : In arboribus propè speluncas Moosmai.

Caules longissimi, repentes, ramosi. Rami subascendentes, fusco-lutei.

Folia arctissime disticha, seniora brunnescentia plus minus disticha, scalpelliformia, acuta, percursa vena solida sursum flexuosa intra apicem evanida, marginibus simplicibus subintegris apicem versus minutissime serruatis, areolis inconspicuis.

Habitus fere Neckeræ. An affinis F. adiantoidi. ?

### Didymodon, Hedw. Hook.—Trichostomum, Brid. ; expte.

1. *Didymodon pomiforme,* Griff.

Caule simplice, foliise lanceolato-acuminatis carinatis integris perichætialibus acuminatissimis, capsula erecta ovato-globosa, operculo oblique rostrato capsulam æquante.

Hab : Ripæ. Myrung.

Caules erecti, filiformes, alteri simplices apice discoideo-gemmiformes graciliores, alteri innovationibus ramosi setigeri.

Folia siccatione falcatim subsecunda, humore sæpius ascendentia, anguste laneeolata, prædita intra apicem vena crassa evanida, areolis fusiformi-angulatis majusculis.

Perichætialia majora, lineari-lanceolata, vena breviter excurrente, sæpe subsecunda.

Vaginula mediocris. Paraphyses paucæ, breves. Pistilla pauca.

Seta terminalis vel ob innovationes lateralis, viridescens, sicca tortilis.

Capsula erecta, ovato-globosa, saturate brunnea, annulo completo prædita.

Peristomium e dentibus 16 ? brevibus plano-subulatis, setaceis, irregularibus, basin versus hinc illinc irregulariter nexis et varie perforatis, scabrellis, apicibus opacis.

Sporula globosa, in acervulo ochroleuca.

Columella inclusa.

Operculum e basi convexiuscula longe et oblique rostratum, capsulâ sæpe paullo longius.

Calyptra dimidiata, lævis.

Peristomium magis Trichostomi.

Adsunt in axillis foliorum superiorum caulium apice discoideorum massæ levissimo tactu separabiles, irregulares, ovatæ vel ovato-fusiformes, celluloso-areolatæ, continentes granulas mobiles difformes.

Var. A. Caules magis elongati; peristomium fugacius.

Hab : Rupes ripæque Maamloo.

Var. B. Minimus, vix triinealis; capsula suburceolata, castaneo-brunnea, peristomii dentibus per paria approximatis, lutescenti-fuscis, apice hyalinis.

Hab : Myrung.

2. *Didymodon squarrosus,* Hook. Musc. exot. 10. t. 150. Trichostomum squarrosum, Brid. Bryol. Univ. 1. 498.

Hab : Ærbores pinetorum Moflong, ubi rarus.

Caules interdum simplices. Foliorum margines a medio deorsum recurvi.

Capsula exannulata. Peristomii dentes breviusculi, e ciliolis setaceis, articulatis, vel arcte cohærentibus, vel ope substantiæ aspectu gelatinosæ semiopacæ annexis.

Operculum capsula duplo fere brevius.

Figura Hookeriana citata articulationes dentium non ostendit lineaque junctionis nimis regularis videtur.

3. *Didymodon longifolius,* Griff.

Caule simplice flexuoso, foliis patentissimis squarrosis lanceolato-linearibus carinatis subintegerrimis, capsula cylindracea, peristomii dentibus sedecim, operculo longe subulato.

Hab : Ripæ Surureem.

Caulis vix semuncialis. Folia siccitate marginibus involuta, tortilia, humore patentissima vel patenti-recurva, superiora ascendenti-patentia, raro subsecunda, e basi anguste lanceolatâ linearia, longa, concavo-carinata, sub lente fortiter augente minutissime crenulata, percursa vena in apiculo diaphano brevi subexcurrente; areolis minutis quadratis.

F. Perichætialia conformia, majora, ascendentia.

Seta terminalis, capillacea, siccitate spiraliter torta, vix 8 linealis.

Vaginula cylindracea, angusta. Paraphyses paucæ. Pistilla plura, stylis longis.

Capsula anguste cylindracea, brunnea, sicca irregulariter sulcata; os incrassatum, rubro-coccineum.

Peristomium siccum erectum, madidum, connivens, e dentibus 16, brevibus setaceis subinæqualibus, simplicibus perparia (sæpe obsolete) infra medium ope trabecularum irregulariter nexis, subdiaphanis, transversim, obsolete lineats, irregulariter marginatis, aurantiaco-rufis compositum.

Sporula rotundata, lævia, in acervulo, fusco-lutescentia, immersa hyalina immixta corpusculis aliquoties majoribus rotundatis opacis.

Columella truncata, filiformis, inclusa. Operculum e basi brevi conica longe recteque subulatum, capsula dimidio brevius.

Calyptra dimidiata, parte fissa semel torta.

D. squarroso, Hook. propinquius, discrepans caule simplici, foliis angustioribus integris, dentiumque peristomii numero.

4. *Didymodon perichætialis,* Griff.

Cuale elongato ramoso, foliis patentissims lanceolato-linearibus carinatis acutis marginibus incrassatis integerrimis, perichætialibus interioribus circa setam convolutis longissime subulato-acuminatis, capsula inclinata subcylindracea, operculo longe et oblique rostrato.

Hab: Rupes arboresque Myrung et Nunklow.

Caulis repens. Rami ascendentes.

Folia siccitate tortilia, margine involuta, humore patentissima vel patenti-recurva, e basi lanceolata longe linearia, percursa vena-crassa in mucronem brevem excurrente, areolis minutissimis opacis punctiformibus.

Perichætialia solidisenia, exteriora caulinis consimilia, superiora longissime circa setam convoluta, intima setam sæpe superantia, acuminibus plano-subulatis cirrhosis, sæpe spiraliter tortis, reflexis vel patentibus.

Seta ob innovationes lateralis, vix uncialis, pallida, sicca torta.

Vaginula longissima, anguste cylindracea. Paraphyses plures breves. Pistilla pauca.

Capsula rarius erecta, inæquilateralis, cylindraceo-ovata, utrinque attenuata, exannulata, fusco-brunnea, sicca sæparcuata.

Membrana interna libera.

Peristomii dentes per paria obsolete approximati, profunde bipartiti, (raro tripartiti), laciniis discretis vel hic illi, nexis, vel omnino cohærentibus, pallide rubri, apicibus albidis opaco-punctulatis, lineis longitudinalibus indistinctis.

Sporula fusco-ochroleuca, subrotundata, lævia, majuscula, immersa hyalina.

Columella inclusa, miniata.

Operculum capsula $\frac{1}{3}$ bre vius.

Calyptra magna, capsula langior, dimidiata, caduca.

Habitus quodammodo Barbularum ramosarum.

Hæc species, cum D. squarroso et longifolio, Trichostomo Bridelii pertinet.

## Funaria, Hedw.

1. *Funaria hygrometrica*, Hedw.

Hab: Colles Khasiyani, ad Maamloo et Moflong.

Statura magnopere variat.

2. *Funaria leptopoda*, Griff.

Caule simplice; foliis lineari oblongis carinatis incurvis flexuosis integris, vena completa seta, elongata recta, capsula sulcata elongato-pyriformi, operculo convexo.

Hab : Sylvæ, Myrung.

Omnia præcedentis, saltem quoad plantam Khasiyanam, sed folia humore siccitateve incurvata, flexuosa, carinata, longiora, seta longissima, 2-2½ uncialis, recta, peristomii interioris ciliis basi altius connatis, operculoque medio vix depresso.

An vere distincta species? an F. calvescens? sed folia nunquam plena?

## Bartramia, Hedw.

1. *Bartramia fontana*, *Suz. var β marchica*, Hooker et Taylor Musc. Brit. p. 147. t. 23. Philonotis marchica, Brid. Bryol. Univ. 2. p. 23.

Hab : Arenosa, Bogapanee.

2. *Bartramia sabulosa*, Griff.

Caule fasciculatim ramoso, ramis cylindraceis, foliis adpressis e basi lanceolata acuminatissimis minute serrulatis vena in subulam longam denticulatam excurrente, capsula subglobosa inclinata sulcata, operculo convexiusculo.

Hab : Ripæ arenosæ rivuli Maamloo agri singfoensis, et Deboro ad Kusoodoo et Rangagurrah.

Caules suberecti. Rami extrorsum curvati, interdum secundi.

Folia arcte adpressa, ramulorum novellorum siccitate sæpe ascendenti-patentia, interdum subsecunda, perichætialia longius subulata, marginibus recurvis.

Seta subuncialis vel ultra.

Capsula inæquilateralis, maturata brunnea profunde sulcata, ore obliquo paullo constricto.

Peristomium exterius humore connivens; dentes plano-subulati, trabeculati, plerumque simplices, aliquando vestigia compositionis hic illic ostendentes, rufo-brunnei.

Interioris membrana lutescens, sedecies plicata, solida vel inter plicas minute perforata; cilia profunde bipartita, segmentis interdum apice cohærentibus, interdum divergentibus, sinubus (plicis alternantibus) nudis vel ciliola minuta gerentibus.

Sporula sordide lutescentia, reniformia, vel oblonga, sublævia, immersa opaca.

Columella brevis inclusa.

Operculum convexiusculum centro depressum.

Var. æ. Statura multoties minor, folia patenti-ascendentia lon giora, sæpe subsecunda.

Hab: In ripis Nunklow. Brid. B. ithyphylœ, fere omnino convenit.

Præcedenti nimis affinis; differt tantum foliis magis planis et adpressis, angustionbus, vena in subulam longe excurrente-operculo convexiusculo (nec conico) peristomiisque magis evolutis.

3. *Bartramia speciosa,* Griff.

Caule vage et fasciculatim ramoso, foliis patentibus lanceolato, acuminatis minutissime serrulatis vena agicem attingente, seta longiuscula, capsula inclinata ovato-rotundata sulcata.

Hab: In collibus Aborendibus in ripis arenosis.

Caules dense radiculoso-villosi, steriles sæpe simplices; rami inferiores vagi, superiores dense fasciculati et fastigiati. Folia laxiuscule imbricata, sicca patenti ascendentia striata, madida patentia sublævia, interdum horizontalia, concaviuscula, sub lente modice au gente minutissime serrulata, vena tenui completa percursa, marginibus infra medium plus minus recurvis.

Perichætialia subconformia, minora. Vaginula mediocris. Paraphyses paucæ. Pistilla plura.

Seta subterminalis, vix uncialis, recta, crassa, rubra.

Capsula madida leviter sulcata, sicca crebre sulcato-striata, fere horizontalis, rubro-brunnea.

Membrana interna libera.

Perietomii exterioris dentes lati, brunneo rubri, lineis transversis hic illic lineolis singulis binis vel ternis longitudinaliter connexis crebre et conspicue notati, intus trabeculati.

Interioris membrana lutescens sedecies plicata, ciliis profund-bipartitis, segmentis acuminatis sæpius convergentibus, ciliolis irregularibus, sæpius binatim compositis liberis vel ciliis adhærentibus interjectis.

Sporula sordide lutescentia, subreniformia, sublente fortifer augente minutissime scabrella, immersa opaca.

Columella inclusa, magna, trigona.

Operculum et calyptra desiderata.

Proxima videtur, B. tomentosæ, Hook Musc. exot. p. 15. t. 19.

*(To be continued.)*

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*The wild Sheep of Afghanistan—" Koh-i-poombur" of the Afghauns.—Bearded Sheep of* Pennant? *by Capt.* Thos. Hutton, *Bengal Army.*

Ovis Cycloceros, Nobis. Plate xix.

Among the many novel and beautiful forms which the late campaign in Afghanistan has presented to our notice in the Zoology of that country, by no means the least curious and worthy of attention is the wild Sheep, which forms the subject of the present paper.

It is now long since Pennant recorded the existence of an animal, which he but imperfectly described, and to which he applied the name of the " Bearded Sheep."

Subsequent authors were unable to determine this species, until an animal was discovered at Cairo, by the eminent naturalists attached to the French expedition into Egypt, which was described by M. G. St. Hilaire under the title of the " Ruffled Mouflon," (Ovis ornata).

This animal Messrs. Cuvier and Desmarest have considered identical with Pennant's " Bearded Sheep," and accordingly the two are now blended, and stand in our systems as the " Bearded Argali," or " *Ovis tragelaphus.*"

I am inclined to think, however, that the animal under present consideration, may lay as good a claim to the name of Bearded Sheep, as the Egyptian species, and is more likely to have been the original from which Pennant took his description than the latter. To avoid confusion, however, I have thought it better not to interfere with established names, and I shall therefore distinguish the Afghan Sheep by the title of "*Ovis Cycloceros,*" a name which is founded on the circular direction of the horns.

A full grown individual of this beautiful and remarkable species stands, according to Captain Hay's observations,* about three feet four inches at the shoulder; from nose to tail five feet four inches in length; horns two feet six inches long, and 12 inches in circumference at the base. This however must be considered the description of an aged individual.

The measurements of a four year old specimen, living in my possession at Candahar, were as follows:—

Height at the shoulder two feet eight inches; length from the muzzle to the insertion of the tail four feet one inch; and the tail itself, which is flat, narrow, and tapering, is four inches to the end of the hair, which however scarcely extends beyond it; beneath, the tail is naked. All the upper parts of the body are of an uniform yellowish or fawn coloured brown; beneath, and on the inside of the limbs, white; knees and fore pasterns pale coloured or dirty white; inside of the hams and buttocks, white; the face bluish grey, and about nine inches long from between the horns to the muzzle: fore-part of the fore-legs, greyish also; a beard commences under the jaws, where it is divided into two lobes, but immediately unites, and forms a black fringe depending from the jaws to the chest. From this character, if this be the Bearded Sheep of Pennant, the name was derived. The tip of the tail

* Journal of the Asiatic Society, No. 100, p. 440.

is brown. In all other parts of the animal's body the hair is stiff, and uniformly short and close lying during the summer, at which season also the colours are the palest ; in winter the coat is coarser and less smooth, and of a darker shade of brown, having beneath it a fine soft short fleece, which, as in the Goats, is displaced in spring.

The beard in full grown individuals is long, thick, and interspersed with white or grey hairs; the commencement of it beneath the articulation of the jaws turning white with age, as does also the tail, and the upper parts generally become interspersed with the same colour.

The remarkable fringe along the throat is strikingly contrasted with the uniform colour of the body, and at once furnishes a well defined line of distinction between this, and every other known species. The horns when mature, attain to a length of 2 feet 6 inches ; they are curved strongly from the base, laterally, posteriorly, downwards, and again upwards, forming nearly a circle ; the internal diameter of which would be about 8 inches and a half; and the external diameter over all, $11\frac{1}{2}$ inches.

The horns may be termed semi-spiral, the tips alone in mature specimens, taking a slightly forward turn.

The form is triangular; they are strongly wrinkled, and the annual markings of increase are prominent; deeply furrowed on the anterior surface. The base of the triangle forms the anterior side of the horn, which is rather more than three inches in breadth at the base; the sides are equal, being three inches and three quarters in breadth, and giving altogether a basal circumference of about $10\frac{1}{2}$ inches to a horn of two feet one inch in length. In older specimens it is more.

The profile is either not at all, or but very triflingly arched; the muzzle clothed, and there is a moderate sized lachrymal sinus, which appears to secrete, or at all events contains, a thick gummy substance, of good consistency, and of a dull greyish colour. The Afghan and Belooche hunters, more especially the latter, make use of this gum, by spreading it over the pans of their matchlocks, to prevent the damp from injuring the priming.

When in a state of inactivity, the hind quarters are raised, as in the annexed faithful representation, much higher than the withers, which gives a stoop to the attitude, the body sloping sensibly from the rump to the shoulder.

The legs too appear long for the proportions of the neck, and in feeding, I observed that the animal almost invariably kept one leg bent, to enable it to reach the herbage. This structure although apparently inconvenient on level ground, would by no means be found so on the sides of the steep acclivities, where the species loves to roam. The ears are shaped like those of an antelope, are of moderate size, and carried erect.

The Bearded Sheep inhabits the mountainous tracts of Khorassan, being found throughout the Soolimoaun, Kojeh Amraum, Hindoo Kush, and Huzarreh Hills, and probably extending into Bokhara; it occurs likewise in the neighbourhood of Herat, and is said to be known in Persia. The exact limit of its range is not yet ascertained, but it is probably extensive.

They are found at less elevations than the Goats about to be described, and during winter frequently descend to the plains and valleys in small flocks. They are pursued by the hunters for the sake of the flesh, which is good and well-flavoured; while the horns are placed, as are those of Goats, as trophies of success, and proofs of skill, upon tombs and temples.

When taken young they are easily domesticated, but the Rams are treacherous, making sudden and fierce attacks upon unarmed persons.

Although they become tame, and will breed readily with the domestic Sheep, yet they do not seem to consider themselves as part of the flock, or in their proper sphere, keeping generally aloof, and striking fiercely at any male that may happen to approach them.

One of these animals was brought by a chief from the Huzarreh hills to Candahar, and kindly presented to me by Major Leech, then Political Agent at that city, a gentleman whose liberality in furnishing information and assistance on all occasions, is as proverbial among those who enjoy the pleasure of his acquaintance, as his knowledge of the country and of the people, is deep and extensive.

This specimen was a young male of about four years old. It had been taken on the hills when quite a lamb, and brought up in the house, evidently in close confinement, as the hoofs had grown out of all natural proportion. By turning him loose into a large court yard, this defect was soon remedied, by the hoof splitting off, and wearing down to the natural size.

In a few days he felt perfectly at home, and reconciled to his new abode, and charged all intruders with a spirit and determination that soon left him in undisputed possession of the yard. A native servant who fed him, and myself, were soon the only persons he would allow to approach him without charging; but I generally carried a short thick stick in my hand, which he had, I suspect, a greater respect for, than for me.

His mode of attack was singular, partaking more of the manners of the goat, than of the sheep tribe.

Instead of charging and throwing in the whole weight of his body, as the tame ram does, he galloped quickly up till within a few paces, and then rose on his hind legs with his head thrown threateningly on one side, exactly similar to a goat. In this manner he made a cut down, and a jerk up, with the ribbed front of his cimetar-shaped horn, as with a sabre; and on one or two occasions when he attacked a large tame ram, which was a noted bruiser, he conquered him by the sheer novelty of his mode of fighting, always closing at once with his adversary and catching him across the face and nose with a sharp drawing cut or jerk of his head, and then bounding out of the way before the blow could be returned.

His action was in general leisurely, and far less active than the goats, though he would frequently at a bound reach the top of a wall six feet from the ground, and then drop over. When irritated, or in a frolicsome mood, he would throw back his head, and bound along heavily with all four feet off the ground at once, like the antelope, but with none of the light and graceful ease, which is so beautifully characteristic of the latter animal.

The female I have not seen, but she is said to be similar to the male in all respects, with the exception of the horns, which are much smaller, and rise upwards and backwards.

This animal is found to differ from the "*Ovis tragelaphus*" of the French naturalists, in having no hairy appendages on the shoulders, nor any tuft of hairs at the end of the tail; in wanting the medial dark line between the colours of the upper and under sides, and in possessing a black line of hairs along the throat and dewlap, instead of being, as in the Egyptian species, of a brown colour, nearly uniform with that of the body.

It differs also very materially in the figure of its horns, which are decidedly triangular, while in the other species they are said to be quadrangular.

The usual length of beard is in adult specimens about five inches long, and it commences at the angle of the jaws, where there is a strong muscular fold on the sides of the throat; from this the hair extends to the chest in a simple black line, and terminates between the fore legs. In young specimens this hair is not elongated, nor does it become so until about three or four years old, but forms merely a black line from which the beard afterwards springs, and gradually increases with age. The tuft at the end of the tail in the Ruffled Mouflon, is entirely wanting in the Bearded Sheep; the length of this appendage is also different, it being two inches shorter in the latter species.

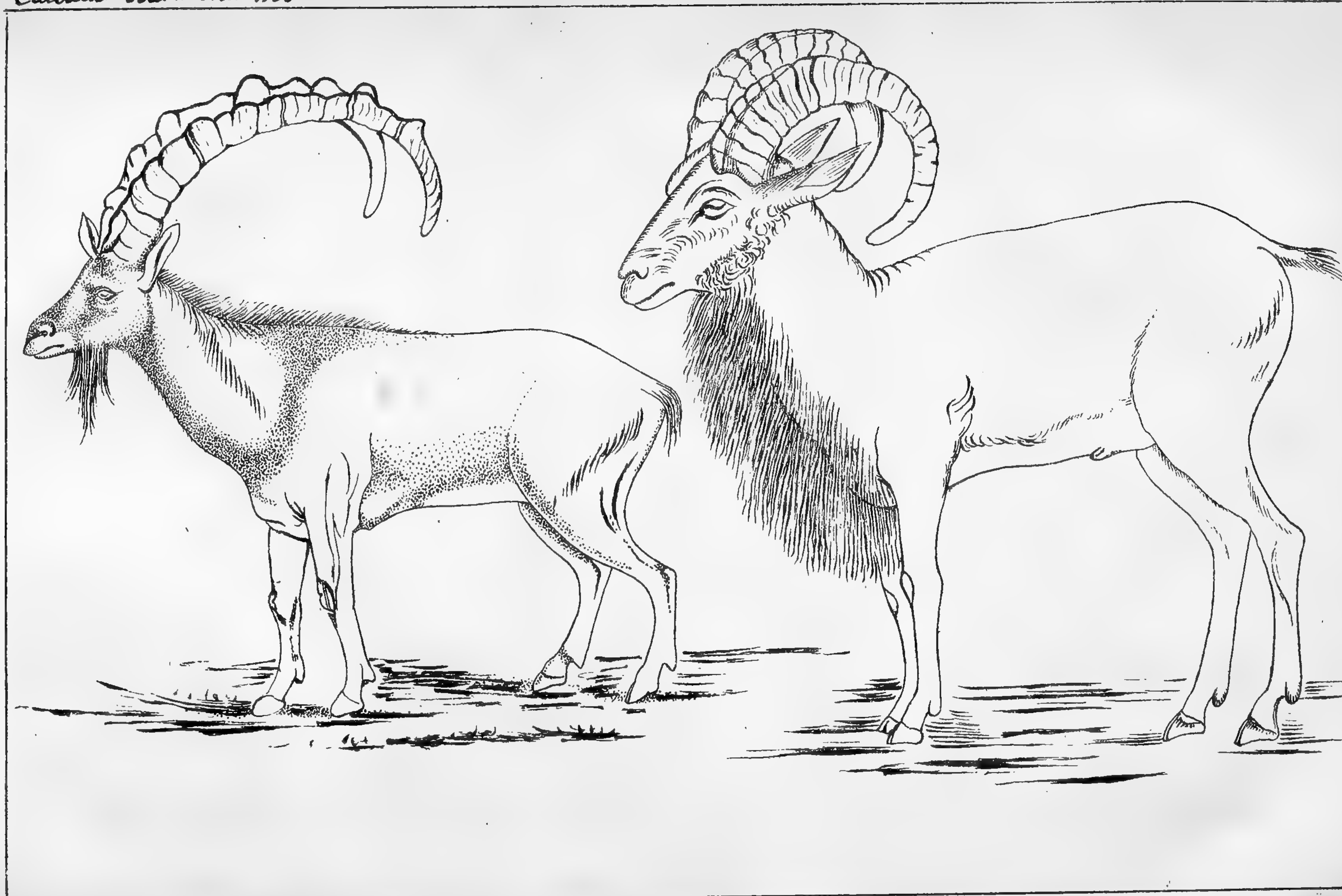
The horns in both are wrinkled most strongly towards the base, nearly smooth at the extremity, and ending in the Bearded Sheep, in a flat obtuse point, which is slightly turned outwards, or rather forwards. In old specimens in both species, they are closely approximated at the base, and curl strongly round in a circular direction.

If it be thought necessary to trace the derivation of our domestic breeds from the wild stock of each country, this species is the only one from which the flocks of Afghanistan could have descended, for it is the only wild species known to the people.

It so happens, however, that the wild breed has a tail of only four inches in length, which is *narrow*, and tapering; whereas the domestic breed is a variety of the well-known "*Ovis steatopyga*," whose tails often attain to such a size as to impede the animal's motions, and are so broad as to cover the whole of the rump as far down as the houghs; and indeed it is said, that in some parts of the country, they actually reach the ground, and are supported on wheeled trucks to enable the animal to move about.

It is evident then from this characteristic alone, that the Bearded Sheep has not in any way contributed to form the domestic stock of the Afghans; for if Pallas be right in attributing the enlargements of the tail to the peculiarities, of pasture, why has it not had the same effects upon the wild, as upon the domestic race? Pasture, however much it might influence the secretion of fat, could never lengthen an animal's tail by *several vertebræ*, which if the domestic breed has sprung from the wild one, it must have done in the present instance.

There are other marked distinctions, however, which will



Capra Ægagrus

Ovis Cycloceros

be at once apparent, on comparing the skulls of the two species; in the *Ovis steatopyga*, the horns have the anterior surface rounded, *instead of flat;* they are spiral from the very base; only semi-triangular, and with the superior edge rounded and folding over; the space between the orbits is one-fourth greater, and the chaffron is strongly arched, all of which characters are wanting in the wild race.

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### "*Borz*" *of the Afghans—Wild Goat of Afghanistan,* "*The Paseng*" *of Authors. By Captain* HUTTON.

CAPRA ÆGAGRUS, Pallas. Plate xix.

This noble animal is an inhabitant of the mountain districts of Afghanistan, especially among the lofty crags of the Soolimaun and Pisheen Hills, where it chooses the most inaccessible place for its haunts. It is, however, likewise found in other places of considerable elevation, and may be said to range more or less abundantly over the greater part of Afghanistan and Persia.

The height of a full grown individual living in my possession at Candahar, was three feet and one inch at the shoulder; from the muzzle to the extremity of the tail five feet one and half inch; length of the tail from its insertion to the tip of the hair five inches. The horns differ in length, according to the age of the animal. Those of the specimen above mentioned, measured along the curve from base to tip, three feet and four and half inches. Width between the tips twenty-two and three quarter inches. Basal circumference eight inches. It was said to be nine years old, judging from the joints of the horns.

In the female, the horns are much smaller. I have one specimen, whose measurement is as follows: length along the curve from base to apex thirteen inches; distance apart at the apex five and half inches; distance apart at the base one and quarter inches; basal circumference four inches; length of face from anterior base of horns to the muzzle nine and quarter inches; breadth across the face from the inner canthus of each eye four and half inches; breadth between the ears five and quarter inches; length of ears four and half inches; length from the inner canthus of the eye to the end of the muzzle five and half inches.

Another one measures along the curve one foot; between the apices four inches; distance apart at base one inch; basal circumference three and half inches.

A third measures along the curve eight and quarter inches; distance apart at the apex five and quarter inches; distance apart at base one inch; basal circumference three and half inches.

The horns in all are much wrinkled with transverse rugæ.

In the male the horns are very large, semi-elliptical, curving strongly backwards, and gradually outwards towards the apex; approximated at the base; divergent at the summits; transversely wrinkled; the annual markings of increase very strong and remarkable, standing forward on the anterior edge or angle in prominent, somewhat, rounded knobs.

This is a peculiarity caused by the acute edge of the horn being chipped and worn away by friction and combat; and the horn being thickest and hardest at the joinings or annual additions, resists the blows which it receives, which the intervening space is incapable of, and the knobs or projecions are thus left at each annual joint. At the base therefore the horns are entire, and destitute of these prominences, from that portion being less subject to blows and friction. Their colour is an earthy grey, changing to blackish at the base.

The colour of the animal varies with age and season, but it may be said generally to be of a brownish grey, more or less intense. During the winter it is paler, and in old specimens altogether pale grey, with the exception of the points about to be noticed.

The face, in the mature male, is of a deep sooty brown, approaching to black, interspersed with grey at the base of the horns and on the cheeks ; the forepart of the throat and the chest are also of the same colour, which rises obliquely from the latter round the shoulders, and unites at the withers, so as to form a dark and distinctly formed collar, while the same colour again extends itself in a stripe along the back from the base of the horns to the extremity of the tail, which is wholly dark brown or black. The tail is short ; naked beneath, and carried, when the animal is alarmed and on the alert, turned up, and firmly pressed against the back, as in the domestic species ; in general however, if undisturbed, the tail is carried pendent.

The beard is moderately long, of a deep brown or black, sometimes interspersed with a few white hairs, and springs from the chin.

The shoulders are of a deep brownish grey, which continues down to the knees from thence to the fetlocks, and forms two bands round the leg, the one at the knee and houghs, the other at the pastern joints ; the belly and underparts are whitish, with a deep brown medial line on the sides, which passes along the anterior edge of the hind legs.

At the first glance, therefore, the black lines on the pale grey are the most prominent features, added to which, are the immense recurved horns and dark beard.

The above, it must be remembered, is the description of a mature animal in its winter garb. In summer it puts on quite a different dress, the whole of the upper parts being of a yellowish or fawn coloured brown ; the mane on the neck and withers nearly or altogether wanting, and the face possesses a brown front or streak down its centre, with a stripe of the same colour from the inner canthus of each eye to the nostril; the throat and chest are less dark, and the collar round the shoulders often wanting. In immature specimens, the colours are much the same as those of the summer dress of mature individuals, but the dark lines are always less intense and often indeed are nearly obliterated.

The adult female has the colours of the upper parts grey, with a shade of pale brown over all; the face possesses a broad dark brown stripe down the centre, with another from the inner canthus of the eye to the nostril; some possess others want, the dark dorsal stripe; and she has *no beard whatever.*

In very young specimens, or those that come under the denomination of kids, the colour is uniformly of a fawn or pale brown, without a trace of the dark points; and the beard in males does not appear until about a year old; the horns pierce through at about the third month.

The attitude when on the alert, and springing fearlessly from crag to crag in the rocky fastnesses, where it delights to roam, is bold and haughty, giving an idea of great muscular strength and agility, which indeed the animal possesses in no ordinary degree, but its speed is not sufficient when it descends to the plains to preserve it from the greyhound. It is, however, only when driven from his haunts by the intensity of the winter, that he condescends to visit the lowlands, and that but rarely happens.

The shoulder has every appearance of great muscular power, and is, what in a horse would bet ermed "*heavy.*" The neck also is massive, doubtless for the purpose of enabling it to support the enormous horns which grace its head. The hind legs are generally kept somewhat in a crouching attitude, as if ready for a sudden spring in case of alarm; this attitude imparts a wildness to the general character of the animal, and at the same time gives it the appearance of being much higher at the withers than at the rump, and the back consequently appears to slope gently from the shoulders to the hind quarters. This feature is much heightened by the occurrence along the back of the neck and on the shoulders of long hair, which stands up erectly, so as to form a well-marked mane, which when the animal is alarmed or angry, becomes a very prominent character. This mane is dark coloured, and forms part of the black dorsal line. The head is usually kept stretched out, as it were, and the expression of the face is gentle though somewhat wild.

The attitude and general character have been very successfully represented in the accompanying copy of a drawing by my friend Dr. P. F. Baddeley.

Its usual quick pace is a kind of canter, which among the hills enables it rapidly to evade pursuit, but is not nimble enough, nor is the stride sufficiently long, to suit it to the plain lands, though for scaling mountainous heights it is admirably adapted. The leaps they take are tremendous, and almost pass credibility. An old male which was for some time in my possession at Candahar, and had been taken by greyhounds in a valley while weak and emaciated at the close of the rutting season, often sprung up to the top of a wall twelve feet high, which formed one side of his enclosure, and after looking round him for a minute or two, with an evident desire to attain to a still more elevated position on the roof of the adjoining buildings, he would drop suddenly from the wall to the ground, and then stand as if rooted to the spot, and without having received the slightest impetus or tendency to fall forward a few paces, which most animals receive when leaping down from a height. This faculty or power of stopping *dead-short,* must be of the utmost service to the animal, and enables it when springing up or down among its native rocks, to check itself, and stand fixed statue-like on the instant, and so avoid falling into the yawning chasms and precipices of the mountains, down which an animal not endowed with this power, would inevitably be hurled headlong, and dashed to atoms.

Another curious and most interesting circumstance I several times witnessed also, and one that evidently evinces on the part of the animal, a knowledge that his horns are given him for other purposes than as the mere weapons of offence or defence when combating with his species.

I had often wondered, while watching the rapid springs of this animal, of what use such enormous horns could be, and whether they were not to all appearance more likely to encumber than to be of use to it. One morning, however, the goat had by a side leap against a wall managed to throw himself to the top of a large and lofty gateway, about twelve feet from the ground; this he constantly did.

In dropping down again from this height, he made no use of the side wall by which he ascended. On the morning in question, his foot slipped just as he was dropping off, and being thus thrown violently forward off his balance, he would, but for his horns, have severely injured his knees and skull; but no sooner did he feel himself falling than he bent his chin firmly down upon his breast, so as to bring his long recurved horns to the front, and *upon these* he received the shock of his fall, without sustaining the slightest injury.

His instantly resorting to this manœuvre on several similar occasions, clearly convinced me, that he knew how to turn his horns to a good account, and proved that they are both in size and shape well and wisely adapted to protect the animal from the death, which a false step would almost invariably lead to, were he unprovided by nature with a suitable protection. Hence we should learn to pause ere we pronounce the gifts of the Allwise, disproportioned, or ill adapted to an animal's mode of life, and we should learn to see and to acknowledge, that nothing has been made in vain, or without positive and peculiar use, according to the declaration" of Him, who created all things, and "*saw that they were good.*"

The female having far shorter and smaller horns, does in no wise invalidate this opinion, since it is a well-known fact, that in the Caprine tribe the female is far quieter, and less restlessly inclined than the males, and therefore much less, or perhaps not at all, subject to the same accidents. So well known is this fact to the mountaineers of the Himalyan districts, that the traders who carry the produce of the lower tracts to the regions of Tartary, invariably transport their merchandise laden on the backs of *females* and *emasculated* goats and sheep; a few males only being preserved and left at home to perpetuate the breed. The same mode is adopted by the mountain shepherds of Afghanistan, to prevent the animals wandering from the flock, when at pasture on the heights.

The eye of this species is of a fine light hazel, or bright brown. There is no lachrymal sinus, and the males have the strong odour, which is characteristic of the tribe, and which Mr. Hodgson has so happily seized upon as a generic distinction between the goats and sheep.

These animals inhabit the highest mountains of Afghanistan, keeping as near as possible to the snows, and they appear to be abundant in certain localities, both in the Huzzarreh and western ranges. In the summer it is difficult to procure them, owing to the inaccessible nature of their rocky retreats, but in the autumn and winter, when the inclemency of the season forces them to descend from their exalted stations to the lower range, they are shot, or even occasionally run down with greyhounds.

Like the Wild Sheep of the American Rocky Mountains, they are fond of entering caves in search of saline efflorescences, and are thus occasionally captured alive; to do this however is a task of much danger, as the animal, if brought to bay, becomes furious, and charges with such impetuous force, that a man would infallibly be borne down by the weight, and probably dashed to pieces.

They are generally secured by entangling their horns with ropes, and thus rendering them harmless.

It is doubtless this habit of entering caves, that has given rise to the native idea of their living in them.

During the winter time, these animals possess beneath their hairy covering a soft wool, of exquisite quality, and of a pale grey or nearly white colour ; the hair at this season too is much longer than in summer, but at no period can it be called long. As the summer approaches, the soft under-coating of wool gradually detaches itself from the skin, as in the domestic goats and camel, and is slowly thrown off together with the winter coat, which yields to a yellower brown hair, which forms the summer clothing ; this latter is likewise much shorter than that which it displaces.

In most immature specimens, the dark collar is wanting, and the dorsal stripe often obscurely perceptible, and indeed sometimes altogether imperceptible. These seem to be more especially characteristic of mature or aged individuals, though they are not solely confined to such, even young ones occasionally exhibiting them. In none but mature animals are they constant. There is also much difference in the size and direction of the horns, some being large, and the tips gradually turning outwards, others again turning inwards, and some being wholly directed backwards. When taken young, they are readily tamed, and breed willingly with the domestic species.

It has been conjecturd that the Ægagrus might probably be found to inhabit the European Alps, and an animal has been figured and described in the Naturalist's Library under this name, on the authority of F. Cuvier, which is said to have been captured in those mountains.

It would however appear, independent of the fact " that there is no proof of the existence of the true Ægagrus in

Europe,"* that the animal alluded to, was a cross-breed between the domestic goat and the Ibex (C. Ibex,) and it is at all events shewn to be distinct from the Asiatic Ægagrus, by its having " the face covered with long and thick silky but loose hair, extremely soft ;† whereas in the species under consideration, the hair of the face is uniformly *short* and *close lying ;* nor does the specimen in the Paris Menagerie at all correspond in colouring, with the Asiatic form; no mention being made of the dark dorsal stripe, medial line, black face, neck, chest or shoulders, nor of the markings of the legs, or colour of the beard.

The present species is rendered interesting from its being now the prevalent opinion among naturalists, that from it have been derived our domestic breeds. The question notwithstanding is far from being decided, and a few remarks on the subject may therefore be considered not unworthy of attention.

If the Ægagrus be the stock from which our domestic goats have sprung, it should follow, that the differences which they now exhibit in general appearances, have been induced by domestication; and it is asserted, that the two breeds should be capable not only of freely producing offspring together, but that such offspring should likewise be capable of breeding *inter se ;* yet on this point there seems to hang something more than a doubt, for the offspring of the goats, which were formerly in the Paris Menagerie, " were either prematurely brought forth, or lived only a short time, in a sick or languishing condition."‡ On this subject I can fortunately likewise produce some additional testimony, which will go far to shew, that the two breeds are distinct species.

* Bell's British Quadrupeds.

† Naturalist's Library.

‡ Bell's British Quadrupeds.

I must here remark, however, that I do not think the mere fact that the offspring of the two breeds being capable of perpetuating the race, will at all prove the domestic goat to have sprung from the wild one; for animals of the same genus though of different species, if closely allied, may produce offspring which will breed *inter se,* as I have more than once proved with canary birds, having reared the young of a *pair of male birds,* which young again in turn produced and reared a brood; the original stock in this case was derived from a canary and a linnet, (Fringilla Canaria and F. Linota, Linn.) My efforts hitherto to obtain a breed from the offspring of the two races, have been attended with no better or more satisfactory results than those which were obtained in Paris, but I trust ere long, to be able to throw more decided light upon the subject, as I still possess a half-breed female, and four of her kids by a domestic goat. It does not appear to me, however, that former experiments have altogether failed; for the point to be decided, was, whether the offspring of the wild and tame goats *could breed inter se,* and this they decidedly *have done,* although the offspring did not live. The offspring never having been reared, is not because it cannot *be produced,* but because experiments have not been tried sufficiently often.

It is not sound philosophy therefore to declare, that because one or two trials have failed, that the fact will not eventually be established. My half-bred female has produced at two different times four kids by the domestic goat, which are all healthy animals, and although she prematurely brought forth on another occasion two kids, which were said to be the offspring of her own produce, yet I have no proof of the fact beyond the statement of the goatherd, who knowing my wishes on the subject, is as likely to have misinformed me as not. But even if he were correct, it must be remembered that the still-born kids were the offspring of a goat, which was not above seven or eight months old, for it was born in April, and the rutting season is in October and November. The experiment consequently was of no value.

But I think that without waiting for farther experiments, which after all will not of themselves be sufficient to decide the question, I can furnish proof of the distinctness of the breeds from the following facts:—

It will be seen, that in the foregoing description of the Ægagrus, the female is altogether destitute of *a beard* under the chin, whereas in the domestic breeds of Persia and Afghanistan, the tame female *possesses* this character. The half-bred female in my possession, although partaking more of the wild, than of the tame species, exhibits the intermixture of the latter, in possessing *a white front to the face*, and in the *presence of a beard.* Now, as it is well known that animals have a tendency to return to the original and natural states, it should follow, (as *the want* of a beard in the wild female is *a natural character*,) that if the domestic breed is derived from the wild one, the former on being crossed by the original stock, *should revert to it;* and the tendency to do this would appear in *the absence* of those peculiarities which were *unnatural.* Yet this is not the case, for although the beard is unnatural in the wild female, yet the half-breed, and even the third generation of the cross, retains it; thus shewing it to be a natural character in the domestic goat, and consequently that the two breeds are distinct.

Besides this, it may be remarked, that in the yearling Ægagrus, the horns are not more than $\frac{1}{4}$ inch separated at the base, and in the adult male were only $\frac{3}{4}$ of an inch apart; while the offspring of the half-bred female by the tame Buck, has the horns *at one year old* rather *more than* two *inches apart at the base.* Again, the ears in the wild stock are small and erect; so are they in the half-breed; but in her offspring by the tame goat, and in the tame breed itself, the ears are large and pendent.

The hybrid female now in my possession exhibits the following characteristics:—Her dam was captured young among the hills of Pisheen, and being brought up with the domestic flock, soon produced the female, which through the kindness of my friend Major Leech, was afterwards presented to me. This cross stands somewhat lower on its legs than the wild goat, is far less active, and shy, and yet although bred and brought up among the tame flock, she still partially retains the distrust of the wild stock. Her horns are flat, and broader than in the true breed; they rise on a level with the plane of the face, and towards the summits gradually turn outwards, presenting the flat surface to the front. The centre of the face is white, bordered with black; this is derived from the domestic sire, and with this exception, the form and direction of the horns, and a beard on the chin, she is in all respects similar to the wild breed. The body is of a yellowish brown, with the tail black, and the dark dorsal stripe; the collar is wanting, (as is often the case with the wild one,) but the chest is dark, and the black markings of the legs are as well defined as in the Ægagrus, and the ears are short, pointed, and erect.

The winter colouring is darker, but in disposition the same, and the soft wool beneath the hairy coat is longer and more abundant than in the wild goat, and finer than that of the domestic one.

In November 1839, she admitted the domestic goat, and on the 30th April 1840, she produced two young males; the one was wholly black with white-spotted semi-pendent ears; white frontal star, and white muzzle.

This colouring was derived from the tame male.

The other was of a pale brown, with black face, black dorsal stripe, black tail, dark medial line, and the markings on the chest and forepart of the limbs, corresponding in all respects to the wild breed.

These kids were produced in a yard, where a wild ram

(*Ovis cycloceros,* Nob.) was also confined, and they narrowly escaped falling victims to his violence; they were then removed, and allowed to select their own retreat. This the mother did for them, by ascending a back-staircase, which was very dark, and led up to a retired lumber room, where empty casks, &c. were kept. From this retreat the mother descended two or three times a day to feed, but the young ones, although only possessing one-fourth of the original wild blood, were so shy and timid, that they never came down except during the short twilight of the evening, when all was still, and the yard nearly deserted ; they then gambolled about in the cool air, retreating again to their solitary den as morning or any intruder approached. The old one now became bolder than before, and sometimes posted herself at the top of the stairs, so as to dispute the passage, which if a person were unprovided with a stick, she usually did successfully.

The shyness of the kids was a strange feature in their disposition, as the young of domestic goats are fearless, and troublesomely tame even from their birth, while these, with but a fourth part of the blood of the original wild stock, were so timid, as to cower beneath the touch, and even at the presence of a beholder. Unlike the frolicsome tame kids, too, they preferred the solitude of their dark retreat, and gambolled together unseen, except by stealth, and the moment they were aware of the presence of an intruder, crouching down into a corner, and throwing timid and furtive glances around them.

Even when other kids were present, they kept apart together, and would not associate with them. This shyness continued until they were about six weeks old, when they became more familiar, but would never allow themselves to be handled. At about two months old, the horns began to protrude, and gradually the kids became bolder, and were turned with their mother into a flock of tame goats. As summer advanced, the brown kid became much darker, and the whole of its previous markings were obscured, or rather concealed, beneath the long hair that sprung up all over it.

The horns retain much of the character of those of the wild goat, but they gradually turn spirally outwards at the end, like the tame breed. At present they are rather more than a year old, and in perfect health, with a short black beard added to their other characters. Their horns are now as large as those of an old Cashmere goat of six or seven years old.

The half-bred female has since given kids twice ; the first time they were still-born, and were said to be the offspring of her own produce above described ; this I doubt, as her first kids were scarcely old enough, and besides, there were two large tame goats in the flock, who would undoubtedly have kept off the young ones. The other pair were produced when the tame bucks were no longer in the flock, and my own opinion is, that the kids which are alive and healthy, are the offspring of her previous produce, but of this I have no proof, and the goatherd says, they are not. This autumn, however, I shall probably be able to obtain a breed *inter se*, or to add farther evidence of the impossibility of their perpetuating their race ;* but whatever may be the result, I cannot agree in thinking, that the tame breeds of Persia and Afghanistan have descended from the Ægagrus, and as certainly not from the species which forms the subject of

* Since writing the above, a domestic goat has produced a fine healthy female kid, the offspring of the young hybrid bucks above mentioned. The kid has pendent ears and a few grey spots above, which are derived from the domestic female ; in other respects it resembles the wild stock, having a black dorsal stripe, black marking on the fore part of the fore legs, and being of yellowish brown colour.

It is at present strong and healthy, and I shall, I trust, be enabled ere long to settle the question as to whether the hybrids can breed *inter se*. The result I shall be happy to communicate.

the following article, and to which from the enormous horns with which nature has adorned its head, I have assigned the name of "*Capra Megaceros.*"

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## "*Markhore,*" or the "*Snake-Eater*" of the *Afghans.*— "*Wild Goat of Afghanistan.*"

### "CAPRA MEGACEROS," Hutton. Plate xx.

(Quere.—"The *Martichore*, or Man Destroyer," as mentioned by Cuvier from the Persian Mythology.*)

The "Markhore" is an inhabitant of the same hills of the foregoing species, but its range appears to be somewhat more limited. Numbers are said to be found in the Soolimaun ranges, and away to the northward of Cabool, but of its occurrence in Persia I could gain no tidings.

Of a female which lived in my possession at Candahar, the following are the measurements :—

Length of the face from the muzzle to the anterior base of the horns, 8¼ inches. From the base of the horns to the insertion of the tail, two feet eleven inches ; tail eight inches, making the total length from the muzzle to the end of the tail, four feet three and a quarter inches. Space between the anterior base of the horns, one and a half inch. Length of the horns eight and a quarter inches. Length of the ear six inches, and from the base of the horn to the articulation of the under-jaw, six inches. Height from the centre of the shoulders or withers, to the ground, two feet five and three quarter inches. Iris golden or reddish yellow.

The colour of this animal was of an uniform yellowish brown, the lower part of the leg from the knee, and hough,

* Jameson's Cuvier's Theory of the Earth, p. 70.

being very pale, nearly fading to white, and with a dark line along their anterior sides. Under and inner parts paler, belly whitish. The female possesses *no beard;* she has a broad and deep chest, stout limbs, and possesses altogether enormous muscular power, which is evinced in the tremendous and surprising leaps in which she frequently indulged. She was quite tame, having been captured young, and reared with a domestic flock. Her horns were spiral and erect, but were usually carried pointing obliquely backwards. There is no lachrymal sinus.

This animal is even more active than the preceding species. The female here described was confined in the same yard with the Ægagrus, and her chief amusement consisted in leaping over the wall, and making her escape to the roofs of the houses, where she leaped and gambolled about on the very narrowest ledges, with as much indifference to danger as if she had been on *terra firma.*

Often have I watched her walking along a place which barely yielded room for her feet, and at a height of nearly thirty feet from the ground, in the nervous apprehension of seeing her fall and fracture her limbs. The only way to bring her down from this *aerial* excursion, was by sending up one or two people to the roof, and driving her down the steps which led to the top. One day after a long hunt, in which she seemed obstinately bent on avoiding the steps, she was at length driven upon a narrow ledge of single tiles projecting from the top of one of the houses, which formed the side of the yard where she was confined. Every instant I expected to see the tiles give way and the animal precipitated to the ground, but she seemed herself to be perfectly aware of the insecurity of her position, and proceeded both slowly and cautiously, frequently kneeling down, and looking as if to calculate the distance she had to fall. At length she arrived at a spot immediately over a covered gateway, about eighteen feet below her, and taking one look around her, she coolly dropped from her station to the top of the gate, and from thence about twelve feet more to the ground. This was done without the least apparent exertion or inconvenience, and the animal walked away to feed without deigning to cast a glance at her pursuers, who were soon obliged to retrace their steps, and descend by the staircase. In leaping the wall, which was at least twelve feet high, she did not spring clear over it at a bound, but invariably aided herself by springing slantingly against the side-wall of the house, from whence, with a sudden and powerful stroke of the hinder legs, she threw herself to the top, and then dropped over. I was obliged to raise the wall with a line of hurdles on which she could not obtain footing, before I could keep her within bounds. Her usual place for reposing was upon the top of the gate-way, which she gained in the same manner. Frequently when she had made her escape unperceived, she has been found feasting in a granary up one flight of stairs, and the moment she heard footsteps approaching, she would spring through the window to the ground, and with a desperate rush succeeded in gaining the summit of the wall, and then quietly dropping into the enclosure, as if nothing had happened, she walked away to feed. She was perfectly tame, and would come and lick my hands in search of pieces of bread, which I sometimes gave her.

In November 1839, she admitted a domestic goat, and in the middle of April following dropped a kid still-born, and after lingering on for two or three days she died also. Her confinement was premature, and she had received some internal injury from a furious blow administered by a wild ram which was at liberty in the same enclosure. Her death was a great disappointment to me, for I had wished to transport her to England; fate however seemed against me, for I not only lost her, but the wild sheep and Ægagrus also. Of the male, I have only been able to procure the dried skins and skulls.

The horns of this noble species are approximate at base, and rise from the crest of the skull on a level with the plane of the face; they diverge gradually from the base so as to form the capital letter V. They are spirally twisted, but differ much in the closeness of the volutions, some turning round a straight and direct axis from the base to the apex, others taking a wider or more circular spiral sweep.

I have one horn sawed off by the head, which was found at Quettah, and presented to me by Col. Stacy, the measurement of which is in direct length three feet six inches, or measured along the volutions three feet eight inches; the tip of this is wanting, and the natives say that many exceed it in length. The basal circumference is ten and one quarter inches, and from the markings of increase, it is supposed to have been eleven years old.

Another specimen, which *is said to be* a young one, measures in direct length two feet three and half inches, and nineteen and half inches between the tips, or measured spirally, two feet seven inches; basal circumference ten inches; age eight years, from the markings. It is said that when full grown, if the horns are placed with their apices on the ground, they give room enough for a tall man to pass through on his hands and knees.

The colours of the male are very similar to those of the female already noticed, but he possesses a long black beard, which in her is wanting; the colour of the upper parts is a yellowish brown, yielding to greyish with age. Along the dorsal ridge is a narrow pale stripe, which is caused by the parting of the hair, but dies out before it reaches the tail; the forepart of the limbs are deep brown, of a chesnut hue, and the tail is of the same colour; the belly white. The hair on the back of the neck is long. The tail is about six inches long.

In Elphinstone's Account of Cabul, he mentions an animal "of the deer species, which he thinks is called Pauzen in Persian." "It is remarkable," he says, "for the size of its horns, and for the strong, but not disagreeable smell of its body. The vulgar believe that it lives on snakes; and a hard green substance, about the size of a Windsor bean, is found in some part of it, which is reckoned an infallible cure for the bite of a serpent."*

The term "*Pauzen*," is evidently the "*Paseng*," or "*Pasan*" of authors, and belongs, as we have shewn in the preceding article, to the Ægagrus which Kampfer noticed under the name of bezoar-bearing goats.† The Snake-eater of the Afghans is the species under consideration, and is a true goat, the strong odour above alluded to, being one of the characters of the genus, and is retained by the skins and horns for years after the animal is killed.

The name of "Markhore," "or Snake-eater," is given to the animal by the Afghans from an idea, that it has an instinctive feeling which prompts it to seek for and devour snakes. Hence it is believed also, that if a man be bitten by a snake, the wound may speedily be healed, and the poison neutralised by eating of the flesh of the Markhore. The hunters also declare, that the fat of the stomach is so excessively nutritious, that it enables them to pursue the chase with greater vigour than any other food, and even after a meal of it, to endure a fast of several days.

The "bezoar" is said to be often found in the stomach of this animal, and is thought to be efficacious in drawing out the poison from a snake bite, and it is applied for this purpose to the wounded part.

No doubt the idea of its efficacy has arisen, not so much from its being found to possess any actual virtue, as from its occurring in the stomach of an animal supposed to be destructive to the serpent tribe.

* Account of the Kingdom of Cabul, vol. i. p. 188.

† Griffith's Cuvier, Mam. vol. iv. p. 303.

These stones are probably formed in a similar manner to the gravel stones in the human subject, and as the latter is a prevalent disease at Candahar, it may perhaps be traced to some impurity, or peculiar mineral quality of the waters of Afghanistan.

The bezoar occurs in the Ægagrus and Markhore, the calculis in the human bladder, and I possess several specimens of bezoar secretions of lime, about the size of a pigeon's egg, which were cut out of tumours in the throat of the common ass. It is said to be a common disease among the asses of Bokhara. The stone is hard and compact internally, exhibiting often concentric layers; on the outside it is rough and coarsely granulated, its colour is white. These are used as medicine by native practitioners, and given internally.

"The most probable etymology of the word bezoar is from the Persian *Pâd-zahr*, *i. e.* "expelling poison, the expeller of poison:" the stone bears this and other designations of similar import in Persian: *e. g. Bâd-zahr*, which seems to be a corruption of *Pâd-zahr*. The word *Pâd* means "relieving, curing, removing (disease), and *garh* is poison."*

This etymology would appear to be particularly applicable, since the stone is not only thought to be efficacious in rendering the poison innocuous, but is also extracted from the intestines of an animal, which is supposed to wage unceasing warfare against the serpent tribe.

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P. S.—Since writing the above, the 42d No. of the Annals and Magazine of Natural History has reached me, and I find therein some observations which need farther notice.

In a paper by Mr. Blyth, entitled "*An amended list of the species of the Genus Ovis,*" read before the Zoological

* Penny Cyclopedia, article Bezoar.

Society on the 28th July, mention is made of the Jhara of Mr. Hodgson, which is said to be " mostly known as the *Jehr, Jhaar,* or *Jhar* to the westward of Nepaul, a name applied by Mr. Hodgson to a very different animal, which is usually called *Surow,* or *Surrow.*" There is evidently a confusing of two different animals here, namely the *Jehr* which is a *Goat,* and the *Jhar* which is an *Antelope.* The *Jehr* of the mountains westward of Nepal, Mr. Blyth should have recognised as the *Jharal* or *Capra Jharal* vel Quadrimammis of Nepaul; and the *Jhaar* or *Jhar* of Nepaul as the *Antelope Jhar* of Mr. Hodgson, known at Mussooree as the " *Surrow,*" and at Simla as the " *Eymoo.*"

Mention is likewise made of the " *Markbur* of Cabul," an animal which Mr. Blyth considers, as " a feral common goat," founding his opinion upon the spirature of the horns, which in all the domestic races, as in the *Markbur,* has an *inward tendency,* at least at the tips ; while " neither the *Capra Ægagrus,* nor any of the numerous distinct species of wild *Capra* known to Mr. Blyth, exhibit this spirature in the least degree.*

The " *Markbur*" here spoken of, is doubtless the " *Markhore,* or Snake-eater" of the Afghans, which I am now informed occurs abundantly in the mountains of Cashmir.

I cannot however agree with Mr. Blyth in considering the animal as " a feral common goat," especially upon such negative evidence as is afforded by the inward spiral twist of the horns, since it is said " *to be alike in no two specimens,*" and therefore evidently cannot be depended upon as a character. Moreover, although the horns of the *Capra Ægagrus* are not spirally turned, yet I possess three out of *five* specimens, whose *tips are decidedly and strongly turned inwards,* a character which is moreover constant in the *Capra Jharal* of Nepaul, and in the *Capra Jemlahica* likewise.

* Magazine of Natural History, No. 42, p. 155.

The Ægagrus is here ranked as a species distinct from the domestic races, although it is still an undecided point whether the latter have sprung from the former or not.

There is likewise a note on the Himalayan Ibex or Skeen, which Mr. Blyth has pronounced to be distinct from the European species. Of this animal I now possess the horns and a skin, the markings of which correspond very exactly with those of C. Ibex of Europe; it is of a brownish grey colour, with dorsal stripe and black band on the shoulders, with the anterior part of the limbs dark brown or black, and a black tail and beard. The tips of the horns in this decidedly wild species are likewise *turned inwards* in the two specimens in my possession. The inward spiral turn of the horns in the *Markbur* would seem therefore to be a very poor, or indeed no proof, of the animal's descent from the domestic stock; for I have here cited no less than *four* wild species, which have either constantly or occasionally the tips of the horns turned inwards, while I possess domestic goats, whose spiral horns turn strongly outwards at the apex.

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## *Remarks on the Calcutta Delta. By* CAPT. HUTTON.

*To the Editor of the Calcutta Journal of Natural History.*

MY DEAR SIR,

Looking upon the "Calcutta Journal of Natural History," as the channel through which the fair and impartial discussion of scientific subjects is to be carried on, I make no apology for troubling you with a few remarks on your summary of the causes, and changes which have been instrumental to the present condition of that portion of the Gangetic Delta, through which the late boring experiments in Fort William have been made.

I trust, however, that no difference of opinion, as to the correctness of the theories we respectively follow, will give rise to the expression or exhibition of other feelings, than those which should ever characterise the discussions of such subjects, and that we may ever bear in mind, however keen we may be in our endeavours to gather converts to our creeds, that truth, and truth alone, is the end for which we labour.

It would appear from the remarks on the deposits of the Calcutta Basin contained in the 3rd No. of the Journal, that about 3333 years ago, the conglomerate now found at four hundred and eighty feet below the surface was deposited by the rivers, which flowed down from high mountains, situated about thirty miles from Calcutta, at a time when the seaward face was as far north as one hundred and twenty-five miles from Fort William.

The untenability of such an argument will I think be presently made apparent; and perhaps furnish proof, of which every day gives fresh examples, of the difficulties, those must ever experience in accounting for geological changes, who rejecting or disregarding the historical facts of the Scriptures, proceed to found their theories solely upon the phenomena and appearances of the strata of the earth.*

Thus, it is said, that " the fossils of the Jumna, of the valley of the Nerbudda, of the sub-Himalayan range of the Irawaddi, have been identified with each other, and it appears probable, that to *this series may also be added the fossils of the Delta.*"†

Now it is an acknowledged and indisputable fact, that the fossils of the Sub-Himalaya are *diluvial,* or the produce of the Mosaic deluge, which by the common consent of geologists, was *the last* of the great changes that have happened upon the earth.‡

It will follow, therefore, as matter of course, if the conglomerate of the Delta be likewise diluvial, that as things which are equal to the same, are equal to one another, it must have been deposited by the deluge also. The identity likewise of the strata " extending from about four hundred and fifty to four hundred and eighty feet below the surface of Lower Bengal," with the succession of strata at the base of the Himalaya, would, as Lieut. Smith justly observes, " lead us to believe, that they owe their origin to the same mighty ocean, which reached to the foot of the mountains."§

But we are informed, that the conglomerate gives proof of having been deposited by rivers, which flowed from high mountains within thirty miles of Calcutta.

* There cannot be one rule for geological investigation and another for botanical; science must be inductive and founded on observation. The Scriptures, according to Dr. Buckland, refer merely to the origin of things as far as related to man himself.—Ed.

† Calcutta Journal Natural History, No. 3, p. 339.

‡ We are not aware of this point having been settled in regard to the Sub-Himalayan fossils.—Ed.

§ Ibid. p. 339.

Now if this be true, and the deluge was *the last catastrophe*, those mountains *must have existed within the historical era of man*, since a period of no more than 3333 years are assigned for the production of the conglomerate, which contains fragments of the diluvial strata.

It will therefore necessarily follow, as no convulsion equal to the removal of *primary mountains* has occurred since the deluge, or within the historical period, that those *imaginary mountains ought to be in existence still!** Yet we do not find such to be the fact.

Nor moreover does it appear very clear, where these mountains could have been situated, or how rivers equal to the transport of primary fragments, to a distance of thirty miles, could have flowed from them, since we are told that at this time, *the seaward face was one hundred and twenty-five miles north of Calcutta, or about half-way between Moorshedabad and Malda,* while the mountains are said to have been *only thirty miles from it.*† They must therefore have formed *rocky islands in the midst of the ocean*, and consequently could not have furnished rivers equal to the transport of the debris, whose deposition presupposes an inclination, such as that of the present deposits at the head of the Delta.‡

The idea, that the primary fragments of which the conglomerate is composed, were brought from *mountains, at no greater distance from Calcutta than thirty miles*, is based altogether on the data furnished by the Bramaputra and Assam rivers. But it appears to be altogether an inadmissible assumption to state, that because those rivers have not now the power of transporting pebbles beyond twenty-five or thirty miles, that therefore they never did possess it, or that the river or rivers which were instrumental to the formation of the conglomerate could have had no greater power of transport than these have now; for if the fall, and

* As we hear frequently, on the best authority, of islands rising up from the depths of the ocean in situations where soundings were unknown before, of mountains disappearing, of entire provinces sinking below, and again rising above the sea, we should indeed be blind to the operations of nature, and the various causes of changes in the surface of the earth, were we to ascribe all their effects to the Mosaic deluge. We may here refer to the earthquake at Chittagong, 1762, and to that of Cutch 1819. During the earthquake 1726, we have it on evidence standing recorded in the Philosophical Transactions, that entire mountains, (whether primitive or not, is nothing to the purpose,) were removed, and not only levelled to the surface, but that they sank considerably below it, and that the sea rushed in and occupied the place on which they stood. At Cutch, we have it equally on indisputable testimony that a large tract of the Run of Cutch sank down beneath the sea, another tract at the same time suddenly rising up; for the particulars of which, we refer to the Geological Transactions.—Ed.

† The sea may have been hemmed in between mountains, so as to form a narrow bay.—Ed.

‡ Calcutta Journal of Natural History, p. 453, No. 3.

consequent velocity of those former rivers exceeded that of the Bramaputra and others, so would their power of transport also.*

But it appears never to have entered into the calculation, that the fall of the present rivers may have been materially altered by the very debris with which they were charged, and from which have gradually risen to light the vast tracts of level lands our continent now possesses. Yet this is a most important fact, and one that must have exercised great influence on the rapidity, and consequently on the power, of transport of the rivers themselves; thus although at present they cannot carry down gravel to a greater distance than thirty miles, time may have been, when their force and powers could have formed a conglomerate at many miles farther down. I do not assert, that they have done so, or that the conglomerate under consideration has been so formed, but I point simply to the possibilities, that may once have existed.

It appears that Lieut. Smith is disposed to class the conglomerate with the diluvial detritus of the Sub-Himalayan range, and other parts of India. It may be asked, however, whether it is supposed to have been of simultaneous deposition with the *now inclined* strata of the Sub-Himalaya, and forms *a continuation of them:* or whether it may not rather be composed of fragments of the primary rocks, (to the uprise of which the others owe their inclination), mixed with the sands and fossils derived from the diluvial beds themselves, and which fragments have been carried down by the rivers, which then first commenced their courses to the sea, when the Himalaya emerged from beneath it to form dry land, and which period, as I have elsewhere shewn from geological reasoning, was the subsidence of the Mosaic deluge.† If the former hypothesis be correct, it would follow that the fossiliferous conglomerate should be found to extend in a substratum from Fort William to the Himalaya, and that it is perhaps *connected* with the Nerbudda and Jumna fossil sites. In this case it should be allowed, according to geological reasoning in similar cases, that *the strata,* containing a greater proportion of the exuvia of animals peculiar to dry land, *were formed on dry land,* and consequently a large portion of India would be shewn to have constituted the antideluvian earth,

* Captain Hutton appears to overlook here one of the clearest results to be deduced from the disposition and nature of the strata beneath Fort William, namely, that of a gradually sinking of the surface; for in no other way can we account for the drift wood, carbonaceous and peat beds at various depths, from 10 to 395 feet, than that they had been deposited on the surface, and afterwards carried down below the level of the sea to their present position, and buried beneath newer deposits.—Ed.

† See Journal of the Asiatic Society, No. 111, p. 228—229.

although now overlaid throughout a great extent by the alluvium which the numerous rivers have swept down from the higher lands, and disposed above it.

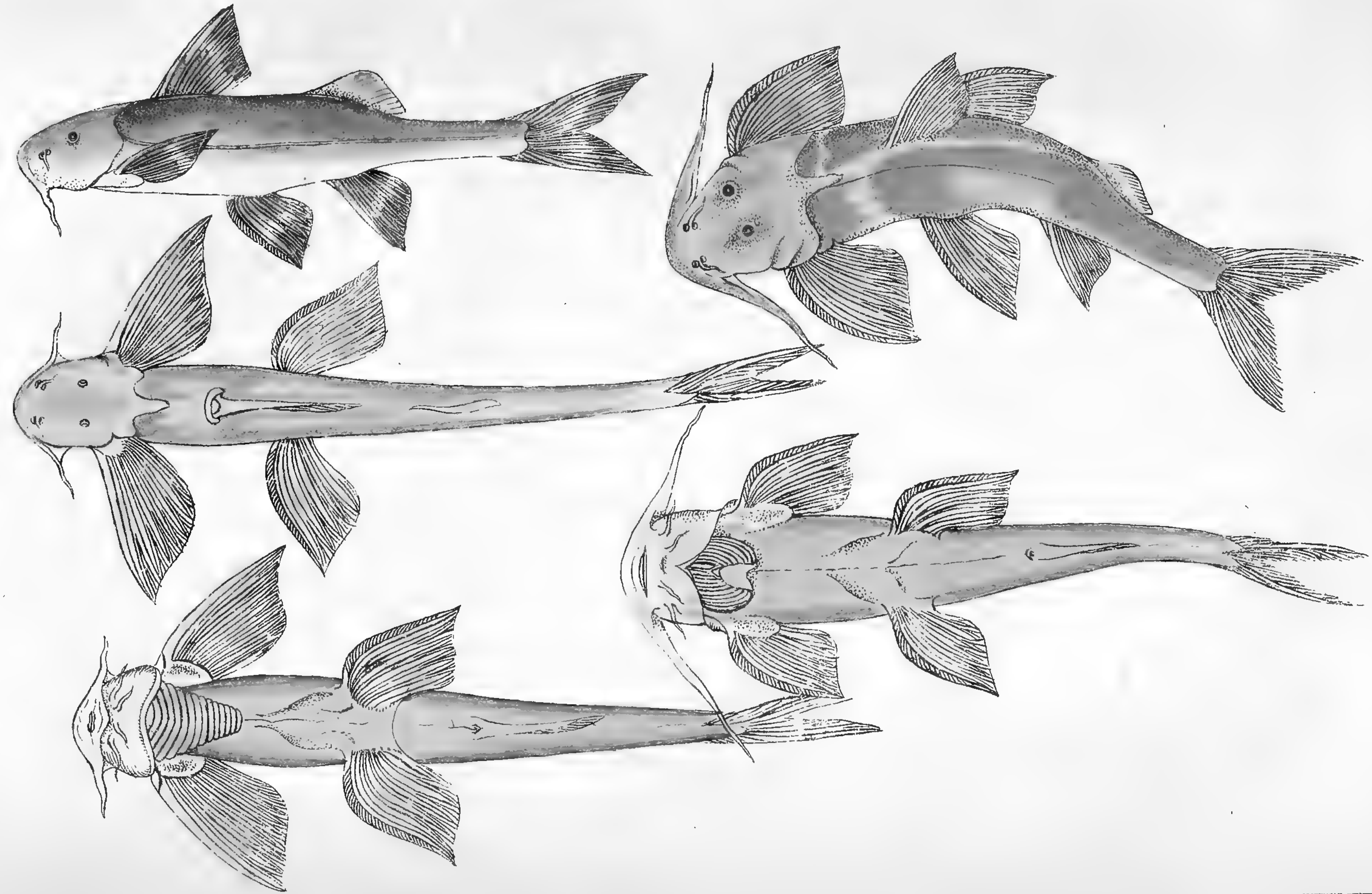
If this be true, it will be at once apparent that the fall of the rivers from the present mountains towards the sea would have been far greater before the deposition of such alluvium than now, for the accumulation of strata, by gradually filling up the slope and forming more level lands, would tend materially to check the velocity and power of transport, until it became reduced to what we find it in the present time.

If, on the other hand, and as in the absence of more positive data, I am inclined to think most probable, the Delta conglomerate was formed of fragments torn from the uprising primary rocks in various parts of India, at the time when the deluge was subsiding,—that conglomerate will have been deposited by *the retiring waters of the ocean, when it was forced back by the uprise of the land;* and in it, and probably in strata deposited immediately upon it, may be imbedded also some traces of the fossils and detritus of the *true diluvium*, brought down by the waves which washed over it as it first emerged to clay, and also by the present rivers, which *then first began* to flow towards the sea.

To the same causes may also probably be referred the distribution of the Nerbudda, Jumna, and Irawaddi fossils, and thus while the inclined strata of the sub-Himalayan range, represent truly the diluvial beds, which were accumulated *during the rise and prevalence* of the deluge, the dispersed fossils of the other localities may be referred, in accordance with Dr. Buckland's opinion, to a "*more modern*" period, namely, to the subsiding of that deluge, which in its retirement from the land, dispersed them abroad, by its currents, from the places where they had been originally deposited. These then, in contradistinction to the stratified beds of the true diluvium, may be properly termed, diluvial detritus.

With regard to the lapse of time required to form a given portion of the Gangetic Delta, we are, I conceive, altogether left without any certain data; for so much must always depend upon the depth to be filled up, and the quantity of detritus brought down, that the periods would vary greatly in duration.

Thus the failure or mildness of the Monsoon for several, or even for a few, seasons, would materially retard the formation of new land, by limiting the supplies of transported matter; while afterwards, in a period of equal duration, but in which the rains had been heavy, and detritus abundant, a larger share of deposits would be recovered from the sea. If now during both these terms, observations should be made



by different individuals, the first would be inclined to assign long lapses of time for the formation of the Delta; while the other would, from his collected data, argue precisely the reverse.

"Could we know the mean or extreme rate of production of stratified deposits at the present day, this would enable us to conjecture the lengths of some geological periods, and with double hazard refer others to this conjectural scale; but even this unsatisfactory estimate would be liable to the further and fatal error of not knowing the ratio of the forces in the different periods. *To assume this ratio,* is only to augment in a still higher degree the amount of improbability."*

It is only, therefore, from facts stored up through a considerable number of years, that we can ever hope to obtain anything like an approximation to the truth; yet this very country in which the opportunities for studying nature in her grandest scale are most abundant, is unfortunately likewise that, in which the least encouragement has been given to such researches.

One thing however is certain, which is, that as the Deluge is admitted to have been the last of the general changes on the Earth, it must follow as a matter of necessity, that *all the alluvial lands of the Continent of India, and I may add likewise of every quarter of the globe, have been deposited since that epoch;* or in other words, *within the* so called *historical era of man, comprising a period of little more than* 4000 *years, since the diluvial strata emerged from beneath the waves.*

"I am aware," says Cuvier, "that some naturalists lay great stress upon the thousands of ages which they call into existence by a dash of the pen;" but the researches of that eminent man all tended to shew, that the present order of things could not aspire to greater antiquity than the Scripture assigns to them.

"It must in fact," he says, "have been since this last retreat of the waters that our present steep declivities have begun to disintegrate, and to form heaps of debris at their bases; that our present rivers have begun to flow, and to deposit their alluvial matters; that our present vegetation has begun to extend itself, and to produce soil; that our present cliffs have begun to be corroded by the sea; that our present downs have begun to be blown up by the wind; just as it must have been since this same epoch, that colonies of men have begun, for the first or second time, to spread themselves and to form establishments in places fitted by nature for their reception."†

* Phillip's Treatise on Geology, Encyc. Brit. page 294.

† Jameson's Cuvier's Theory of the Earth.

Now in the article under consideration, a period of 3333 years has been assigned, as an approximation for the formation of that portion of the Delta extending from its present limits, *to the point* situated at 215 miles North of Calcutta, *which is supposed to have formed the* " *seaward face,*" at the time when the lower conglomerate was deposited. Thus leaving only about 1000 years of the historical period to account for the accumulation of all beyond.

If however, I have assigned the true cause for its formation, it will be seen that the river deposits, which are estimated to amount in bulk to six miles per annum, would have extended themselves over a far wider area than that which has been assigned to them, for the conglomerate which is estimated at sixty feet in thickness is a deposit, not of the rivers, but of the retiring sea, consequently sediments to the amount of sixty feet in depth extending over the whole area below the point assumed for the " seaward face," would have been deposited elsewhere.

But however interesting it may be to note the actual accumulations of the present time, we are, as I have already stated, aware that none can claim a greater antiquity than about 4000 years ; and thus the conjecture of a modern geologist, that the Bramaputra and Ganges have become united within the historical period,* amounts to *a mere truism*, for if Cuvier shews us, the present rivers *have only begun to flow* and to deposit alluvial matter since the last order of things commenced, and that commencement is to date from the last retreat of the waters, the above-named rivers could absolutely have become united in *no other period* than the historical one, from the simple fact, that *from that era, and from that only, can they date their origin.*

That the power which streams of the present day possess of transporting detritus is less than they formerly possessed, must be apparent from the reflection that the very plains accumulated by their agency, must naturally raise their beds, and so check their currents, so that although now the Bramaputra and the Assam rivers can only carry pebbles to a distance of 25 or 30 miles from the hills, it is very possible, nay even more than probable, that they have once carried them much further.

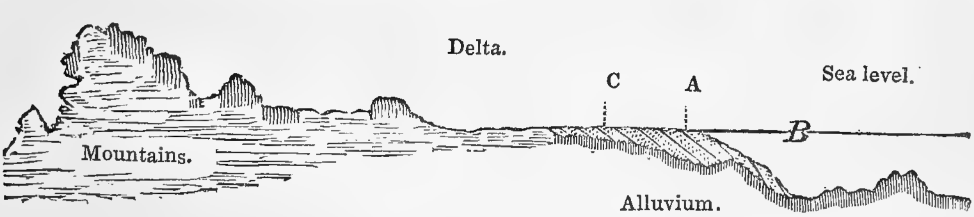
" The Adige and the Po, are at the present day higher than the whole tract of land that lies between them ; and it is only by opening new channels for them in the lower grounds, which they have formerly deposited, that the diasters which they now threaten, may be averted. The same causes have produced the same effects along the banks of the

* Calcutta Journal of Natural History, No. 3, page 454.

Rhine and the Meuse; and thus the richest districts of Holland have continually the frightful view of their rivers held up by embankments, at a height of from 20 to 30 feet above the level of the land."* This rising is undoubtedly accelerated in these instances by the practice of embanking the rivers, but " M. Weibeking, the director of bridges and highway in the kingdom of Bavaria, shews that the property of raising the level of their beds is common in a greater or less degree to all rivers."†

It is evident then that a consideration of the causes now in operation will not always furnish us with the surest means of calculating the time occupied in forming the dry land of bygone years, since it becomes apparent on reflection, that not only have great fluctuations in the quantity of detritus, and force of rivers taken place, but also that the farther the Delta is carried onwards into the sea, the longer will be the time required to cause a new portion to rise above the waters, and this simply from the fact, that the farther we recede from the mountainous tracts of any country, the deeper becomes the Ocean, and consequently the longer time will the alluvium be in accumulating sufficiently to appear above the surface.

Thus, if we calculate the age of our Indian alluvial continents, by the time we find to elapse in forming a square mile above the sea, in the present day, we shall probably err considerably, for it will be evident at once, from the annexed figure, that the alluvial land at A. would take a longer time to appear above the water B. than when it was forming in the neighbourhood of C.




Supposing therefore that the supplies of detritus from the hills was at all times equal, the land would have formed more rapidly in former days than at present, because the depth to be filled up was not so great as now, and if this be true, and land did actually accumulate more quickly in former times, it is evident that no such lapse of years would be required as modern theorists assume to be the case.

* Jameson's, Cuvier's Theory of the Earth.

† Ibid.

But Cuvier declares, and he is no mean authority in such matters, "that these formations must have increased still more rapidly at first, when the mountains furnished more materials to the rivers;"* so that we should in former times not only have had *larger supplies* of detritus, but *a less depth* to deposit it on, and it is therefore obvious, that no great lapse of ages would be required for the formation of our existing strata, even if unsupported by the admitted fact, that the present order of things cannot be older than about 4000 years.

Nor can I see in the strata of the Delta anything to warrant the conclusion, that long periods of repose and action have been alternately instrumental to the formation of those deposits, or that risings and sinkings of the mass have occurred. Certainly the alternations of thick beds of sand, with clays and calcareous seams can never authorise the supposition, for we have examples in the coal formation of our native land to shew us, that it is very possible for calcareous strata to alternate with sandstones, and yet that they shall have been deposited in an estuary, without the aid of repeated revolutions of salt and fresh waters, as was once the current belief.

On this head I need only refer to the magnificent work of Mr. Murchison on the Silurian System, extracts from which have appeared in this Journal.

It is now found therefore, that the opinion which long prevailed among geologists, that the occurrence of alternate beds of marine and fresh-water strata, each imbedding its own peculiar exuviæ, was proof that long periods had elapsed during which the sea and fresh-waters alternately prevailed, is no longer tenable, for it has been ably shewn by one of the first authorities of the day, that such alternations prove nothing more than the influx of some mighty river charged with the produce of the land, into some estuary of the sea; and consequently that while the Oceanic waters were depositing those limestones which are termed marine, the rivers were depositing among them other strata which are proper to fresh-waters; thus they are proved to be of contemporaneous origin although alternating, and a most important blow is thus struck at the progressive system, for the animals of the one formation which were supposed to indicate a period when they alone were living, are found to be contemporaneous with the forms peculiar to the other.

Such enlightened researches as those of Mr. Murchison must happily tend, ere long, to shake to their foundation the false and pernicious

* Jameson's, Cuvier's Theory of the Earth.

systems, which call to their aid the assistance of an indefinite lapse of ages, wherewith to account for the various revolutions which they assume in spite of revelation, to have been the agents by which our strata were produced.

Now the operations which were instrumental in producing the strata of the coal measures, are simply repeated at the mouths of the Ganges, although perhaps in a more limited degree than in those bygone days, when nature appears to have had more ample stores, and to have acted on a grander scale. Thus we have still a broad and rapid river charged with its own and with the produce of the land, pouring its turbid waters into the gulf, which it discolours for a distance of sixty miles from the shore. How know we then that after ages may not find repeated there, effects similar to those which were produced in former years during the accumulation of our secondary strata ?

In the formation of Deltas, if within the Tropics, the strata of which they are composed must necessarily be subject to the greatest possible degree of variation, both in respect to their materials and thickness, influenced as they are by the changing seasons, and the nature of the detritus and sediments brought down.

Thus in the season when the monsoon is raging, and the rivers are full and overflowing, their force and velocity will enable them to carry down the sands and silts in most abundance, and a deposit of sand or sandstone of more or less coarseness is the ultimate result.

But we must remember likewise that besides the sands, the waters would be charged with muddy sediments of finer and lighter particles both in suspension and solution, which, when the monsoon abated and the waters became more tranquil, would be deposited in a clayey stratum above the sands, whose greater specific gravity had caused them to sink first.

Nor is this a mere vague hypothesis put forth at random in support of a preconceived theory, but is based on the results of Mr. Everest's experiments on the quantity of earthy matter brought down by the Ganges river. Our whole data therefore stands thus :—

| Season. | Velocity ft. per hour. | Cubic feet discharged per second. | |
|---|---|---|---|
| Rains, ...... ...... ...... 4 months, ... | 494,208 | 23,800 | |
| Winter, ...... ...... ...... 5 months, ... | 71,200 | 7,435 | |
| Hot weather, ...... ...... 3 months, ... | 36,330 | 4,445 | |

34 grains per wine quart was found to be the average for the rains.

Now as a wine quart of water weighs 14545 grains, we have about $\frac{1}{428}$th part of solid matter by weight. But as the specific gravity of this cannot be stated at less than 2, we have $\frac{1}{856}$th part in bulk for the solid matter discharged, or 577 cubic feet per second. This gives a total of 6,082,041,600 cubic feet for the discharge in the 122 days of the rains :—7.8 grains per nine quarts was the weight determined for the five winter months or $\frac{1}{1838}$th part in weight, and $\frac{1}{3676}$th part in bulk, which gives 19 cubic feet per second, or a total of 247,881,600 cubic feet for the whole 151 days of that period : 3.8 grains per wine quart was the weight allowed for the three hot months, which gives a $\frac{1}{3827}$th part by weight, and a $\frac{1}{7654}$th part by bulk, or about 408 cubic feet per second for the discharge of solid matter, and a total of 38,154,240 cubic feet for the discharge during the 92 days. The total annual discharge then would be 6,368,077,440 cubic feet."* Now it is easily conceivable, since there is such a difference in the volume and velocity of the river during the three periods here pointed out, that the nature of their deposits must vary considerably likewise; for since we perceive a difference of 19,355 feet per hour in the velocity of the stream between the rainy and summer months, it is at once apparent that the one period would have the power of transporting much heavier and greater quantities of matter than the other, and therefore of giving origin to strata differing from each other both in composition and thickness.

It would appear, moreover, that the admixture of the marine fluid with the turbid waters of rivers, has always had a tendency to produce calcareous deposits enclosing the exuviæ of fresh waters. These are called "lacustrine limestones," from their containing lacustrine exuviæ, but it does not appear to have been taken into consideration, that some cause is necessary to be assigned for the formation of the limestone, since all our experience tends to shew, that the proper deposits of rivers and other fresh waters are sands and clays ; sometimes it is true calcareous matter is intermixed, but in such cases the probabilities are in favour of its having been imbibed by the waters in their passage over calcareous rocks.

Besides, the occurrence of such genera as Melania, Paludina, Planorbis, Unio, Cyclas, and others is no proof whatever of the *lacustrine origin* of those limestones which contain them, for in tropical countries such as those in which the secondaries are thought from their fossils to have

* Journal of the Asiatic Society, vol. i. p. 241.

been deposited, all the genera here enumerated are as common to the rivers and nullahs as to lakes. This remark applies particularly to India, where the rivers are found to carry down the exuviæ of species inhabiting them, such as planorbis indicus, nanus, compressus bengalensis, premorsa, melanostoma, &c. Unio marginalis, U. olivaceus, and one or two Corbiculæ, and others mixed with the exuviæ of numerous species peculiar to the land, and some of these brought down from almost incredible distances; for on the banks of the Indus at Roree, I found a dead specimen of a Pupa, as yet only known to inhabit the Himalaya. From these facts it will be seen, that the probabilities are still more in favour of the correctness of Mr. Murchison's views, when he assigns these formations to estuary deposits.

Such lacustrine limestones too, in most cases are found to be impure, and to want that fineness of grain and crystallisation, which characterises the true marine limestones.

The deposition of calcareous matter therefore by the rivers, which flow into estuaries, may be occasioned probably by some chemical combination between the waters of the sea, and the soil-charged waters of the land, and if this be true, then may we reasonably account for the deposition of three distinct strata in the deposits of the Delta, in the short time occupied by the prevalence and fall of the monsoon; namely, the sands, the clays, and the calcareous lacustrine clay. Moreover, it would appear, that the deposition, or rather *precipitation* of lime, took place from the waters of the estuary itself, caused by the chemical commingling of the two fluids; for so long as the river preserves itself unmixed, the deposits along its course are simply those of sands and clays, and not until it has entered the estuary, are the calcareous strata formed.

From the period of these three deposits till the ensuing monsoon, a longer time would be allowed for the formation of other strata, which, as we have seen from Mr. Everest's observations, would vary also with the varying volume and velocity of the streams according to the seasons. The sluggish stream of the winter months, and the rapid rising and falling of the river as the spring set in and thawed the mountain snows, would all more or less influence the nature and extent of the deposits in the Delta.

Nor must we overlook the fact, that as those strata were deposited at the mouth of a large river debouching into the sea, so they would be subjected to the action of the waves, by which other deposits of sands differing in quality from those of the river, would be heaped upon them, as the volume and force of the river decreased after the monsoon, or as an

3 Z

occasional storm might direct the ocean landward.* Besides which, we may take into consideration the effects which would be produced by the constancy of the S. W. monsoon, during a portion of the very seasons when the rivers have the least power ; by its agency the sea would advance upon those tracts which the river had gradually contracted from, until the returning flood season should again propel the fresh waters far onward into the estuary.

Nor should the occurrence of peat and carbonaceous matter in such situations at all surprise us, for the vegetable productions of the land, especially the tamarisk, (Tamarix Indica,) are carried down in large quantities in some seasons, while at others, they are nearly, if not altogether, wanting. It would naturally happen besides, in an ever-shifting scene like that of the Sunderbuns, where islands are formed in one year, to be swept away, or to have their vegetation overlaid by new soils in the next, that the alternations of their seams of carbonaceous matter would be frequent, *although often local,* and we must bear in mind, that what is at present occurring in those quarters has once perhaps, also happened in the tract on which Calcutta now stands.

It is argued, that " the series of layers, twelve feet deep, consisting of calcareous clay and decayed wood, could not have been deposited at any depth beneath waters;" and therefore to account for their occurring so far below the surface, they are supposed to have " *sunk down bodily to their depth.*" The proofs of this sinking, however, if based on no better data than are here given, are far from being conclusive or even satisfactory, for as it is an established fact that large rivers throw up, " *along the sides of their mouths,*"† the detritus which they carry down, so it becomes more than probable that the " *driftwood*" here alluded to, was so thrown up and accumulated, and covered by " the stratum of calcareous or lacustrine clay, containing fragments of a very soft friable shell," which owed its origin, according to the hypothesis above hazarded, to the admixture of the marine fluid with the soil-charged waters of the river precisely in such situation, namely, *at the mouth or embouchure of the river ;* and these are again succeeded by sixty feet of sands, which may have been thrown over them *by the sea, from whose waters* was derived the calcareous matters by which the lower portion is cemented together, (rather than from the argillaceous bed *on which* it

* See *passim* Account of Storms and Inundations in Cuttack, 1834.

† If Captain Hutton will refer to Lieutenant Smith's section, he will find the beds in question are some of them 395 feet below the level of the sea, and that they consequently cannot have been thrown up, however they may have been carried down.—Ed.

*rests ;)** while the upper loose portion would indicate that the volume of the river had increased by the arrival of the monsoon or heavy rains, which enabled it to dispose its silts "intermixed with fragments of quartz, felspar, and granite, twenty five-feet deep," which it is truly remarked, "indicate a more rapid current entering the basin."

After this it would appear "that a season of repose" occurred, in which was deposited "a thick stratum of fine ferruginous sand intermixed with clay," and subsequently, "the currents again became disturbed and so continued, while a coarse quartzose conglomerate, ten feet in depth, took place;" this too, "is followed by a bed of fine calcareous clay, five feet in thickness, and corresponding in its characters with the lower calcareous clay which is supposed to have been a lacustrine deposit."

These three deposits in my opinion indicate nothing more than the simple fact, that a lapse of time followed the monsoon, during which, from the usual decreased force of the river, the sea again returned to deposit the fine ferruginous sand mixed with the clays more properly the produce of the river, with which its waves were commingling, until the return of another monsoon or a violent inland storm caused the river to deposit† "the coarse quartzose conglomerate," followed again by the calcareous lacustrine clays as its force abated, and the sea resumed its former chemical action. If to these causes we add the probability, that during the deposition of the earlier strata, some mountain lakes had burst through their barriers and escaped, we shall derive an additional agent in producing the coarser materials of the deposits.

I do not attempt to point out, more particularly how the strata beneath Fort William have been accumulated, because I have had no opportunities of inspecting them; nor do I think it necessary to do so, since if the *causes* I have assigned are thought sufficient or probable,

* It is suggested that the *superior sandy stratum* has been cemented by calcareous matter derived from the *underlying stratum* of calcareous clay; this however would appear to be founded in error, for had the calcareous bed *rested upon* the sandstone stratum, it might have been reasonably argued that the calcareous matter with which the latter is cemented, was derived from the former *by infiltration*, but as it lies *below the sand*, the cementing of the latter must be due to other causes, as the solution of lime would not have *ascended*.

*Note by the Editor.*—We have had numerous opportunities of seeing sand consolidated in this manner by the infiltration of water containing oxide of iron till it reaches a subjacent impervious bed, from thence it consolidates the superincumbeut sands from below upwards. Captain Hutton here seems to have misunderstood us.

† We confess we do not clearly comprehend this, for the rivers alluded to by Captain Hutton, must either have been running at a depth of 300 feet below the sea, or the sea must since have risen to that height above its former level. We rather suggest a sinking of the surface at different periods in this situation.—Ed.

it must be left to those geologists, who are furnished with more opportunities for practical observation, than fortune or favour seems inclined to grant to me, to assign the strata to the various portions of the seasons above alluded to. It may be observed, however, as a rule, that it is very possible to be unable to account *for all the* changes and divisions observable in such deposits without in the least invalidating the general theory of causes assigned for their production, just as we see in the secondary formations, that geologists are pretty well agreed as to the general conditions under which they were accumulated, without having been able satisfactorily to assign every variation to its actual cause.

Having thus far commented on the views set forth in a previous number of this Journal, it may perhaps be expected, that I should at least attempt to shew, what I consider to be the facts deducible from the information we possess regarding the geological formation of our presidency. As this, however, if done properly, would occupy far more space that can well be afforded in a publication of this nature, I shall content myself with giving a mere outline of those circumstances, which I think will go far to prove the truth of what I have already suggested.

Turning then to a Map of India, we find that from the Delta of the Ganges to the foot of the Outer-Himalaya, stretches an extensive tract of alluvial lands, whose general inclination from the hills is so gradual, as to warrant our terming them horizontal. This alluvial plain is the production of the numerous rivers and minor streams, which flow down from the various mountains by which it is bounded and intersected. The larger rivers are supplied from the elevated chains of the Himalaya, which stretch in a diagonal direction from S. E. to N. W. from the northern and eastern boundaries; the west is bounded by the Soolimaun and Belooche mountains, while the Rajmahl and other minor ranges scattered between these boundaries and the sea, may be considered as the intersecting or *interrupting* chains, which here and there break the vast continuity of the alluvial lands. This alluvium is the produce of the rivers and streams, all of which date from the commencement of the so-called historical era, that is, since the subsidence of the Mosaic Deluge. This point is granted by the common voice of geologists.

Below the alluvium of the Delta, at the depth of 450 to 480 feet, is found a conglomerate composed of fragments, of primary rocks, intermixed with fossil remains and detritus, similar to those which occur in the inclined diluvial strata of the Sub-Himalaya, and identical likewise, it is thought, with the dispersed fossils of the valley of the Nerbudda, of the Jumna, and of the Irawaddi. The distance at which the conglomerate lies from those diluvial strata of which it contains portions, together with the size and weight of the primary fragments of which it is chiefly composed, lead at once to the conclusion, that it must have been deposited by waters possessing far greater power of transport than any of the rivers of the present day, even when most swollen by the periodical rains.

To overcome this difficulty it has been suggested, that some mountains existed within 30 miles of Calcutta, and that streams flowed down from them, bearing along fragments of the rocks which composed those mountains. This doctrine is at once seen to be erroneous, and is refuted by the fact, that the conglomerate from containing fragments of diluvial strata, cannot possibly date beyond the historical era, and therefore, if its component materials were furnished by mountains within 30 miles of Calcutta, those mountains ought to be still in existence, because no convulsions equal to their removal have occurred since the present order of things commenced. We must therefore have recourse to other and more powerful agents than our present rivers, and in order to shew what that agent probably was, we must first take a glance at the geological formations which give support to, and from which have been derived the materials of, the alluvial plains.

It has been shewn already in my geological report on the Western Himalayas, that the great central chain is composed of primary rocks of the usual character; namely, granites, gneiss, mica, and chlorite slates, hornblende and clay slates, while upon either flank of the great belt, rests a series of secondary strata, inclined at a considerable angle with the horizon.

These strata of course are at once seen to owe that inclination to the uprise of the central primary chain upon which they lie, and which uprise or outburst must have taken place subsequent to the deposition of those strata which it afterwards elevated.

Again, on the outermost southern flank occurs a belt of diluvial deposits, containing the remains of vast animals which became extinct at the period of the deluge ; these strata are likewise inclined, and resting in some places upon the secondaries above mentioned. It consequently follows, therefore, in accordance with strict geological reasoning, that their inclination must have taken place subsequent to their deposition, and that it has been occasioned by the uprise of the primary rocks, through the double series of secondary and tertiary formations, which had both been horizontally deposited above them. As a natural consequence, therefore, the Himalayan ranges are satisfactorily proved to be post-diluvian, or subsequent to the deposition of the diluvial strata, or, in other words, they can only date as mountains from the commencement of the historical or post-diluvian era.*

This point being gained, we may now proceed to trace the events which occurred, from the rise of the waters which deposited the last series of strata, until their subsidence, and the commencement of the present order of things.

At the period when the deluge was produced, the present mountains of the Himalaya were mere horizontal strata, beneath the gradually accumulating aqueous deposits of the secondary series, which were then submerged beneath the ocean, or beneath the waters of an estuary. The situation of the land which bordered that estuary is now traceable in the diluvial strata of the Sub-Himalayas, extending from the Punjab to the Irawaddi, in which are entombed the exuviæ animals, which at that distant period inhabited the dry land.

That large rivers flowed down from this land into the estuary, which is indicated by the secondary strata, is proved beyond a doubt by the occurrence in the diluvial beds of the remains of Trionycs, Emides, and the larger Saurians, and that the climate of the land was wholly tropical is likewise proved by the presence of these animals intermingled with the exuviæ of Elephants, Mastodons, Hippopotami, and others. These then inhabited the rivers and the land of the secondary era, precisely as do the analogous species of the modern era inhabit rivers and terai, which skirt the present mountains.

Now as secondary rocks occur along the western boundary from the ocean through Beloochistan to Cabul, and from thence again along the Himalaya in a south-easterly direction, along the northern and eastern boundary to the Irawaddi or the sea, it is evident, that this anti-diluvian country must have formed an extensive island, or perhaps one of a group of islands, (traces of others occurring beyond the Himalaya,) and it is therefore easy to be seen, that as the waters of the deluge rose, the animals of the rivers and the land being enclosed on every side, would have been overwhelmed together in one common ruin.

When the waters had stood sufficiently long above the surface of the globe to effect the purposes for which they had been permitted to

* We should rather say that the effects referred to are to be ascribed to local changes, such as those occasioned by the Earthquake at Chittagong, changes which have operated at all times as they do at present; although we do not deny that they may have been more general at one time than another.—Ed.

transgress their proper bounds, some vast upheavements of the submerged mass occasioned *antipodal* depressions into which the waters naturally subsided, and once more left the rugged and shattered surface of the earth a dry land.*

Among the ranges then produced, arose the mighty Himalya, which with others in various quarters of the globe rising to a height, which had been before unknown in previous conditions of the Earth, naturally caused a larger body of water to be withdrawn, by which the secondaries which had hitherto lain submerged, were now exposed and added as dry land to the former Earth, large portions, at least, of which again became uncovered, as we see in the diluvial strata in various countries of the present day.

With this uprise of land and subsidence of the ocean, commenced the historical or post-diluvian era, from which the origin of all existing rivers and alluvial strata must necessarily date; and as the waters were violently thrown back by the outburst of the mineral mass, the retiring *debacle* this formed, naturally carried off with it, in its headlong and irresistible descent, the commingled fragments of the shattered rocks, and again strewed them in its course to form the earliest deposit of the then commencing modern era.

Here then is the mighty agent by which the materials of the lowest and weightiest strata of our present alluvial plains were hurried from the mountains to distances now unattainable to the pebbles of the present streams, and to this agent I would refer the deposition of the fossiliferous conglomerate of the Gangetic Delta.

From the accumulation of this stratum, until the present time, the formation of alluvial matter has been progressive, and entirely carried on by the existing rivers of our continent, varying according to the mildness or severity of the seasons, the consequent power of transport of the rivers, and the deficiency or abundance of detritus.

I do not think it necessary now to enter farther on the subject, as I shall have occasion, in the regular essays I have promised you, to notice the various changes the Earth has experienced, more fully than my present space will admit of; and enough is here said to shew, that the doctrines advocated in the paper under consideration, are at least in part erroneous.

From the foregoing remarks, therefore, it would perhaps appear, that

* Although we have proofs of the rising and sinking of the land, there are none to shew that the level of the sea has ever undergone any great change, and the language of Scripture in this respect is therefore regarded as figurative, or adapted to the mind of man in the infancy of society.—Ed.

the inferences which have been drawn from a consideration of the deposits in the Gangetic Delta, as detailed in the Third No. of this Journal, are untenable, in as much as they require *the present existence of primary mountains within thirty miles of Calcutta,* which mountains *are known* not *to exist;* and yet they *could not have been removed within the historical era,* in which the theory *requires them to have existed;* and arther, because such inferences would assign an age to the recent deposits of the Indian continent, once at variance with the admissions of geology, and with the recorded facts of history.

*Mussoorie, 30th August,* 1841.

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## *On the fresh-water Fishes collected by* William Griffith, Esq., F. L. S. *Madras Medical Service, during his travels under the orders of the Supreme Government of India, from* 1835 *to* 1842. *By* John M'Clelland, *Bengal Medical Service.*

Mr. Griffith's travels have put us in possession of two distinct collections of the fresh-water Fishes of India, which from the light they cast on the geographical distribution of these animals, are unquestionably the most important accession to this branch, that it has fallen to the lot of any Asiatic traveller to make.

These collections consist of specimens found by Mr. Griffith during his travels in the Mishmee Mountains, a part of the Himalaya bounding the eastern side of Upper Assam, in 1836 and 1837; of specimens found by Mr. Griffith in Boutan in 1837 and 1838; of collections made by Mr. Griffith himself in the Kasyah Mountains in 1837; and by his collectors in those mountains during the years 1837, 1838, 1839, and 1840, and who are still continued in his service up to the present period.

They consist, lastly, of collections made by himself at Loodianah, and on the Indus, from thence to Ferozepore, and from the Indus to Shikarpore, the Bolan Pass to the Helmund, and from thence to the tributaries of the Oxus on the northern declivities of Hindoo Koosh. The fishes of the Cabool river were next carefully investigated by Mr. Griffith, as well as those of the streams in the Khybur Pass, the rivers and ponds in the Punjab, and the Ganges above Seharanpore.

Some other valuable collections which were made by Mr. Griffith were lost, particularly specimens forwarded from Loodianah in the beginning of 1839, which may have fallen into improper hands; others, particularly the Shikarpore collections, were spoiled in consequence of the jolting motion of the camels, on which they were necessarily conveyed under the most difficult circumstances; and others, for want of better means of preserving them, were kept merely in salt. With these exceptions, the remainder of the collections arrived in Calcutta, if not quite safe and free from those injuries to which such perishable objects were of necessity exposed during a military campaign, at least in a state to admit of the species being accurately identified, and such as are new, described.

In preparing a list of the specimens collected by Mr. Griffith, it would be desirable to point out a few of the more striking results to which they are likely to lead, and how far they are calculated to improve what is known of species peculiar to India. Still we would wish it to be remembered, that what is recorded as new or curious by one, may be found to be quite the revers by another, possessed of better facilities for study. It is satisfactory to know, that Mr. Griffith's collection not only of fishes, but all the other fruits of his extensive and precarious travels which have been almost uninterrupted from 1835 to the present time, are intended to be preserved as objects of study and investigation in apartments allotted to such purposes by the authorities at home. It is therefore unnecessary here to do more than direct attention to the subject, as the collection itself may be better investigated at home, (as far as its state of preservation will admit,) while the living animals will become objects of study and amusement, we trust, to future travellers and residents in places where they have been collected with so much care by Mr. Griffith. The following are Mr. Griffith's own remarks on the fishes he met with in Affghanistan and adjoining provinces.

"I find," he observes, "on referring to my notes appended to a numerical list of the Fish of Shikarpore, that the proportions are as follows:—

| | | |
|---|---|---|
| "Cyprinidæ, | Pæonominæ,.. .. .. | 22 |
| | Sarcoborinæ,.. .. .. | 17 |
| "Siluridæ, | .. .. .. .. .. | 8 |
| "Ophicephalus, | .. .. .. .. | 3 |
| "Chamba, (Buchanan,) | .. .. .. | 1 |

"The list was prepared from the native names, and it appeared to me at the time, that several species had fluctuating names. Not one of the Shikarpore fish has escaped the effects of the journey.

*From Kutch Gundava.*

"From the bunded waters at Mysoor I obtained several.

"Cyprinidæ 4, including a beautiful Systomus, much like S. Canius. As. Res. vol. xix. pl. xliv. fig. 6.

"1 Ophicephalus.

"1 Silurus.

"The stream of the Bolan Pass up the ravine in which our road passed abounded with fish, especially the small branch stream at Gurmab. Three springs which Dr. Henderson examined he found to have the temperatures of 77°, 77°, 82°. In the 82° one, Systomus above alluded to was found, and S. bimaculatus.

"In the Bolan rivers I have noted the Mahasir in abundance, but not attaining any size. The largest I took was perhaps 3 lbs. They afforded excellent fly-fishing with light tackle.

"1 Opsarion, also a fly-taker.

"1 Oreinus, like the Nepoora of Assam.
"3 Gonorhynchi.
"1 Silurus, Kuggar, from the still deep pools that occur here and there under cliffs.
"1 Macrognathus.

*From Gurmab.*

"1 The Mahasir, Barbus megalepis.
"1 Barbus, closely allied to the Mahasir.
"2 Gonorhynchi.
"1 Systomus bimaculatus.
"1 Systomus Canius.
"At Quettah, which is fairly within Affghanistan, and the waters of which no longer run into the Indus, but are either lost in details, or make their way to the tributaries of the Helmund, I obtained
"1 Barbus, a beautiful silvery small fish, with a bright longitudinal red streak.
"2 Other Cyprinidæ.
"1 Gonorhynchus.
"1 Loach.
"Of these the Gonorhynchus is the most common; it is found all over Affghanistan.
"From the Arghandab, a rapid and considerable sized tributary of the Helmund, which runs within two or three miles of Candahar, I obtained
"1 Barbus, of the characteristic Affghanistan form; viz. elongated body, very small closely set scales.
"1 Loach of largish size, with a flat head, colour reddish, with conspicuous brownish mottlings.
"1 Silurus.
"From the Turnuk I only obtained one Barbus, the same as the Candahar one; numbers were taken by baiting with a Cicada, which occurred in profusion on short

stunted bushes in the Turnuk valley. See a note by Captain Hay, Journal of the Asiatic Society.

"The Cabul river at Cabul does not present any great variety; the two most common are a species of Barbus, and one of Oreinus.

"Towards its origin, and throughout the upper part of the Mydan valley, a species of Oreinus is very abundant, numbers may be taken with a worm, the only instance I know of a fish with a Gonorhynchoid mouth taking bait. This same species swarms in the fine springs (from limestone) at Sir-i-Chushmah, which are the main source of the river: the fish are considered sacred, and appear to eat any thing presented to them; the size does not exceed 5 lbs.

"In the small channels by which the springs run off, a Loach is very common. The most remarkable fish however is a dark coloured Loach-like Silurus, which is not uncommon about Julraiz.

"Of these three fish, both Oreinus and Loach occur, the former in abundance in the Helmund at Gridun Dewar, altitude 10,500 feet. At this place I have known the Oreinus to take a fly with freedom.

"The late Captain Edw. Connolly shewed me among his Seistan papers, sketches of two fish inhabiting the lower part of the Helmund, of these one was a genuine Cyprinus, the other a Loach.

"The Cabul river at Jellalabad present us, in addition to two or three small scaled Barbi and Oreini, with certain tropical forms, such as the Mahasir and a Silurus, very like, if not identical, with the Poftah.

"From the same river at Lalpore, altitude —? I procured a fish I believe identical with the Nepoora of Assam, C. falcatus of Hardwicke, a Barbus, a Gonorhynchus, a small Mahasir, and a remarkable fish, which appears to me the type of *types* of Carnivorous *Pæonominæ*.

"The fish of the Koonur river, the largest tributary of the Cabul river, so far as I know, are all characteristic of Affghanistan, consisting of a Barbus with an elongated body, enormously developed fleshy lips, the lower being three-lobed, another Barbus, and one or two Oreini.

"In the waters of the Khybur Pass, which are chiefly derived from a copious spring from cavernous limestone, about half a mile above Ali Musjid, an Oreinus and a Perilampus occur in profusion, and may be taken in numbers by baiting with worms.

"These waters do not, except during the floods, reach the plain of Peshawur, being gradually lost in the loose shingly bed of the ravine towards its mouth.

"The characteristic forms of Affghan fish are doubtless the small scaled Barbi and Oreini, and these far exceed the others in number. No Ophicephali, none of the Indian Siluridæ, no Macrognathi, no Chamba, no Clupea. The fish are as distinct from the Indian forms as the plants are.

"The only ordinary sized scaled fish I am acquainted with beyond the influence of the plains, is the beautiful silvery Cyprinus of Quettah.

"By characteristic, I do not mean that these forms are limited to Affghanistan, because they occur perhaps to equal extent in the Himalayas, to the streams of which those of Affghanistan approximate more or less in the common features of rapids and bouldery beds.

"It will be interesting, by way of contrast, to gain a knowledge of the Affghan fish from those rivers, which in their courses through certain vallies, lose for a time their mountainous character; such for instance as the river of the Peshawur valley, the Elora near Candahar, and the Cabul river eastward of Cabul, and before it re-enters the hills.

"On crossing the great chain, separating Affghanistan from the plains of Toorkistan, which may be accomplished without exceeding an altitude of 13,000 feet, even by taking the highest route, that of the Erak Pass, a great change in the fish appears to occur, and Salmonidæ appear to take precedence of the Cyprinidæ.

"A species of Trout abounds in the Bamean river, and up its small tributaries derived from the Koh-i-Baba to an altitude of about 11,000 feet.

"A species of Barbus with small scales, is likewise common in the Bamean river.

"The only other fish I have any knowledge of, inhabiting the waters of the Toorkistan face of the Koh-i-Baba, is a Loach found at Kaloo, at an elevation of 11,000 feet.

"The curious change in the fish does not appear to be accompanied by any marked change in the physical configuration of the country in its plants, animals, or birds.

"I regret exceedingly, that from the loss of so great a portion of my collections of fish I should have to substitute inexact for exact information. Collectors will do well to bear in mind, that the preservative powers of spirits are diminished by long and constant land carriage, such as that of camels, and to obviate all risk from this cause, by preserving specimens of each kind with arsenical soap.

"The fish of Peshawur are almost entirely of Indian forms, the Cabul river is there a large splendid stream.

"Along all the lines, within the influence of the plains, an intermingling takes place, and in proportion to the easiness of access from the plains, will be found to depend the numbers of Affghan and Indian forms.

"Of the fish of the Chenab, Ravee, and Gatlup, remarks would be superfluous, as the characters of those rivers are decidedly Indian. I may mention, that the Mahasir is to be found in the Jhilun, at the place of the same name; but the river here has not altogether assumed the quiescent character, characteristic of the rivers of the plains.

"The fish of Affghanistan, except perhaps those of the valley of Peshawur, cannot be considered as administering to any extent to the food of the inhabitants.

"It is only about Jellalabad, and more especially up the Koonur valley, that I have seen Affghans employed in fishing. The only nets in use are common casting nets, but this method did not appear to me so successful as that of the hook and line.

"At Julraiz and Gridur Dewar, I have caught as many as forty fish in the course of three or four hours, and at Olipore, I was by no means unsuccessful. Yet I have seen three men with casting nets not average more than one fish each throughout a whole day."

Of the family Cyprinidæ, the number of specimens met with by Mr. Griffith is very great, comprising nearly three-fourths of all the others met with during his travels.

Of the Bengal species, the *Rohee,* the *Calabase,* the *Meerica,* and the *Catla,* as well as the *Bangon,* and various descriptions of *Pootie,* extend to the ponds and river of the Punjab. The latter Mr. Griffith traced as far as Peshawur, and it may be remarked of these small and insignificant species in Bengal, that they become more developed both in size and numbers in the rivers of the North-western Provinces generally.

Two Bengal species of Leuciscus are found in the Cabul river as high as Jellalabad; namely, *L. margarodes* and *Leuciscus mola,* as well as *Cyprinus (Leuciscus) angra,* and *Cyprinus curchius,* Buch. Four Bengal species of *Gobio* are also found in the same river; namely, *G. limnophilus, G. bicolor* and *pangusia,* as well as *Opsarius baicala, Systomus sophore, immaculatus,* and *chrysopterus,* together with two species of *Perilimpus;* namely, *P. Sutiha* and *ostreographus. Pimelodus rita* has also a wide circulation in this quarter, having been found by Mr. Griffith in the Khybur Pass, in the Chenab, and in the Cabul river. *Pimelodus aor,* Buch. has been found also by Mr. Griffith to be one of the characteristic fishes of the Indus, as well as of the Ganges above Seharanpore, but disappears in Affghanistan. Jellalabad is the farthest limit to the north-west to which the species of Hindustan extend. Two species of *Ophicephalus* are found there, and which are unknown in Bengal, and also a *Cirrhinus,* which has been named in honour of Sir A. Burnes, from whom Mr. Griffith received every assistance in his pursuits. A similar compliment has also been paid to other officers to whom Mr. Griffith was also anxious to acknowledge similar obligations. The *Ophicephalus wrahl* and *Morulius,* Buch. both occur at Loodianah, and indeed there does not appear to be any great difference between the fishes of the Indus and those of the Ganges. The species in both rivers appear to be generally the same where the currents are alike, but some species appear to be more developed, both in regard to size and number in one river, than in the other.

The *Herbivorous Cyprins* and *Pimelodinæ* being the characteristic species in the lower parts of those rivers just above the influence of the tides, while the large scaled Barbels begin to appear and form the characteristic species as the currents approach to rapids with gravelly bottoms. In the higher parts of the plains, the *Nepura* or *Gobio malacostomus** is the only herbivorous species of *Cyprinidæ* that can be said to be at all common, their place being supplied by *Opsarions* as that of the *Cirhins* is supplied by the large scaled, and for

* Cyprinus falcatus, Gray, Hard. Illust.

the most part carnivorous Barbels, which prey upon smaller species.

These large scaled Barbel there attain a gigantic size, one specimen in the collection of Mr. Griffith being four feet in length. They would also appear to ascend the rapids and enter some of the larger streams in the principal mountain vallies, and young specimens have been found by Mr. Griffith in the rivers at Deyrah Doon and Sadoo, as well as in the Cabul river at Jellalabad, and the streams of the Bolan Pass. *Opsarius gracilis*, or the *Goha* of Hindustan, an elegant species which from the green spots on its sides is usually, but erroneously, regarded as Trout, has been found from 15 to 18 inches in length in Deyrah Doon, at the junction of the Sone and Kurruch with the larger river, where the difference of temperature between the three streams attracts a large assemblage both of the fishes of the mountains and the plains to one spot.

The *Nepura* seems to occur in great perfection at Peshawur, and occurs as high as Lalpore; it is also abundant in the Dhoon, Roopur, and Sadoo; and from these situations which are its highest limits, it descends along the great rivers for two or three hundred miles into the plains.

The streams of the Himalaya and Hindoo Koosh are inhabited by other forms, which the researches of Mr. Griffith have been mainly instrumental in bringing to notice.

The mountain, or small scaled Barbels of the Himalaya were discovered and brought to Europe by Baron Hügel about ten years since. It was only in 1839, that their peculiarities were made known, and in the mean time Mr. Griffith's travels in the Mishmee and Boutan Mountains had made us familiar with several species which were distinguished from the common Barbels of the plains by their small scales, and blunt fleshy snout. The specimens brought to Europe by Baron Hügel were distinguished by a peculiar cleft in the lower part of the body in front of the anal fin, which is bounded laterally with scales of peculiar form, and thence named *Schizothorax*. The annexed figures which represent the bones of the head in these species, shew that as previously described they embrace two distinct groups, known by the elongation of the head. Fig. 1 represents the bones of the head and jaws in *Schizothorax esocinus, Heck.* and Fig. 2 the same bones in *Schizothorax plagiostomus, id.* The first is the type of *Schizothorax proprius,* and the latter of *Oreinus,* a subdivision which the collections of Mr. Griffith are sufficient to establish, and which in the descriptions which follow, we have noticed in more detail. The peculiarity of these mountain Barbels depends in a great measure on the union of the maxillary and intermaxillary bones, which renders them incapable of protruding the mouth forward in reaching their prey as the *Mahaseer,* and all the large scaled Barbels do. Mr. Griffith has, however, discovered an intermediate group, which while it presents the small scales and anal cleft of the mountain Barbels, possesses the protractile mouth of the large scaled Barbels of the plains, and of this interesting sub-genus which we have named *Racoma,* Mr. Griffith brings to light five undescribed species from the sources of the Oxus, the Helmund, and of the Cabul river.

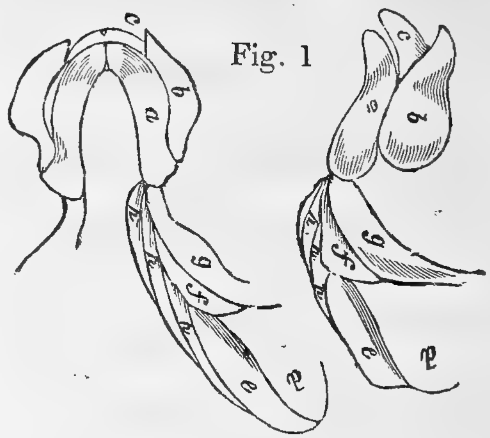


Fig. 1

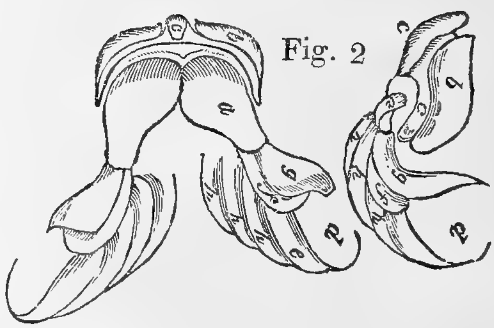


Fig. 2

These discoveries will render the genus Barbus of Cuvier, which depended at first on a few isolated species, one of the most perfect groups in Natural History. Mr. Griffith did not merely content himself with specimens, he has also executed excellent drawings of these new species, in which the colours and living forms are satisfactorily represented. This has proved the more fortunate, as some of the most interesting of these peculiar specimens have not yet reached Calcutta, having been accidentally left behind with the Ornithological portion of the collections.

The following is the list of drawings here alluded to, which Mr. Griffith has left in my possession :—

Oreinus maculosus.
Oreinus Griffithii.
Oreinus plagiostomus.
Schizothorax Edeniana.
Racoma labiata.
Racoma Chrysochlora.
Racoma nobilis.
Opsarius gracilis.
Opsarius bicciratus.
Barbus progeneis.
Barbus hexastichus.
Barbus spilopholus.
Salmo orientalis.

The above are all large sized coloured drawings, with the structure of the mouth, intestines, and such parts as required particular illustration, fully represented. In addition to these, we have outline figures of the Barbel of the Bamean river, *(Racoma gobioides,)* with the form of its intestines magnified ; the same of a species of Bangon, and of a Systomus found at Peshawur, together with sketches of the intestines of various species of Pimelodus.

The absence of all species of the Salmons from India and the Himalaya, has already been noticed as a curious fact. That extensive family is characteristic of temperate climates, and it was naturally expected, that at certain altitudes in the Himalaya some of its numerous forms might be found. Such is not the case, and the first and only species that has been found by any Indian naturalist, was discovered by Mr. Griffith in the Bamean river, a stream that falls from the northern declivities of Hindoo Koosh into the Oxus. The species appears to be undescribed, and has been named *Salmo Orientalis.* We may here mention a curious fact of an opposite nature from the one just noticed, *i. e.* the existence of *Silurus Glanis,* (an European species,) in the mountains on the eastern side of Assam. The specimen found by Mr. Griffith is about six inches in length, it is discoloured rather, and the fin membranes shrunk, from having been preserved in spirit along with plants, but there can be no doubt as to the identity of the species with that of Europe. This species has been found in the north-western parts of Asia, but we have never before heard of its existence so close upon the borders of India; and as the same fish has been found in America and Africa, it will probably prove to be one of the few animals that are nearly, if not quite universally distributed.

In Mr. Griffith's collections from the Kasyah mountains, there is one, or perhaps two, undescribed species of that singular genus *Platycara,* and two undescribed genera of *Siluridæ* of the sub-family *Pimelodinæ;* namely, *Glyptosternon* and *Olyra.* The former representing amongst *Siluridæ,* the *Platycara* amongst the *Cyprins,* and the latter genus blending in a great measure the characters of *Siluridæ,* with those of the *Loaches.* See Plates VI. VIII. and XXI.

The light that these newly discovered forms, (which we owe to the zeal and enterprize of Mr. Griffith,) is likely to cast on the natural affinities and relation of groups, is most important not only to Ichthyology, but every branch of Natural History. They go far to supply perhaps the only desiderata that were wanting to complete the several groups to which they belong; and whatever difference of opinion there may be upon other points, it will be allowed perhaps, that there cannot be one law for fishes, another for birds, &c.

so that whatever tends to a perfect knowledge of one group, must serve to elucidate another. This idea, which was first happily conceived by Mr. MacLeay, has since been generally adopted, and has already given an impulse and an interest to Natural History unknown before. In concluding these remarks, we may add a general list of the species contained in Mr. Griffith's collection. It is as well however to say, that Mr. Griffith's Researches were botanical; and that whatever he has done in Ichthyology and other branches of science, has been accomplished in addition to a masterly investigation of the Flora of the countries he has visited, and which we trust he will live to communicate to the world.

1. *Newly discovered species.*

Racoma, McClell. et Griff. a new genus.
Racoma gobioides, *id.*
Racoma chrysochlora, *id.*
Racoma nobilis, *id.*
Racoma labiata.
Racoma brevis, *id.*
(Racoma chrysochlora to Racoma brevis:) Drawings only as yet received, the specimens with the birds on their way to Calcutta.
Schizothorax, Heckle.
Schizothorax proprius, McClell. Sub. Gen.
Schizothorax intermedius, McClell. et Griff. iii.
Schizothorax Edeniana, *id.*
Schizothorax Ritchieana, *id.* i.
Schizothorax barbatus, *id.* iii.
Oreinus Griffithii, *id.*
Cirrhinus Burnesiana, *id.*
Opsarius piscatorius, *id.* x.
Opsarius bicirratus, *id.*
Cobitis, *id.*
Cobitis boutanensis, *id.* i.
Esox indica, *id.*
Ophicephalus indicus, *id.* ii.
Ophicephalus montanus, *id.* ii.
Silurus indicus, *id.* i.
Pimelodus anisurus, *id.* i. in spirits, 136.
Pimelodus indicus, *id.* i. ditto, 137.
Salmo orientalis, *id.* iii.
Ambassis indica, *id.* ii. one in spirits.
Macragnathus caudatus, *id.* i.
Systomus barbatus, *id.* i.
Platycara anisura. (?) *id.* ii. in spirits.

Platycara lissorhynchus, *id.* i.
Glyptosternon, McClell. a new genus.
Glyptosternon sulcatus, *id.* i. in spirits.
Glyptosternon striatus, *id.* i. and two in spirits, iii.
Glyptosternon reticulatus, *id.*
Glyptosternon pectinopterus, *id.*
Glyptosternon labiatus, *id.* i.
Olyra, McClell. a new genus.

| | |
|---|---|
| Olyra longicaudata, *id.*<br>Olyra inermis, *id.*<br>Olyra.——— ? | There is but a single specimen of each of these species, and this has been injured in examination, and therefore not sent. |

2. *Species before known to exist, but not characterised.*

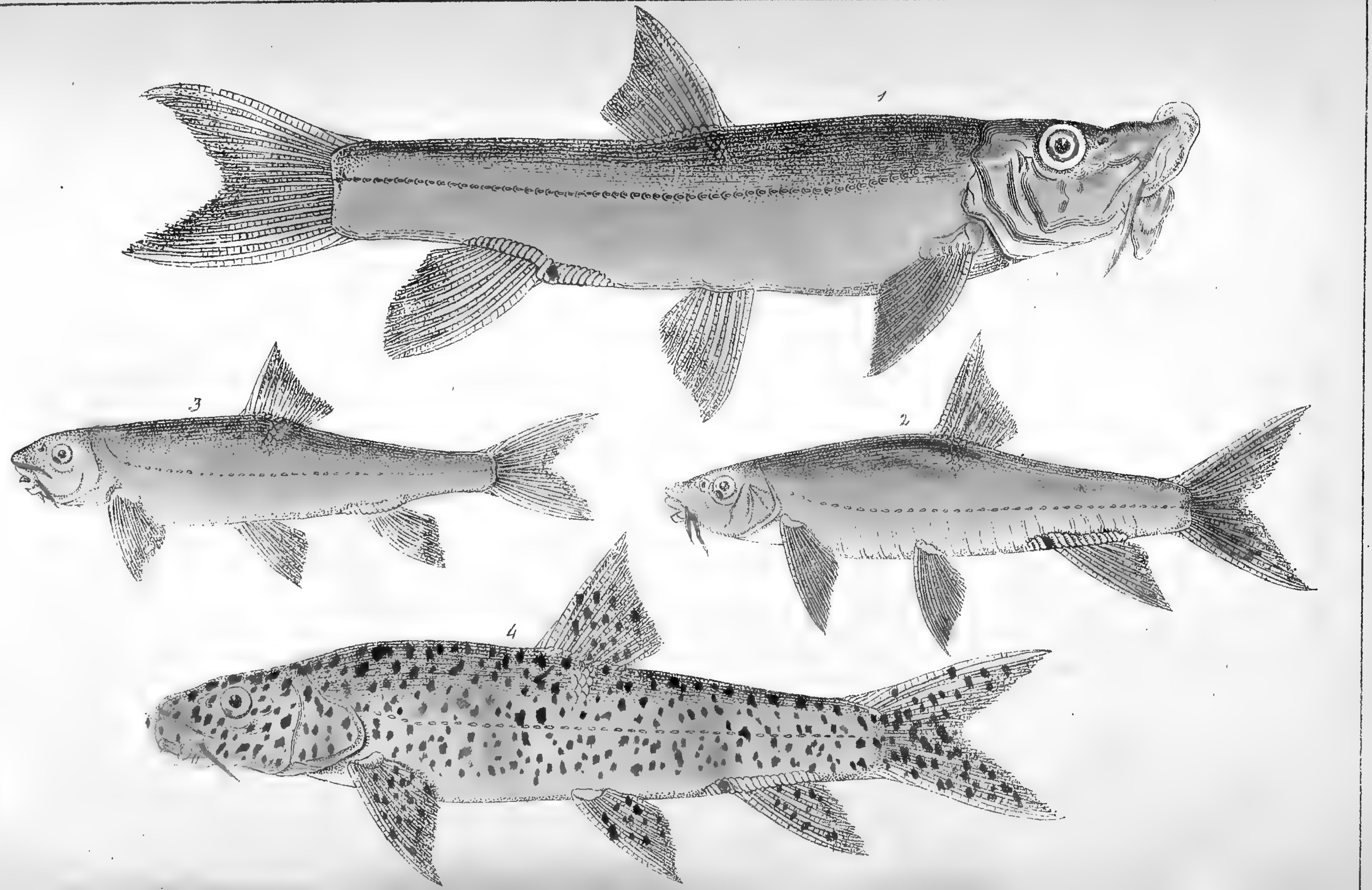
Schistura grandis, *id.* Hardwicke's Illust. t. 94, *id.*

3. *Species placed in Genera to which they did not belong.*

Oreinus plagiostomus, *id.* v.

4. *Species whose habitation has been rendered more defined.*

Ambassis ruconius, McClell.
Ambassis phula, *id.*
Barbus spilopholus, *id.* v.
Barbus hexastichus, *id.* ix.
Barbus macrocephalus, *id.* ix.
Barbus progeneius, *id.* iii.
Clupanodon chandpole, Buch.
Clupanodon manmina, Buch. iii.
Cirrhinus rohita, *id.* v.
Cobitis marmorata, Heck. i. in spirits.
Cobitis armatis.
Cois nandus, Buch. i.
Cyprinus mrigala, Buch. vi.
Cyprinus calbasus, Buch. ii.
Cyprinus dyocheilus, McClell.
Cyprinus catla, Buch. ii.
Cyprinus cursa, Buch.
Cyprinus cotis, Buch. iv.
Cyprinus angra, Buch.
Cyprinus curchius, Buch.
Cyprinus cursis, Buch.
Esox concila, Buch. i.
Gobio ricnorhynchus, McClell. xiii.
Gobio lyssorhynchus, *id.* iv.
Gobio isurus, *id.* vi.
Cyprinus pangusia or Boga, Buch. iii.
Gobio bicolor, McClell. i.
Gobio limnophilus, *id.* i.
Gonorhynchus gobioides, *id.* xi.
Leuciscus brachiatus, *id.* viii.
Leuciscus lateralis, *id.* xii.
Leuciscus daniconius, *id.* v.
Leuciscus dystomus, *id.*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Leuciscus mola, *id.*
Leuciscus margarodes, *id.*
Macragnathus ornatus, *id.* i.
Notopterus karipat, Lacepede, iii.
Opsarius gracilis, *id.* iii.
Opsarius pholicephalus, *id.* i.
Opsarius fascicatus, *id.*
Opsarius baicala, *id.* i.
Ophicephalus lata, Buch. ii.
Ophicephalus wrahl, Lacep. ii.
Platycara nasuta, *id.* i. in spirits.
Ophicephalus marulius, Buch.
Pimelodus aor, Buch. iv.
Pimeladus rita, Buch. ii.
Perilampus recurvirostris, McClell. i.
Perilampus ostreographus, McClell.
Oreinus maculosus, McClell. xii.
Perilampus sutiha, McClell.
Silurus glanis, Auct. i.
Silurus singio, Buch.
Silurus boalis, Buch. iii.
Systomus malacopterus, McClell.
Systomus chrysosomus, McClell. i.
Systomus immaculatus, McClell. ix.
Systomus ticto, McClell.
Systomus chrysopterus, McClell. iv.
Systomus sophore, McClell. ii. in spirits.
Systomus pyropterus, McClell. xx.
Schizothorax esocinus, Heckle.
Varicorhinus diplostomus, Heck. i.

NOTE.—The numbers placed after the names refer to the number of specimens despatched to the Museum at the India House. The names without numbers, refer to species of which the specimens were not in a sufficient state of preservation to forward.

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The following are the characters of the undescribed species in these Collections :—

## I. *Afghan Collections.*

### FAMILY CYPRINIDEÆ, Cuv.

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### SCHIZOTHORACINÆ, McClell.

are Barbels with minute scales and a naked membranous space in front of the anal fin, bounded laterally with enlarged scales placed vertically like eave-tiles. Their lips are thick and fleshy, and their intestines vary from three and a half to six lengths of the body.

They inhabit the Mountains of India and Central Asia.

*Sub. Gen.* RACOMA,* McClell. et Griff. Pl. XV.

are distinguished by their protractile jaws like those of the large scaled Barbels, the intermaxillaries forming a moveable rim, by means of which the mouth, when opened, is projected forward.

*Observation.*—Their stomach is wider and more highly organised than the intestines, which are continuous with it. The whole length of the alimentary canal is about 3½ lengths of the body. They prey upon small fishes, and are speedily taken with worms. They inhabit the sources of the Helmund, the Oxus, and the Cabool river. Our knowledge of them is entirely derived from the MSS. drawings and specimens of Mr. Griffith.

1. *Rocoma Gobioides,* t. xv. f. 3.—*Bamean Barbel,* Griffith MSS.

This species, of which there is but a single specimen in Mr. Griffith's collection, bears a resemblance in the form of the mouth and head to the common *Mrigalla* or *Meeriga* of Hindustan, beyond which, it presents no resemblance to any known species. The specimen is somewhat altered in shape, being merely a preserved skin ; but Mr. Griffith took the precaution of making a correct outline figure of the fish itself when fresh.

The head is small, being about one-fifth of the entire length including the head and caudal fin, and is scarcely equal to the depth of the body. The snout is round, small, and but little prominent ; the mouth opens horizontally, and the intermaxillary has but little motion ; the operculum terminates behind in a round point, which is directed backward. The depth of the body contracts suddenly at the dorsal and anal fins, which are accordingly inserted on oblique bases. The anal cleft extends for about half an inch in front of the fin, and the vertical scales in this situation are twice the depth of the ordinary

* Etym. Rakoma, a torn garment.

scales on other parts of the body. The dorsal fin is placed midway between the eyes and the commencement of the caudal fin, and is preceded by a slender soft pointed ray which becomes broader at the base and serrated behind. The ventral fins are placed rather behind the commencement of the dorsal, and the anal fin is situated about half way between the dorsal and caudal.

$$D. \frac{3}{8} : P. 19 : V. \frac{1}{11} : A. 6 : C. \frac{6}{\frac{18}{6}} :$$

The common colour of this species is yellowish brown, darker on the back, and becoming yellowish white below. The intestines and stomach form a continuous tube coiled up in the anterior part of the abdomen about $3\frac{1}{2}$ lengths of the body. Mr. Griffith found them to take worms greedily.

Habitat-Bamean river lat.——* ? N. E. long. elevation——* ? feet above the sea; length about 12 inches.

2. *Racoma chrysochlora*, nob. t. xv. f. 2.

Mouth directed forward, intermaxillaries protractile, without spots, scales small, raised on the lateral line, vertical anal scales large, colour brownish yellow, operculum square behind, intestines convoluted in a conical form in the anterior part of the abdomen, and equal to six lengths of the body.

$$D. \frac{3}{8}: P. 19 : V. 10: A. 8: C.$$

Habitat. Lolpore, Cabul river, length about 10 inches. Griffith's MSS.

The specimens of this fish have not yet arrived in Calcutta, having been left behind with Mr. Griffith's extensive collection of Ornithology. The characters here given are taken from Mr. Griffith's notes, and the figure reduced from his very excellent drawing.

3. *Racoma nobilis*, nob. t. xv. f. 4.

Operculum narrow and rounded behind, body and fins covered with numerous small spots.

$$D. \frac{3}{9} : P. 19 : V. 11 : A. 8.$$

Stomach distinct from the intestines and highly organised. The entire length of the intestinal canal is only one and two-thirds length of the body. Preys on small fish; a highly carnivorous type, and

* * These measurements are given from Mr. Griffith's observations in papers which we have not yet had access to.—Ed.

except as to shape, a beautiful fish ; takes worms and offal. Griffith's MSS. Length about 18 inches.

The specimens of this fish are also with Mr. Griffith's Ornithological collections.

4. *Racoma labiatus*, t. 1, pl. xv.

Length of the head greater than the depth of the body, and equal to a fourth the entire of length. Intermaxillary very protractile and covered with a thick adipose integument, a thick trilobed integument to the lower jaw, cirri terminating in trident points.

$$D. \frac{3}{8} : P. 19 : V. 10 : A. 7.$$

Intestines short, disposed in $3\frac{1}{2}$ or four double folds.

Habitat. Pushut, Koonar river near Jullalabad.—Griffith's MSS.

Mr. Griffith remarks that this singular form is nearly allied to the Lalpore species, but that the intestines of the latter are infinitely longer, nor is there any enlargement of the lips in the latter; but this last character Mr. Griffith remarks is not so remarkable in young specimens.

5. *Racoma brevis*, nob.

The head is short and compressed, the lips covered with a thick fleshy membrane, which forms a loose appendage to the lower jaw. The depth of the body nearly equal to one-third of its length, the fins are small, the fin membranes strong, the rays slender, and the dorsal spine slender and soft, the fin rays are.

$$D. \frac{2}{7} : P. 20 : V. 11 : A. 7 : C. \frac{5}{\frac{19}{5}}$$

Habitat. Helmund river.

There is but one specimen (not very perfect) of this species in the collection.

*Sub. Gen.* SCHIZOTHORAX, Heckel.

The head is elongated and conical, the snout prominent and pointed, intermaxillaries fixed, lower jaw long and narrow, but shorter than the upper ; lips soft and round.

The intestines with the stomach form together a tapering tube about $3\frac{1}{2}$ lengths of the body. The species are so far carnivorous as to take worm greedily. Griffith's MSS.

*Observation.*—The species are all so nearly alike, that they are distinguished with difficulty.

*A.* Lower lip presenting a free reflected margin only at the angles of the mouth.

1. *Schizothorax escocinus,* Heckel Fische aux Cachmir.

Although this species has before been described, it is necessary to give the following characters, in order to distinguish it from the others :—

Head elongated, snout somewhat depressed, width of the mouth equal to two-thirds of the length of the lower jaw, which is pointed at the apex; operculum terminating behind in a narrow point: dorsal spine large and terminating in a membranous point; body spotted; scales very minute.

$$D. \tfrac{3}{8} : P. \tfrac{1}{19} : V. \tfrac{1}{9} : A. \tfrac{1}{6} : C. 19.$$

Habitat. In tributaries of the Helmund and the Cabool river. (Griffith.)

2. *Schizothorax intermedius,* Nob.—Dorsal spine soft, small, and slender; scales rather above the ordinary size; width of the mouth equal to the length of the lower jaw, which is round at the apex; edge of the lower lip thin and hard; caudal fin short.

$$D. \tfrac{4}{8} : P. \tfrac{1}{18} : V. \tfrac{1}{10} : A. \tfrac{2}{6} : C. 19.$$

Habitat. Cabul river at Jullalabad. Tarnuck river. (Griff.)

*B.* Reflected margin of the lower lip free at the apex.

3. *Schizothorax Edeniana,* nob.—Reflected posterior margin of the lower lip entire, lips thick, round, and soft; snout depressed, dorsal spine slender, soft, but harder at the base, where it is slightly serrated; lower jaw broad at the base, but narrow at the apex; posterior margin of the operculum rounded, scales rather above the ordinary size in this group; the fin rays are,

$$D. \tfrac{3}{8} : P. \tfrac{1}{19} : V. \tfrac{1}{9} : A. \tfrac{1}{7} : C. \frac{5}{\frac{19}{5}}$$

Habitat. Cabul river at Koti-i-Ashruf, Mydan valley, and Sir-i-Chusmah. It rises freely to the surface, and takes worm greedily. The intestinal canal which is $3\tfrac{1}{2}$ lengths of the body, is filled with a livid coloured pulp. (Griff.)

This species is named in honor of a Nobleman to whom Science is indebted for the opportunities afforded to Mr. Griffith of extending his Botanical Researches from the Straits of Malacca into Central Asia.

4. *Schizothorax Ritchieana,* nob.—Reflected posterior margin of the lower lip trilobate; lips broad, round and soft; width of the mouth equal to about $\frac{1}{2}$ the length of the lower jaw, which is narrow at the apex; snout narrow and compressed; dorsal spine large, scales very small, lateral line raised, body spotted.

$$D. \frac{4}{8} : P. \frac{1}{19} : V. \frac{1}{9} : A. \frac{1}{6} : V. 19.$$

Habitat. Affghanistan. In the Helmund there is a variety of this species, (No. 74,) with a small dorsal spine, and the lateral line less conspicuous, which will probably prove to be distinct. Griff. (Coll.)

This species is named in honor of Dr. Ritchie of the Bombay Service.

5. *Schizothorax barbatus,* nob.—Head elongated as in *S. ecocinus,* but much compressed at the snout; width of the mouth equal to about half the length of the lower jaw; lips thin and hard on the edge; dorsal spine very large, compressed and bony.

$$D. \frac{3}{8} : P. 20 : V. 12 : A. \frac{2}{6} : C. \frac{\frac{4}{19}}{6}$$

Habitat. Cabul river at Jullalabad. (Griff.) Differs from all the precedingin the narrowness of the lower jaw; it is nearly allied to *S. ecocinus.*

*Observations.*—The intestines in Schizothorax vary from four to six lengths of the body. The stomach is a more capacious part of the same canal, their habits are herbivorous; one species only being known to take bait and worms freely, and their intestines are always found to be loaded with a dark pulpy matter. Griff. MSS.

### *Sub. Gen.* Oreinus, McClell.

The head is short and thick, the mouth transverse. The intermaxillary bone is suspended horizontally, so as to be carried by the muscular structure of the snout upward and forward in opening the mouth, lower jaw short and broad. The upper lip soft and continuous, with a reflected mammilated fold which passes across the lower jaw, behind a hard and cartilaginous lower lip.

1. *Oreinus maculatus,* As. Res. vol. xix, p. 274.—This species sel-

dom exceeds six inches in length, it is an intermediate form between Schizothorax and Oreinus; it is allied to the former by the length of its intestines and its habits, as it is said by Mr. Griffith to take bait and worms most greedily. We are indebted to Mr. Griffith also for an excellent drawing of this species.

Intestines four lengths of the body, during the first $1\frac{1}{2}$ length they are of considerable diameter, thence they are much contracted. (Griffith.)

Habitat. Khybur Pass, where they are very common. The head of the Ali Musjid stream swarms with them; Cabul river, Himalya, and Gundamuck. (Griffith.)

There appears to be two varieties of this species, one with a somewhat stronger dorsal spine than the other.

2. *Oreinus plagiostomus*, nob.—*Schizothorax plagiostomus*, Heckel. The breadth of the mouth is equal to a third of the length of the head, and of the interval from the extremity of the snout to the pectoral fins; snout thick, smooth, round and fleshy ; posterior margin of the operculum round. Dorsal spine slender and soft; colour yellowish brown above, below yellowish white, with a few leprous spots on the body.

$$D. \frac{3}{8} : P. 19 : V. 10 : A. \frac{2}{6} : C. 19.$$

The vertical scales at the base of the anal are rather large. The intestines are six lengths of the body, but in young specimens, they are only $3\frac{1}{2}$ lengths of the body. The stomach tapers gradually to the intestines, and is about equal to their length. (Griffith.)

Habitat. Helmund river at Girdun Dewar, where they are very numerous, and attain the ordinary size of a foot in length. (Griffith MSS.)

3. *Oreinus Griffithii*, McClell.—The breadth of the mouth is equal to half the length of the head, and of the interval from the extremity of the snout to the commencement of the pectorals. Dorsal spine large, vertical scales at the anal obsolete, posterior margin of the operculum round, snout smooth.

$$D. \frac{4}{8} : P. 20 : V. 11 : A. \frac{1}{6} : C. 19.$$

The intestines are six lengths of the body, and contain a brownish pulp. (Griffith.)

This species although perfectly distinct, differs but little in appearance from Oreinus plagiostomus.

Habitat. Affghanistan, Koonur river, Pushut. (Griffith.)

*Genus* CIRRHINUS, Cuvier.

1. *Cirrhinus Burnesiana,* nob.—Head short, thick, and round, post operculum narrow and small, lower jaw short, mouth inferior.

D. 9 : P. 16 : V. 9: A. 7.

Habitat. Cabul river at Jullalabad. The specimen was imperfectly preserved in salt.

*Genus* OPSARIUS, McClell.

1. *Opsarius piscatorius,* nob.—Back arched in front of the dorsal fin, anal inserted under the hinder part of the dorsal, mouth small, sides silvery, with nine transverse bars.

D. 8 : P. 16 : V. 9 : A. 8 : C. 19.

This species is very small, and is distinguished by the number of rays in its anal fin.

Habitat. Seharanpore.

*Opsarus bicirratus,* nob.—Two cirri; length of the head equal to the depth of the body; the dorsal is placed a little anterior to the anal; 35 scales along the lateral line and nine incomplete bars on the sides.

D. 8 : P. 13 : V. 8 : A. $\frac{2}{10}$ : C. 19.

Habitat. Khyber Pass and Cabul river at Jellalabad.

*Genus* COBITIS, *Linn.*

*Cobitis.* Suborbitor species. Head compressed, a nebulous streak along the lateral line, caudal barred; two first rays of the dorsal short.

D. $\frac{2}{8}$ : P. 9 : V. 9 : A. 3 : C. 17.

Habitat. Loodianah. This is probably *Cobitis armatis?*

Fam. ESOCINIDÆ.

*Esox indica,* nob.—Commencement of the dorsal and anal fins exactly opposite; the fin rays are,

D. 12 : P. 11 : V. 7 : A. 15 : C. 15.

Habitat. Loodianah, where it is called, *Khan.* (Griffith.)

## Ophicephalus.

1. *Opicephalus indicus,* nob.—Two plates or scales in the interval between the eyes, and one in front on the snout. Length of the head equal to half that of the body, exclusive of the head and caudal fin. About 36 scales along the lateral line from the operculum to the caudal; the fin rays are,

$$D.\ 26 : P.\ 17 : V.\ 6 : A.\ 17 : C.\ \frac{\frac{1}{12}}{1}.$$

The jaws are narrow, and the young only appear to be marked with a few obscure bars at the base of the caudal fin.

Habitat. The Chenab in the Punjab, and Loodianah, where it is called Doarka and Dourra. It is also found in the Cabool river.

2. *Ophicephalus montanus,* nob.—Three complete scales in a row between the eyes, with three triangularly placed scales in front on the snout. About 43 scales along the lateral line. Pectoral fins crossed with fine bars.

D. 32 : P. 14 : V. 6 : A. 17 : C. 13.

In large specimens the head is dilated and broad, and the three scales in front of the row between the eyes are sometimes wanting.

Habitat. Baisoot, Jullalabad, Himalaya, and Sadoo, (Griffith.)

## Siluridæ.

1. *Silurus indicus,* nob. Four soft rays in the dorsal fin which is very small, the head is short, the operculum terminating behind in a rounded obtuse corner, directed obliquely downwards, with a slender, pointed, and smooth conical spine in the pectorals; seven rays in the ventrals preceded by a short one; four cirri.

$$B.\ 11 : D.\ 4 : P.\ \tfrac{1}{3} : V.\ 8 : A.\ 71 : C.\ 18.$$

Habitat. Loodianah, the Punjab, and the Cabool river at Jullalabad. This species is called Puftah at Loodianah, and is the same as the Puftah of Bengal, and identical with *Silurus canio, S. duda,* and *S. chedra* of Buchanan, which would seem to be but varieties of a widely diffused and common species.

*Pimelodus anisurus,* McClell.—Lower lobe of the caudal shorter than the upper. Head short and anteriorly compressed with the opercula, terminating on each side by a narrow rounded point, directed horizontally backward. First dorsal placed on the anterior third of the back, sides streaked; eight cirri.

B. 10 to 15 : D. $\frac{2}{8}$ : V. 6 : A. 9 : C. 15.

Nearly allied to *Pimelodus cavia,* Buch.

Habitat. Loodianah and Cabool river at Jullalabad.

2. *Pimelodus indicus,* nob.—The lower lobe of the caudal shorter than the upper. Head compressed; eight cirri, the two reaching beyond the ventrals, the others as long as the head. The back is equally arched from the snout to the caudal. The anterior dorsal is small and placed over the interval between the ventrals and pectorals, the posterior dorsal is placed opposite to the anal. The dorsal spine small, round, slender, and only about half the length of the succeeding soft ray. The pectoral spine is strong for the size of the fin, and serrated behind. The branchial membrane is thick and opaque, containing but two small rays; the fin rays are.

D. $\frac{2}{6}$ : P. $\frac{1}{7}$ : V. 6 : A. 8 : C. 18.

Habitat. Loodianah.

### Gen. Glyptosternon, McClell. Pl. vi.

Teeth like velvet, mouth situated in the lower surface of the head, which is broad and flat; eyes small and directed upwards; spines when present, are concealed within the membranes of the fins; the pectoral and ventral fins are broad, falcate, and situated in a plane with the lower surface of the head and body, which is more or less covered with mammilated and striated cuppers, for the purpose of adhering to stones. Without osseous plates on the body.

The stomach is a blind sack, the intestine being given off near the anterior orifice. It usually contains the remains of insects. They inhabit the mountains of India and Central Asia.

The species are numerous, widely diffused, and with a single exception have all been discovered by Mr. Griffith.

*Glyptosternon reticulutus,* nob.—Without spines, the first ray of the pectoral and ventral fins soft and pinate, giving off soft pointed cartilaginous rays along the anterior margin, which are enveloped in the membrane of the fin. The under surface of the head and anterior portion of the body form a flat corrugated surface.

Habitat. Sir-i-Chusma, at the source of the Cabul river. (Griffith.)

### Fam. Salmonidæ.

1. *Salmo orientalis,* nob.—The length of the head is equal to the depth of the body, and to one-fourth of the entire length, inclusive of the head and caudal fin. The dorsal commences on the middle of the back, half way between the snout and the commencement of the caudal. The ventrals are placed beneath the hinder portion of the dorsal, and the posterior adipose dorsal is placed over the hinder portion of the insertion of the anal. The caudal and the dorsal fins are dark brown; on the lower parts of the body the fins are of a reddish hue. The back and the sides are interspersed with red and olive green irregular spots, which are also extended over the head, opercula, and dorsal fin.

B. 12 : D. 12 : P. 14 : V. 10 : A. 10 : C. 19.

A single row of hooked teeth extend along the edge of the lower jaw, and the intermaxillary is continued along the edge of the maxillary bone, as well as the edge of the angular bone, thus making two rows in the upper jaw ; a few teeth are also found on the vomer, and six (three on either side,) near the apex of the tongue, all of them hooked.

Habitat. Northern declivities of the Hindoo Koosh, and Bamean river, one of the tributaries of the Oxus. (Griffith MSS.)

This species which seems to differ from any known member of the family in the size of the head and the depth of the body, affords the first instance of a Salmon having been found any where in the vicinity of India. There are no Salmonidæ in Affghanistan, or any of the countries to the south of the Hindoo Koosh ; the latter would therefore appear to be the boundary between the peculiar species of India, and those of Europe and northern Asia.

### Gen. Ambassis, Cuvier.

1. *Ambassis indica,* nob.—With a blackish stain in the upper por-

tion of the sclerotic of each eye, and another on the apex of the anterior dorsal. The depth of the body is nearly equal to its length, exclusive of the head and caudal fin. Frons obliquely raised, head short, eight erect spines in the dorsal, and three buried at the base of the fin. Three erect spines at the base of the anal, and one buried in the integuments.

$$D. \tfrac{3}{18} : P. 12 : V. \tfrac{1}{5} : A. \tfrac{3}{13} : C. 17.$$

Habitat. Loodianah.

1. *Chanda (Ambassis) Ruconius*, Buch.—With a slight dark lunate spot on the upper part of the eye, and an irregular stain on the apex of the dorsal. Depth of the body equal to half its length exclusive of the head. Frons nearly parallel with the lateral line, eight erect spines in the dorsal, and three buried in the integuments at its base, and three erect and one buried at the base of the anal.

$$D. \tfrac{8}{16} : P. 13 : V. \tfrac{1}{5} : A. \tfrac{3}{16} : C. 18.$$

Habitat. Loodianah and the Punjab. (Griffith.)

Gen. Macrognathus.

1. *Macrognathus caudatus*.—Caudal distinct, 30 prickles or more in front of the dorsal fin.

*Khasya, Boutan, and Mishmee Collections.*—

Gen. Cobitis.

*Cobitis Boutanensis*, nob.—Snout somewhat depressed, lips fimbriated six cirri.

D. 8 : P. 11 : V. 8 : A. 6 : C. 18.

Habitat. Boutan, on the Mishmee mountains.

Gen. Schistura.

*Botia* (*Schistura*) *Grandis*, Gray. Hardw. Illust. t. 94 : f. 3.

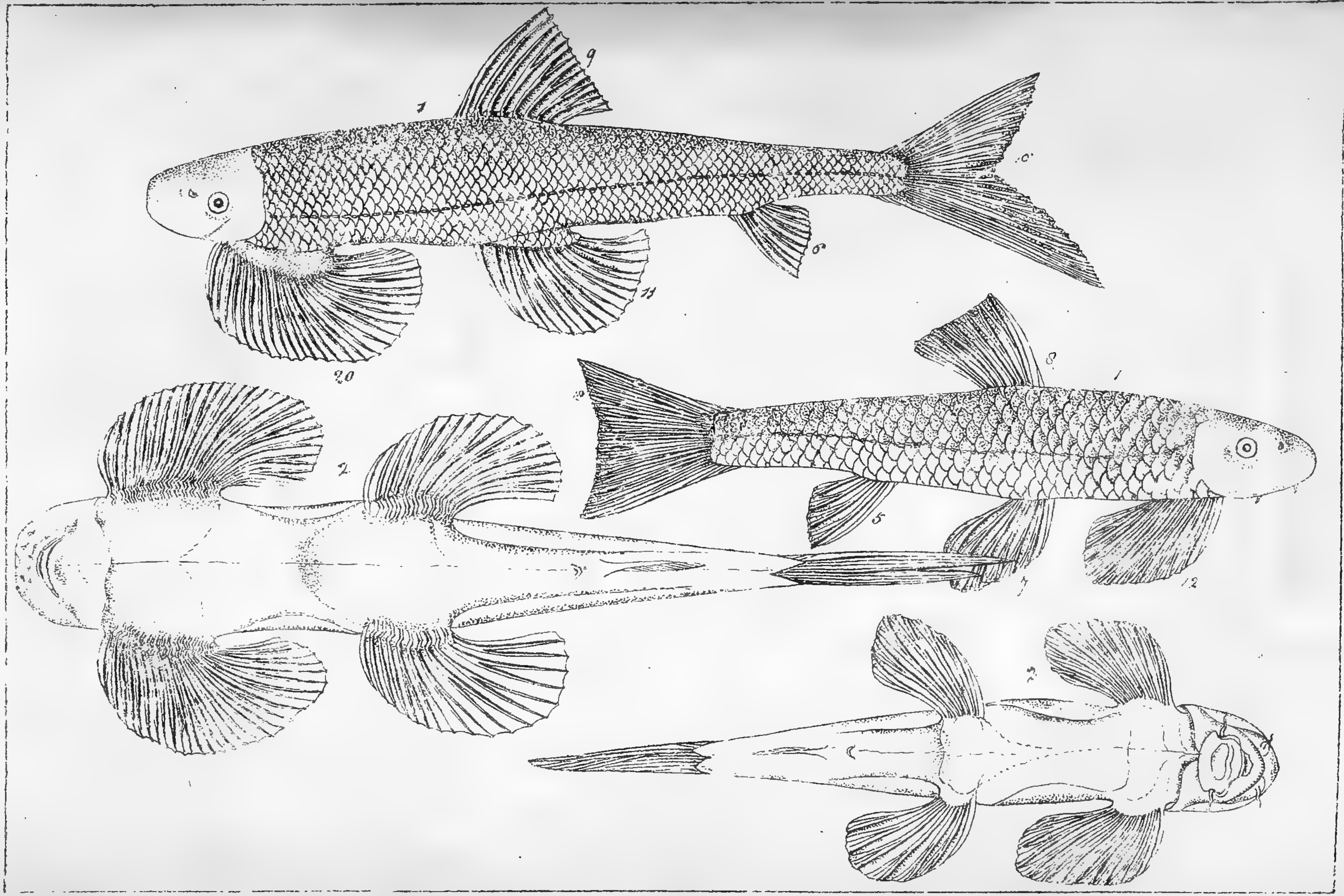
The head is long, much compressed, with two strong prickles beneath each eye, mouth narrow, four short cirri suspended from a single pedicle on the snout; and two from a single pedicle at the apex of the lower jaw, and one at each corner of the mouth.

$$D. 10 : P. 14 : V. 9 : A. \tfrac{1}{7} : C. 19.$$

Body and fins covered with irregular green spots and streaks.

Habitat. Kasyah mountains.

Pl XVIII



Gen. Platycara, McClell.

*Platycara anisura*, nob.—Caudal entire, presenting an oblique falcate margin behind having the lower rays of the fin longer than the upper. Head and lower parts of the body quite flat; mouth lunate, small, and presenting a prominence on the lower surface of the head, with five rudimental cirri in front, and two at the corners of the mouth, scales of medium size, body long and slender.

D. 10 : P. 21 : V. 11 : A. 7 : C. 19.

Habitat. Kasyah mountains.

*Platycara lissorhynchus*, nob.—Head flat below, but arched, and thick above, with a disc behind the mouth, snout smooth and round, caudal square, scales large.

D. 9 : P. 18 : V. 9 : A. 6 : C. 19.

Habitat. Kasyah mountains.

Fam. Siluridæ.

Sub. Fam. Pimelodinæ.

2. *Gyptosternon sulcatus*. t. vi. f. 1, 2, 3.

An oval disc on the breast between the pectorals, composed of transverse plates as in the sucking fish, (*Echineis remora*,) and a series of similar plates on the broad lower surface of the first rays of the ventrals.

D. 8 : P. 13 : V. 7 : A. 9 : C. $\begin{matrix}5\\ \overline{16}\\ \overline{5}\end{matrix}$.

Habitat. Kasyah mountains.

3. *Glyptosternon Striatus*. t. vi. f. 1, 2.—Mouth wide, eight cirri; a striated sucker on the breast, a single short slender spine concealed in front of the dorsal, first ray of the pectorals and ventrals broad, flat, and soft, except at the base; and enveloped in membrane which is finely corrugated in pinate folds below, a few serrated points on the hinder margin of the first ray of the pectorals.

B. 8 : D. 8 : P. 11 : V. 6 : A. 9 : C. 17.

Habitat. Kasyah mountains.

4. *Glyptosternon pectinopterus*.—Mouth wide, cirri eight; striated on the breast, but the first ray of the dorsal which is pinnate and soft, affords along its anterior margin a row of sharp points; in other respects this species differs but little from the last.

B. 9 : D. 8 : P. 9 : V. 6 : A. 7 : C. 17.

Habitat. The mountains of Simla.*

5. *Glyptosternon labiatus*—Lips multilobate, reflected and spread continuously around the mouth, so as to form a broad flat sucker; anal fin very small, dorsal perfectly soft and free from spines and bristling points, posterior adipose dorsal long, cirri very short.

D. 7 : P. 14 : V. 7 : A. 6 : C. $\overset{3}{\underset{3}{\overline{17}}}$.

Habitat. Mishmee mountains, (Griffith.)

## *Gen.* OLYRA, McClell. Pl. xxi.

Body soft, long, and cylindric, with two dorsals, the first radiated, the second adipose, head elongated and flat at the snout, operculum terminates behind in an oblique point directed towards the dorsal fins, anal long, caudal entire, teeth like velvet, confined to the jaws, no dorsal spine nor any thing peculiar about the branchæ; from six to eight slender cirri.

*Olyra longicaudatus,* McClell. t. xxi. f. 1. Pectorals preceded by a rough spine, jaws of equal length, six setaceous cirri, and the middle rays of the caudal prolonged to a lengthened point.

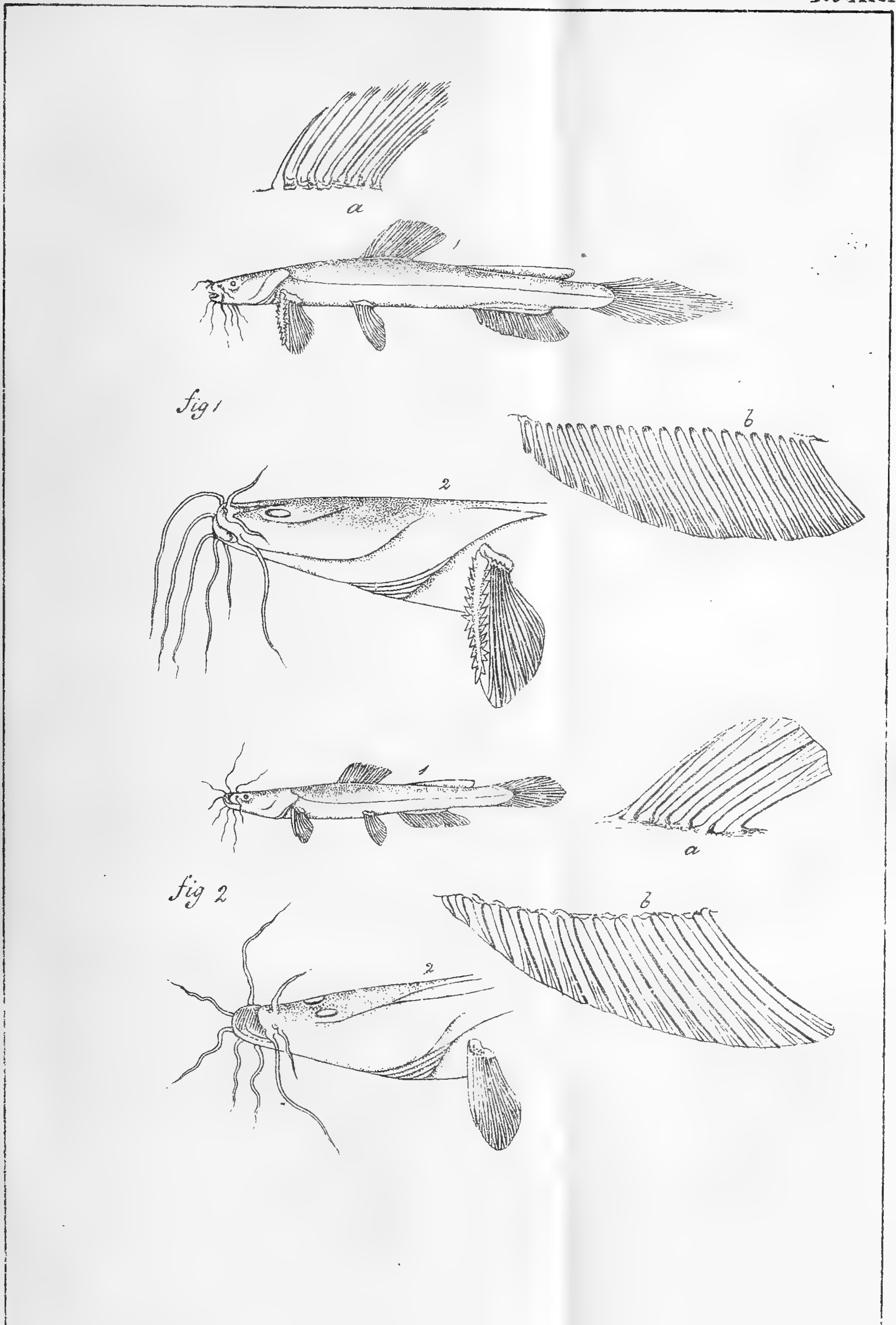
B. 6 : D. 7 : P. $\frac{1}{6}$ : V. 5 : A. 23 : C. $\overset{9}{\underset{3}{\overline{12}}}$.

The body is long and slender as in *Cobitis,* the air vessel, which is membranous, is placed in the anterior part of the abdomen; the stomach is a short blind sack, having the pyloric orifice near the entrance of the œsephagus, and the intestine small. This species seems to bring the affinities of the *Siluridæ* and *Cobitidæ* closer to each other than they seemed to stand before.

*Olyra laticeps,* McClell. t. xxi. f. 2. Lower jaw longer than the upper ; head much depressed at the snout; eyes small and vertical; the anal fin rays gradually increase in length from the commencement of the fin ; caudal entire ; six or eight slender cirri ; teeth like the pile of velvet.

B. 13 : D. 7 : P. 9 : V. 7 : A. 15 : C. 18.

* We add this species here, although we were indebted for it to the scientific zeal of the late Dr. Macleod, Inspector General.


a
1
fig 1
b
2
1
a
fig 2
b
2

Habitat. Kasyah mountains.

This species differs from *Pimelodus Cyclopium* in the caudal being entire and the anal long, and but for these two characters, we should have referred it to Mr. Swainson's American genus, *Cyclopium.*

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## *Correspondence and Papers relative to the manufacture of Glass and Earthen-wares and Fire bricks in India: received from the Government.*

*From* Mr. J. C. Pyle *of Furrackabad, to* T. C. Hunter Esq. *of the same place, dated* 28*th December,* 1840.

1. In compliance with your request, I have now the pleasure of sending a few common green glass bottles made by me at Futtehgurh.

2. Experiments to ascertain the point as to the possibility of making green glass bottles here with ingredients *boná fide* the produce of the country, were commenced upon by me on the 5th October last, and by persevering in them, I have been at last able to produce the bottles above alluded to, which notwithstanding their imperfections, decide the practicability of the manufacture.

3. The bottles forwarded are of two kinds: one of a dark, the other of a light green colour. In the dark green bottles, the principal ingredient is Ganges' sand, procured from the river here below the Fort. In the light green bottles, the principal ingredient is an earth procured from the other side of the Jumna. The flux is obtained from "raye," of which there is an extensive plain on the other side of the city of Furruckabad. The pots or crucibles in which the ingredients to form the glass were melted, were made of a very refractory clay procured from the other side of the Jumna; the furnace was built of fire bricks made of the same refractory clay; the fuel used was wood.

4. Upon comparing the bottles I have sent, with the English muster bottle you gave me, the following imperfections are apparent:—

1*st.* My bottles contain a number of air specks or bubbles in the body of the ware.

2*d.* The impression of the East India Company's mark is very indistinct.

*3d.* The rims round the mouths of the bottles have not been neatly fixed on, nor the mouths well rounded.

*4th.* The bottles are much thicker on one side than the other, especially near their bottoms.

5. With regard to these imperfections, (bearing in mind that this is the first attempt I have made to produce an article superior to common "*kanch*," of which all the country glass is made,) the first is the principal one, and it arises chiefly from the small scale on which the experiment was made, as the pots did not contain twenty pounds of glass each, and the heat was only kept up for ten hours; but in English glass houses,t he pots hold from one to two thousand pounds each, and the heat is kept up from forty-eight to sixty hours; so that on a larger scale, and by a longer continued heat, this fault would vanish.

6. The remaining three imperfections are entirely mechanical, and with able workmen, would cease to exist. It appears that in England, (vide Gray's Operative Chemist, page 557,) six persons are employed in the blowing of a single glass quart bottle, whereas I could only procure one glass blower in the whole of the city of Furruckabad, and this man had never been in the habit of operating upon any thing better than common country "*kanch*," which is very fusible, and so overdosed with alkali, as to be soluble in water.

7. I must observe, that the glass blowers of this country are able to work up English flint glass, the melting point of which is much lower than green bottle glass, and that various articles of flint glass are made at Delhi and Lucknow from broken English white glass, which they purchase for five or six Rupees a maund; but to melt green bottle glass is entirely beyond their power, as they possess no furnaces or pots capable of bearing the requisite heat. Flint glass melts, as stated by Nicholson, (article Glass,) at the temperature of ten degrees wedgewood; blown glass at thirty; and bottle glass at forty-seven. Now although the degrees of heat here stated may not be perfectly correct, still they may be supposed to be relatively so, which will easily account for the native glass blowers failing in all their attempts to melt bottle glass. It is also I believe impossible for them to melt crown, *i. e.* window glass, (although they can bend it,) the melting point of which is so much below that of bottle glass.

8. I beg further to state, that I should have been unable to send you the accompanying bottles, were it not for the practical knowledge I gained whilst Assistant to Doctor Julius Jeffreys some years ago, with respect to fire bricks, fusible and infusible clays, intense heats in furnaces, &c. when he was establishing his pottery for the manufacture of stoneware soda water bottles, and although he was ultimately successful, (for bottles of stone-ware are now made here equal to those imported from England,) still this among other causes tended to involve his affairs irretrievably, as the expences he incurred were upwards of 25,000 Rs.

9. I have also the pleasure of sending the following specimens :—

i. Two small crucibles; these are made of the same materials as the pots in which the glass was melted.

ii. A piece of the clay, used in making the fire bricks of which the furnace was built.

iii. A small parcel of the composition, used in making the dark green glass bottles.

iv. A small parcel of the composition, used in making the light green glass bottles.

10. In conclusion I beg to state, that as these experiments are very expensive, and my means not large, owing to the great competition in the business in which I am engaged, (the manufacture of soda and other mineral waters,) and besides as I have a family to support, I am sorry to say, it is not in my power to continue them any further, the object for which they were instituted having been gained, viz. the production of green glass bottles made of materials the produce of the country, superior to any common green glass bottles which have hitherto been made in it.

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2. *From* MR. J. C. PYLE, *to* R. N. C. HAMILTON, ESQ. *Commissioner, Agra, dated 3rd September,* 1841.

I beg to acknowledge the receipt of your letter of the third ultimo, with enclosures relative to the manufacture of glass in the Upper Provinces. My delay in answering it has arisen from my having applied to Calcutta for information on certain points connected with the glass trade of that port, but I am sorry to say, I have not been favoured with the same.

2. In reply to the first question in your letter under acknowledgement, I beg to state, that a certain demand of 4,850 rupees per annum, is not a sufficient inducement to establish a glass manufactory. In a glass furnace, after once the fire is lighted, the heat is kept up night and day without intermission, until the furnace becomes unserviceable; now the smallest sized working furnace would produce articles to more than ten times the amount noted above, and unless an outlet could be found for them, the manufactory would fail for want of encouragement.

3. In reply to question 2d, I beg to state, that exclusive of the Government demand noted of Rupees 4,850, (to which I will refer in the after part of this letter,) there must be a large consumption of common Wine or Beer bottles in Calcutta, and if through the Custom House returns, information could be obtained as to the number and value of these, a most desirable point would be gained.

4. Reply to question 3d. The locality of the manufactory would depend in the first place on the proximity and cheapness of fuel and of water-carriage.

1*st*. On the nearness or cost of conveyance to the mart where the articles made are to be sold.

2*d*. On the cost at the manufactory of the materials of which glass is to be made.

3*d*. On the cost of fire clays and fire bricks at the manufactory.

4*th*. On being able to procure able workmen on reasonable terms upon the locality.

5*th*. My own personal knowledge of the country does not enable me to mention any spot, which I could recommend for the establishment of a glass manufactory; for although I know of a spot where the materials for producing the glass are in abundance, I am not aware that there is any quantity of fuel near, or in other words to be obtained cheap. I also know of a spot where I believe the best fire clay in Upper India is to be obtained, but fuel is scarce, and therefore neither of these spots are suited for a glass manufactory.

5. The statement sent by the Officiating Apothecary, East India Company, simply states the number and value of glass bottles and

vials, imported and expended for the year 1840-41, to the exclusion of all chemical glass vessels; the value of the latter will, I think upon enquiry, be found considerable.* I beg moreover to state, that the presidency of Madras could easily be supplied with the glass-ware from the port of Calcutta.

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*From* Mr. J. C. Pyle, *to* J. Thomason, Esq. *Secretary to the Government N. W. P. Dated Agra, 6th September,* 1841.

I beg to acknowledge the receipt, through Mr. Dodd, of Dr. W. B. O'Shaughnessy's Pamphlet " On the improvement of Bengal Pottery," and to state, that as Mr. Julius Jeffreys late associate in business and his authorized agent, I deem it necessary, (Mr. Julius Jeffreys being in England,) to notice certain parts of the same.

| *Copied from Dr. W. B. O'Shaughnessy's Pamphlet.* | *Replies.* |
| --- | --- |
| 2d Page. 2d.—" With reference to Mr. Assistant Surgeon Jeffreys' experiments, I am in possession of no accurate information. The great ingenuity and perseverance for which that gentleman was distinguished, render it very probable that he did succeed. Indeed the chief difficulty in this and all such trials, seems to be the general dependence thereof on private resources at the first starting." | Never called for from me.—I have been a resident of Futtehghur for years past and carried on Mr. J. Jeffreys' concerns there, from the time of his departure until they were sold by order of the Civil Court; since which they have remained in my possession, with the exception of the nitre works. |
| 3d Page. 4th.—" A strict search in the Museum of the Asiatic Society only led to the finding of one | |

* The expenditure of these articles might be supposed to be large, although in reality it is very small, and must continue to be so until the manufacture of sulphuric acid is once entered upon on a large scale for the supply of public establishments. All other Chemical Manufactures would follow, and with them a demand for glassware.—Ed.

promising clay marked "Cheerra-poonjee," evidently a felspathic earth, proceeding from decomposed granite."

A few lines addressed to Mr. J. C. Pyle, mineral water manufactory, Futtehghur, would have brought forward a fund of information regarding Stone-ware Soda water bottles made there, which are equal, if not superior to English; also of the fire bricks made at Futtehgur, which in point of infusibility are superior to the celebrated Stourbridge bricks, although not so shapely.

No salt used in glazing the ware.

4th Page. 13th.—"I should not conclude this Report without prominently stating that I have seen a fragment of excellent Salt glazed Stone-ware, bearing the stamp "Futtehghur," and which I am informed was manufactured by Mr. Jeffreys, late of our Medical Establishment. I have been unable to procure any information as to the materials this gentleman used, the processes he employed, or the expense of the vessels. The manufacture has been abandoned since Mr. Jeffrey's departure from India."

No information was ever called for from me.

The manufacture was not abandoned on Mr. Julius Jeffreys' departure from India, but was carried on by me long after, and is still, with the exception of the establishment not being entertained, in working order; for I made it a point to keep the ovens, mills, vats, buildings, &c. in good repair. (Proof: the manufactory itself, and the manufactory books.)

5th Page. 18th.—"Made a trial on fire bricks sent to the Mint by Dr. O'Shaughnessy, and said to be prepared from materials raised near the river at Colgong, and consisting of three parts of Colgong Khari clay and a part of fuller's earth, "Saboon muttee." The brick was placed on its end in one of the Mint parting furnaces, with another Stourbridge fire brick, and fired on with coke to the greatest strength the draft would admit of, for five hours, and remained to cool down the next day. On examining the bricks on the following day, it was found that the Stourbridge brick was completely vitrified; but had not lost its figure. The Colgong brick was also vitrified, and had lost its figure on one side, it having run into holes; but on the other side, one of the original letters, which the brick was marked with, remained a very little disfigured. Previous to putting the brick into the fire, I observed that the materials composing it had not been well mixed, and which I think accounts for the irregular wasting that took place."

The late Mr. J. Prinsep tried some native clays sent to him by Mr. Julius Jeffreys, and found them superior to imported clays. Mr. J. Dodd, Assay Master, Agra, can furnish a copy of Mr. Prinsep's note on the subject, also musters of fire bricks made at Futtehghur.

6th. In troubling you with this communication, I beg to state, that I am willing to give any assistance in my power towards the improvement of Indian Pottery ; but at the same time to submit, that I see no reason why Mr. Julius Jeffreys, who ruined himself in his endeavours to improve the manufactures of India, should not receive the credit due to him for his exertions.

7th. Accompanying I have the pleasure of sending a few specimens of Stoneware made at Futtehghur, (I am sorry I have not more by me here to send,) and to mention, that a reference to my letters addressed to R. N. C. Hamilton, Esq. Commissioner of Agra, on the manufacture of glass, will be found to bear upon what I have herein stated.

8th. I beg further to state, that some months ago I forwarded through Dr. T. C. Hunter, Civil Surgeon of Futtehghur, to the Secretary of the Medical Board, Calcutta, a few specimens of Stoneware made there, but am not aware of any notice having been taken of the same.*

* We have recently received from Mr. Pyle, through the kindness of Captain Rainy, samples of various kinds of stoneware vessels manufactured by Mr. Pyle, and regard them as equal to Englishware in all essential qualities.

*Extract from a Report of* J. Homfray, Esq., *to* C. D. Russell, Esq., *in reply to a Circular from the Coal Committee, dated* 26*th March,* 1841,

Returning down to where the first traces of sandstone are found near to Serampore, we find on the south bank of the Damoodah, at a distance of about two to three miles, a range of hills of igneous origin, in reality of all compositions of granite, porphyry, and all the subdivisions of granite. This range runs parallel with the Damoodah, where in a line with the collieries, we find the first basaltic dykes issuing therein, and the whole of them, which are very numerous, can be traced to that source. Beneath these hills, in many places, a white porcelain earth, in character the same as the kaolin of China, is found, and from which I had some coarse pottery moulded in England; but it was pronounced to be unfit for fine ware. Between the river and a place called Mulliary, it exists in quantity, and there is also much found in other localities towards Bancoorah. Accompanying the coal is also found very good fire clay, and from which fire bricks are constructed by Messrs. Jessop and Co. in Calcutta, which they occasionally use in their iron smelting furnaces; it requires much care in the selection.

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*From* Mr. W. B. Turner, *late Superintendent of the Rajah of Travancore's Foundery,** *to* J. McClelland, Esq. *Secretary to the Coal Committee, &c. dated* 10*th October,* 1839.

I beg leave to inform you, of a thing that may prove of the greatest benefit to the work the Committee are about undertaking, that is, that there is excellent clay, equal to the Stourbridge, for making fire-bricks, crucibles, &c. to be had in Moulmein, near the military cantonment, not far from the European Grave yard. I made bricks, crucibles, and retorts for Dr. Campbell, to analize different minerals found by me, when Engineer of the Honorable Company's Steam boat

* At present Engineer to the Ceylon Government Steamer "Seaforth."

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The specimens consist of a large jug, a sugar bowl, and ewer, of the most graceful shapes, and ornamented to shew the facility with which the material may be moulded, as well as the perfection to which Mr. Pyle has brought the manufacture.

These articles are now in our possession, but we think they ought to be presented either to the Society of Arts at home, or some other institution capable of affording encouragement to, and protecting the interest of, such inventions.

Perhaps in India the best, or indeed the only way, in which the latter object can be effected is by an appeal to the Government.—Ed.

*Diana* in Burmah. I have never met with clay equal to this in any part of India I have travelled. Indeed it would be considered an inestimable treasure in Bombay or Travancore. This I will thank you to represent to the Governor General. There is no clay in Travancore or Malvar that will stand the fire in any other shape than the pots contained in the specimen box, which I hope you have received before this. There is no cast steel exported from Travancore, but a great quantity from Salem and Porto Novo.

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*From* James Dodd, Esq., *Assay Master, Agra, to* J. Thomason, Esq., *Secretary to Government, North Western Provinces, dated 6th August,* 1841.

I have herewith the pleasure of forwarding to you for the inspection of His Honor the Lieutenant Governor, specimens of fire clay, which I have every reason to believe are the productions of these Provinces. I am unable to speak of the qualities of these clays from personal acquaintance, if I except a few experiments made on them with the mouth-blowpipe, and I should have waited till I had gained further information about them, had I not lately heard that a great stir had been caused in Calcutta by the arrival of some fire clays from Singapoor. My object now is merely to draw the attention of His Honor the Lieutenant Governor to the fact of there being several kinds of fire clays in these Provinces, to state what has been the result of the experiments of other persons on some of these, and to enquire how far the Government are disposed to sanction an expense for the purpose of fully investigating the properties of all of them.

2. It may be as well for me in the first place to observe, that crucibles of fire clay will be required for the Bullion Depôt and Assay Office, and that although these could be obtained from Calcutta, yet when one bears in mind the liability there is to breakage during transport, and that so good a material for the purpose of crucible-making is found in the neighbourhood, I cannot help thinking that it would be desirable for some to be manufactured of this clay, and in that c[illegible]ll the outlay should not be placed to the score of the experiment, since the furnace for firing the crucibles would answer every purpose for examining the fire clays as to other qualities.

3. After a very partial inquiry, I find fire clays can be obtained from four localities, two places in Bundlecund affording them, one kind can be got at Delhi, and another from Gwalior. The specimen marked No. 1, one of those mentioned as coming from Bundlecund, was examined by the late Mr. J. Prinsep, who stated as the result of the experiment tried upon it, that it was far more refractory in the fire than the celebrated Stourbridge clay sent to this country from England: the English clay was fused, while the other remained unaltered by its side. The fragment of a glass pot, No. 5, composed of specimen No. 1, bears testimony to the goodness of the material from which it was formed; for although it has held glass in a state of fusion, it does not itself appear in the least degree altered, neither has the fused matter at all penetrated its pores: the glazing which may be noticed on the outside has been caused by the silica uniting with the alkaline ashes of the furnace. The other clay from Bundlecund, marked No. 2, of which in combination with No. 1, Soda-water bottles are manufactured, is much more fusible than the other clays which have been examined; this substance may be the result of decomposed felspar, and I found the edges of a fragment of it exposed to the blowpipe flame became translucent and rounded, behaving very like felspar when similarly treated. I am of opinion, this clay might be employed for the highest purpose of pottery, the No. 1 clay has given the Stoneware specimens a dark tinge; but I believe if another clay had been used, retaining its white appearance at a high heat, this tinge would not have been produced. Specimens marked No. 6, are fragments of Soda-water bottles, and in order that an opinion may be formed of the value of the composition of which these are made, I beg to refer you to Specimen No. 7, a fragment of an English Stoneware bottle, and I think you will agree with me in saying, that the India manufacture is not a looser by the comparison.

4. The whole bottle is also of Indian origin. Of this ware, might be made various articles for chemical as well as culinary purposes; viz. retorts, retort heads, receivers, funnels, mortars, evaporating dishes, spirit lamps, jars of all descriptions and gallipots, jugs, teapots, pickle jars, flower pots, &c.: and in many instances, where glass bottles are at present used, I think a great saving would accrue to Government, from the employment of those made of the country

Stoneware. The Delhi clay No. 3, seems to have been hitherto unexamined by any one; I may be wrong in saying this, but I have neither heard, or read any particulars respecting it. The native goldsmiths here hold it in high esteem for making crucibles for melting gold and silver in, at a heat necessary for these purposes; the clay stands well, and does not change its colour, it contains a good deal of mica, and a very small grained transparent sand. I am not sure that it comes from Delhi, but it bears the name of that place, and further inquiries shall be made about it. The specimen No. 4, was also examined by Mr. Prinsep; this he found to be less refractory than No. 1, but still surpassing in that respect the Stourbridge clay, so that we have in India two clays for fire bricks, both superior to that which is sent out from England, and of this fact no one in Calcutta seemed to be aware. As late as the beginning of the present year, within the last few months, Government purchased and sent for the use of the Bullion Depôt and Assay Office at Agra, 1200 fire bricks; better could have been obtained at Futtyghur. What I have said I feel would be much more satisfactory, could I now give any information respecting the cost of the fire bricks, and of the clay from which they are made, but this at present I am not able to do. Should the Government consider the subject deserving their serious attention, and order me to examine the fire clays, which I have now alluded to, I have much pleasure in being able to state, that I should be assisted in my investigations by Mr. Pyle, who, as having been connected with Mr. Jeffreys in all his experiments on the productions of this country, will be able to render me most valuable service.

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*Extract from a Report, by* Mr. A. T. Christie, *dated the 5th of September,* 1832.

Para. 4. A few miles to the north of Mangalore, and in connection with the laterite, I discovered an extensive deposit of pure Porcelain clay, very closely resembling that of Lemoges in France, of which the beautiful Sevres-ware is formed. I need not point out the importance of this article. Being found close upon the Coast, it might be easily shipped, and sent home as dead weight; or with the assistance of Chinese workmen, it may hereafter become an article of manufacture in India. I also found it in considerable abundance, and nearly of equal purity on the Neilgherries.

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*Report upon the manufacture of Pottery and Porcelain in South India, by Captain* J. CAMPBELL, *Assistant Surveyor General, dated Ryacotta, 22d September,* 1841.

1. All the varieties of Pottery and Porcelain are composed of silica and alumina in varying proportions, but as these earths are perfectly infusible in the strongest heat, the mixture could not therefore be aggregated together into a compact mass, without the aid of some substance which would partially fuse it.

2. Lime has the property of rendering a mixture of silica and alumina very fusible, and it is therefore used in the proportion of about one per cent. in the finest kinds of Porcelain, to which with the aid of a little potass, and a very high heat, it imparts that degree of semi-transparency, by which they are distinguished from what is generally called Earthenware.

3. Earthenware differs from Porcelain principally in containing more alumina, by which it is easier hardened in baking, but is always more or less porous, in consequence of which, it requires to be covered with a fusible varnish or glaze.

4. As the pure earths are seldom found in nature in a finely comminuted state, the materials for Porcelain and Pottery are derived from various earths and clays, by the admixture of which the proper proportions of the ingredients are insured. By the scientific operator, the knowledge of the component parts of the materials is derived from chemical investigation and analysis; by the merely practical man, from repeated trials of the properties of various mixtures when subjected to a strong heat.

5. In Porcelain, the principal material used is kaolin earth, found in Cornwall and in various parts of the continent, and which is generally considered by Geologists as decomposed or decayed granite. decomposed felspar, decomposed mica, and several other rocks; but which probably owes its origin to none of these, being particularized

by being very slightly fusible while, felspar is particularly so, and granite is one of the most fusible of known rocks. It probably owes its present state to that infusibility at a time when the aggregation of the more fusible rocks, with which it is associated, took place.

6. The principal material in the Earthenware is the finer kinds of clay found in Dorsetshire and Devonshire, but which as they are too aluminous to stand the operation of drying and baking without cracking, are mixed with a large proportion of silica derived from grinding calcined flints to an impalpable powder, whence it derives the name of "Flint-ware," by which it is most properly distinguished. Of this ware are formed plates and dishes, and articles of the same kind.

7. In a former Report I have shewn, that kaolin earth abounds in the red marle formation of Mysore, of a quality as fine, or perhaps finer than Cornwall affords, and in quantities which are inexhaustible, and have proved its fitness for the manufacture of Porcelain, by using it in the preparation of crucibles capable of bearing the very highest heat of a very powerful blast furnace, with a very slight degree of softening, and by which they become merely baked into a kind of coarse porcelain of a very pure white colour.

8. That South India abounds in clays of every variety of purity and colour, cannot be doubted, though the subject has never yet been properly investigated.

9. The common red calcareous clay used by the native potters is well known to every one, but the ware which they manufacture from it is quite unable to stand a heat above redness, from the readiness with which one of the ingredients (carbonate of lime) combines with silica and alumina, giving off at the same time its carbonic acid, which causes the fused clay to assume the form of a spongy, bubbly mass.

10. The fact of the carbonic acid being thus given off, proves that the carbonate of lime is only in the state of a mechanical mixture with the other ingredients, and not in chemical combination; whence is certain, that it may be easily removed by the action of acids upon the clay, (perhaps cheaply by employing the common country vinegar,) and the clay thus fitted for firing at high temperatures.

11. The natives who flux a mixture of white quartz and crude soda for making a coarse glass for the bangle-makers, use small

chatties made of clay as crucibles for containing the materials; and brass-workers throughout India use for melting brass, crucibles of good quality, formed of a mixture of red clay, sand, and charcoal, which stand a high temperature for a long time; also the whole of the cast steel made in India is fused in crucibles made of a red clay; and as steel requires for its fusion almost the highest heat of a blast furnace, it cannot be doubted that clays sufficiently refractory for the purpose of making pottery, can be readily found, if properly sought for.

12. The white goglet of Arcot is well known, and the black and blue clays of various parts of the country are too common to require note, while the beautiful black clay, (probably manganesian,) have been long admired in the Beder-ware, of which hookah bottoms of high price are manufactured.

13. That pipe clay abounds, is shewn by the readiness with which troops obtain it in all parts of India, although I am unable to specify the localities from which the supplies are derived.

14. A silicious material is readily found in the white quartz which abounds in all parts of South India, of a finer quality and greater degree of purity than can be afforded by any kind of flint, and any degree of admixture of lime required in the manufacture may be produced by fusing together quartz and pipe clay with lime, either as a carbonate or in the caustic state, and grinding down the mass afterwards for mixture with the other materials; while the soda required in the preparation of glasses, can be procured as a mineral product in any quantity, (as shewn in a former Report.)

15. In preparing the material in England, the calcined flint is first ground to an impalpable powder in a mill, and the clay earth is worked and mixed in mills for the purpose.

16. The materials thus prepared, are mixed and stirred up with water, (called blunging the clay,) and being then allowed to settle, the coarser and gravelly particles are deposited, while the finer are drawn off suspended in the water, and it is then strained through sieves of lawn, by which all impurities are separated, and the fine pulp thus formed is called "slip."

17. The quantity of the materials which the various slips contain, is ascertained by their specific gravity, and these being mixed together in proper properties, the proper mode of managing which

is considered by the manufacturers as a great secret; they required intimate mechanical mixture of the materials it procured, and the superfluous water in the fluid pulp is evaporated in a cistern called the slip kiln, to which heat is applied.

18. The slip thus reduced to a pasty mass is removed, and is stored for many years in chambers on stone floors, where it is probable some chemical reaction goes on between the component earths, by which they are better fitted to react upon each other in the firing. Indeed it is almost certain, that such reaction has place, because in some of the mills in which the slip is very finely ground between two horizontal stones for the manufacture of Porcelain, the stones when allowed by accident to remain at rest for an instant, are so firmly cemented together, as to resist the action of a very considerable force to separate them again.

19. The evaporated slip now called clay is then "wedged," by beating it with mallets, and cutting into pieces with a spade, by which all the air bubbles it contains are dislodged; or in large works, a machine with revolving knives, which alternately cut and press it, produces the same effect.

20. The clay is then taken by the "thrower," who first subjects it to the operation called "slapping," by which any remaining air bubbles are completely dislodged, and it is then stuck upon the apex of the "potter wheel," and is fashioned, while revolving, by the naked hands, into the form of the vessels required.

21. The clay having been "thrown" into the rough form of the vessel, it is allowed to dry for a short time, and being then in what is called the "green state," it is fixed in a lathe, and turned with tools, or rather scraped into a correct form.

22. When the vessels required are of irregular figures, or are ornamented, they are formed by squeezing or "pressing" the clay between moulds made of Plaster of Paris, and the handles, spouts, &c. are formed in the same way, and are stuck on with a little soft "slip."

23. The ware is then put in cases of infusible materials called "seggars," and is fixed in what is called the biscuit oven, so named from the appearance of the ware after its removal, in which state it is fitted to receive and imbibe colours, prints, or paintings.

24. The next process is " glazing," in which the porous biscuit is dipped into a sort of pulp formed of more fusible materials than the ware, and it is again fired in the " glass oven," with a heat just sufficient to make the glaze run, and cover the ware with a thin hard transparent covering of glass, through which the colours, &c. laid upon the biscuit, become visible. The best receipts of these glazes are considered of great value, and are carefully concealed.

25. In coarse pottery, the glazing is effected in the first firing by throwing into the bottom of the oven a quantity of salt, the fumes of which react upon the surface of the vessels, and flux the surface, so as to render them impervious to liquids.

26. With the exception of adjusting the proportions of the mixture of the slip, there is obviously nothing in the above processes which natives of India are not just as capable of performing as Europeans, and from their easy acquirement of manual dexterity, may possibly perform better; and as the materials are abundant, labour cheap and plentiful, and wood fuel still covers vast tracts, there can be no reasonable doubt, but that the manufacture of porcelain and pottery might be carried on in South India.

27. The demand for the manufacture of Pottery in India is not likely to be great, and among the articles probably required may be enumerated—

Gallipots and vessels, for packing medical preparations for the medical stores.

Jars, for holding corrosive liquids and spirituous liquors, for which the native chatties are quite unfit.

Earthen vessels for preparing and refining sugar.

Firebricks, which may be made in Bangalore, for a very little more than common bricks; the only increase of expence is the quantity of fuel required to ignite them properly.

Crucibles, for melting metals in the Government founderies.

Retorts, for preparing corrosive liquids and acids in parting silver from gold.

And what may probably eventually prove to be the largest demand, coarse plates and dishes for the use of the European soldiery in India; for from what I have observed, they are reduced to the miserable expedients of tin pots and native chatties, while if I mistake not, the labouring class in England, always use cheap coarse white plates and jugs, &c. in their cottages.

28. That the above may be made advantageously in India cannot admit of a doubt, and it is also probable, at a cheaper rate than in England, but whether the establishment of the manufacture will afford a profitable return, must remain a matter of doubt until the experiment is tried.

29. Natives of India do not possess the information necessary for undertaking an experimental manufacture of this kind, and even if any had the information, although not deficient in ingenuity, yet they entirely want the energy and application necessary to meet contingent difficulties.

30. Englishmen of sufficient capital and attainments are not likely to invest their capital, or to give their time or attention to this manufacture, where so many more channels for commerce are open.

31. If the experiment of the manufacture is desirable, either upon the confined principle of economy, or for the more extensive purpose of disseminating among the Natives of India a practical knowledge of the enlightenments of European science, and the talents and skill employed in European manufactories, it is most probable it can only be effected by the direction of, and on account of, Government.

32. The experiment undertaken merely by practical men of no education, who have been employed in Potteries, could be of no use in India, as such persons must be wanting in all the information and resources required to establish a manufacture with new materials, and with workmen, with whose capacities and peculiarities they must be ignorant of; and gentlemen of education, who possess an experienced knowledge of the manufacture, could hardly be expected to afford their services under 700*l.* or 1000*l.* per annum.

33. If the experiment is undertaken, it is probable that among the Medical Officers, or in the Officers of the Army, individuals may be found, who without any practical knowledge in the manufacture, yet may possess the necessary information to devise or direct the establishment, as it will be plain from the foregoing sketch of the processes, that manual skill is but little required in the matter.

### *Dr.* O'Shaughnessy's *Experiments on Pottery.*

Along with the foregoing papers we also received a pamphlet entitled, "On the Improvement of Bengal Pottery, by W. B. O'Shaughnessy, M. D. Assistant Surgeon," from which we learn that four parts of Colgong *Khari,* and one part of the *Saboon Muttee* of the same place afford a good stoneware, which may be glazed with borate of lime, and thus made to supersede the imported earthenware.

In our endeavours to see the stoneware thus made, we were only fortunate enough to obtain inspection of a single specimen, and that a very small eight ounce jar; which, for ought we have been able to learn, seems to be the only one manufactured. Nor is there any thing to shew or explain why, after having discovered the right proportion of his materials, and the proper method of treating them, the Doctor did not make at least several jars, large and small, of the different kinds required; particularly as he was provided, as appears from his pamphlet, with all the necessary practical resources for doing so. The furnace erected for these experiments cost 650 rupees, and there was probably an equal outlay for mixing vats and other similar appliances on a large scale, which ought to have enabled the experimenter, with the aid of the workman who we also learn from the pamphlet was employed under his orders, to have produced results of corresponding proportions. He has not done this, and it would be impossible for any one else to follow up his experiments without incurring the same preliminary expense as if no previous trial whatever had been made. The next conclusion, and indeed the only other to be gleaned from Dr. O'Shaughnessy's pamphlet, is the following, which we purposely print in italics, because it appears to be at variance with the results which follow, and which were obtained in another quarter. "*To glaze the common Kedgeree ware of Bengal, I look upon as a vain attempt. It is so fusible itself that no glaze but one containing an unusually large proportion of lead could be employed at all.*"

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### *Experiments made at the Honorable Company's Dispensary, Calcutta, to obtain common earthen Jars.*

The jars required for the issue of medical stores, and which it was the object of the Medical Board to have provided when the subject was referred to Dr. O'Shaughnessy, are classed according to the quantity they are intended to hold, from 25lbs. down to ½lb. finding no other available way of obtaining earthenware of this description for current use. The supplies from home being suspended, specimens of the jars required were shewn to the *Comars,* or *Potters,* in the Bazar, and the simplest method of glazing explained to one of the most intelligent of them, who was told merely to cast a handful of salt into the fire when the pots were at a red heat. He reported the result, which was unfavourable. He was then directed to pound a certain proportion of flint, and mix it with the clay of which the pots were made, and again to try the salt. This attempt succeeded partially. He was then desired to bring specimens of the materials used to the Dispensary for inspection, when his clay proved to be the common Bengal blue clay of which the Kedgeree pots are made, and the flint used merely the common *whin,* or greenstone of which the roads in Calcutta are repaired. The *Comar* was recommended instead of the latter to use quartz rock. He seems however to prefer his own way, nevertheless he has ever since continued to supply well formed jars with a fine, shining, dense, and impervious glaze. The glaze is however acted upon, and slowly removed by dilute acids, and would not therefore do for pickle jars, but answers for ointments, powders, neutral salts, and all those purposes for which the English jars were imported. As an encouragement to the *Comar,* he was offered the English invoice price of the article, exclusive of charge for freight, and loss for breakage, and he has continued since (May 1841,) to supply all the jars required at the following prices, with an understanding that he is to continue his experiments till he produce a glaze that will stand the action of acid.

| | | | Rs. | As. | | |
|---|---|---|---|---|---|---|
| 16 lb. | Jars | at | 6 | 0 | per | dozen, |
| 8 lb. | do. | at | 3 | 8 | per | do. |
| 6 lb. | do. | at | 2 | 4 | per | do. |
| 4 lb. | do. | at | 2 | 0 | per | do. |
| 2 lb. | do. | at | 1 | 0 | per | do. |

The whole expenditure of these articles at present is not such as would pay European superintendence, but it is sufficient to excite competition with the natives. The article produced from Bengal clay is never likely to supersede the excellent stoneware manufactured at Futtygurh by Mr. Pyle, and for which the country stands indebted to the enterprise of Dr. Julius Jeffryes. This improved Kedgeree ware agrees in every way with the corresponding description of coarse English crockery; it is of course unfit for chemical purposes, and is only calculated for packing medicines, for holding water, milk, ghee, oil, and the like; and as it requires a little common salt for the production of the glaze, somewhat more fuel, and a little more labour, it is consequently somewhat more expensive than common Kedgeree ware; but being glazed it is capable of being perfectly cleansed, and therefore may be repeatedly used when the Kedgeree ware cannot. For this useful result we are indebted to the pains which Mr. Dick, and other assistants in the H. Co's. Dispensary took to make the *Comars* understand the instructions given in Dr. Ure's Chemical Dictionary for glazing this description of ware. Although the vessels we have thus succeeded in obtaining, answer all the purposes for which earthen jars have heretofore been imported from Europe, for packing medical stores, yet the ware is much inferior to what it might be made. Indeed it is inferior to native earthenware, of which a sample has been received from Capt. Bogle. It is inferior also to the Pegu ware. Both of these last kinds of crockery are glazed; and the glaze unaffected by acids of any description, under any circumstances. With the sample received from Capt. Bogle, we had no information. The colour and appearance of the glaze, however, reminded us of the chillums made at Moorshedabad, being of the same green colour. On reference to Capt. Showers for information relative to the glazing of the latter, that gentleman was good enough to furnish a sample of the materials used, of which oxide of lead was one of the principal ingredients, the green colour, which is not essential, being given by the addition of copper filings. This and all lead glazes we have tried are easily removed by acids. We trust however now that attention has been directed to the subject by Government, that inquiries will be instituted into the native methods of glazing, and the materials used for the purpose.* With regard to clays, one of the best we

* We require very much to know something of the manufacture of Pegu earthenware, which is of a coarse, cheap, substantial character, and is coated with a thick black glaze, upon which acids have no effect whatever.

have seen has been furnished by Mr. Inglis of Cherra Ponji. Captain Jenkins supplied us with decomposed granite, which seemed capable of receiving a glaze from the fumes of salt, but from the imperfect means of grinding and previous preparation to which it was exposed, it could not be made sufficiently tough and adhesive, and this will be an obstacle to the production of any kind of ware in India, for many years to come, except such as may be made from natural clay. A second sample furnished by Captain Jenkins, and said to be the pipe clay discovered by Mr. Bedford in the Caribari hills, proved to be fine white sand, somewhat adhesive when moist, but quite friable when dried.

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## *Apparent objections to Captain* Hutton's *Theory of the formation of Terrestrial Strata. From a* Correspondent.

Any one perusing the two lately published essays* of this author, on the very intricate subject, which he has attempted to elucidate must acknowledge the ingenuity he has exhibited in his endeavours to make all parts of his scheme consistent with the Mosaic records, with actual geological facts, and with one another. It is much to be feared, however, that he has, in his zeal to establish his theory, but become an addition to the number of certain preceding labourers in this interesting field, whose case he has described towards the close of his last article in these words: "How easy is it for an author to be absolutely blind to those facts, which are opposed to his favourite fancies, while they are otherwise apparent to every one besides."

But with hopes, however slight, that such is not his case, I have ventured to note down the following apparently insuperable objections to his theory; should he deem them of sufficient importance for his notice, and succeed in overruling them, the consciousness of my obtuseness, (which I will then gladly confess,) will be compensated by the additional explanations I shall have elicited, and which, if satisfactory, will go far to make his scheme perfect.

I understand the principle and basis of his conclusions to be, to demonstrate, that there have been two great geological revolutions of our earth; viz.

* Calcutta Journal of Natural History, No. 4 and No. 7.

The first at the date of the fall of man, and his expulsion from Eden : that the curse called forth by his transgressions " immediately operated in reducing the temperature of climates ;" " by which numerous species of animals and plants became extinct :"* thus accounting for the organic remains, which we find deposited previous to the completion of the secondary geological strata.

The second revolution he dates at the Mosaic deluge, by which, he says, " the temperature of climates was still further reduced ;" and again, " various species of plants and animals destroyed :"† this revolution forming the tertiary and diluvial strata, and the fossil remains which are found therein, being thus accounted for.

I. The most obvious objection to the above account of the first revolution is the absence of all mention in the Mosaic record of either of the remarkable events thereon attending ; viz. the change of temperature, and the destruction of such various tribes of plants and animals as we find embedded in the transition and secondary strata ; which entire silence is sufficient to throw discredit on the probability of these events. No mention is made of any part of the creation having been destroyed, or any new creation made when our parents were expelled from Eden. We are merely told that they were driven from the confines of the blessed spot, into the wide world beyond, which had been so lately the scene of creation of the vegetable kingdom, and of " *every* living creature after his kind."

II. But although we have no direct testimony of these destructive events, the author adduces two verses of the first Chapter of Genesis (v. 29 and 30), which he considers sufficiently explicit to warrant the conclusion he has come to: these verses say, that to every beast of the earth, every fowl of the air, and creeping thing was given " every green herb for meat ;" ergo, it is argued, there could have been no carnivora at that time ;—ergo carnivora were created subsequent to the Fall. Now this position may easily be disputed when it is remembered, that even in the short record we have of the period previous to the Fall, we have positive mention of at least one carnivorous animal ; viz. the serpent: but passing over this objection, and granting that the chain of argument so far holds good, such argument cannot

* Calcutta Journal of Natural History, p. 397.

† Ibid. p. 398.

prove the supposed change of temperature, inasmuch as we find it by no means a fact, that herbivora are more suited to a hot climate, and carnivora to a cold one, but rather the contrary.

III. Again, the verses in which our Lord curses the earth, and ordains that it shall bring forth thorns and thistles, and require the sweat of man's brow to make it yield him sustenance, cannot assist his argument of the reduction of temperature, for he cannot prove that any reduction of temperature was at all necessary to produce those effects. Did we find that "thorns and thistles" and useless weeds flourish only in a comparatively cold climate, or that the fertility of our earth increases in proportion to increased average range of the thermometer, then indeed there would be some ground for his argument, but we know that such is not the case ; but that the temperate zones and regions of the earth are the most fertile and luxuriant in their vegetable gifts that are suited to man, and that we find vast tracts of the hottest regions entirely barren and waste : moreover, that "thorns and thistles" are found in the hottest temperatures that any vegetation at all can exist in.*

Now, had we warrant in the Bible for either one of the supposed events, *i. e.* the reduction of temperature and the destruction of animals and plants, the other might possibly be taken for granted by inference ; but in the absence of either being mentioned, we are reduced to rest our belief in Captain Hutton's Theory on two hypotheses, each leaning on the other, and as far as the Bible is concerned, destitute of any extraneous support ; and as in physics it is manifest that any two bodies in such a dilemma must fall to the ground, I fear Captain Hutton's argument is liable to the same fate.

IV. The same objection of want of all positive record in the Bible of the phenomena attending the first curse, as above noticed, may be applied with equal force against the supposed further thermal reduction, and its destroying effects, which are described as attending the second revolution, that is to say, the Flood, as described by Moses.

* According to the calculations of Humboldt, the natural order of Compositæ to which thistles belong, constitutes 1-7th of the Phœnogamous plants of France, $\frac{1}{8}$th of Germany, 1-15th of Lapland, in North America 1-6th, *within the Tropics of America* $\frac{1}{2}$.—See Lindley's Natural System of Botany, order Compositæ.

It is hard to believe how a reduction of temperature sufficiently violent to cause the extinction of the numerous species of animals and plants, which we find buried in the tertiary and diluvial strata, though not in existence since those formations, could have escaped even the most casual notice in an historical record of the period; and severely felt also, as such a change must have been by Noah and his family.

V. But, as in the case of his first revolution, Captain Hutton here also produces a text from the book of Genesis, which he conceives affords some grounds for his Theory: it is in the words (chap. ix. v. 10,) "from all that go out of the ark to every beast of the earth," and he infers that the "beasts of the earth" here referred to, are to be construed as meaning large series of animals, introduced by many successive creations since the time of the deluge. Now even supposing such post-diluvian creation, (which we shall attempt to shew presently are not warranted by actual geological discoveries,) they could in no way prove the alleged meteorological changes of the first or second revolutions, or the destructions thereon attending. His argument appears to stand thus :—

Beasts have been created since the deluge.

1. As such beasts were not created before the deluge, the antidiluvian climates cannot have *been suited* to their natures.

2. This unsuitableness consisted in the temperature of climates *being higher* before the flood than after.

3. Consequently a reduction of temperature took place at the deluge.

Which reduction of temperature caused the *extinction* of certain species of animals and plants.

Therefore there were species of plants and animals up to the time of the flood, which did not exist afterwards.

Now as we have no warrant in the Bible for either of the three positions here assumed, and numbered as above, and as they cannot be inferred from the mere fact of post-diluvian creations, we are reduced to consider such positions, as far as the Bible is concerned, as mere hypotheses, and therefore in no way capable of strengthening the construction which Captain Hutton puts upon the verse last quoted.

So that the Mosaic record affording as little authority for these supposed changes of the second revolution as it did for those of the first, we are brought back to the point from whence we started, that the Bible, *per se*, affords no support to Captain Hutton's Theory.

VI. But how do geological discoveries, actually made, accord with Captain Hutton's views? Do the organic remains which we find embedded in the strata under consideration help to corroborate, any more than the Mosaic record, the facts of these supposed revolutions? On the contrary, we find *all* the remains of vegetables and animals of those by-gone epochs as yet discovered, belonging to extinct species, many of them to extinct genera, and all differing from any known species now in existence;* whereas if a *part* only of the vegetable and animal creations had been destroyed by those revolutions, the remainder, that is, the persisting species, which were able to bear the reduction of temperature, would also, as a natural consequence, have been found also embedded in the same strata, as they grew and died on the same localities; the utmost difference being, that the latter died perhaps a few years later in the common course of nature.

VII. The supposition that the mere reduction of temperature described as attending the first revolution would be sufficient to form all the strata of such vast thickness which we find alternating up to the completion of the secondary strata, is at variance with all we know of the relations of cause and effect in Nature's economy. The author says, that this first revolution "was *at once* carried into effect;" that "the effects of this dreadful curse were *at once* felt," such are his words at pages 394-5. Now, leaving the earlier conglomerates of the transition series, in which remains of animal life have been found, and the whole Silurian system, let us consider one example from the carboniferous series: the latter, in one place in England alone, measures a thickness of more than 4000 feet, and contains 32 distinct beds of coal; how could such an arrangement as this have been the effect merely of any change of temperature, however severe and sudden such change might be supposed?

VIII. Neither can the difficulty be got over by the supposed upheavement of mountains and other volcanic phenomena, said to have also attended the first revolution, which the essayist calls in to his assistance in accounting for these huge stratified formations;

* Phillip's Guide to Geology, 1834, p. 61-63.

though without a shadow of Scripture warrant for so doing. No sudden volcanic impetus, though combined with a reduction of temperature, is sufficient to account for such a carboniferous series as above described; many of the strata containing the impressions of large trees, which must have taken years to attain their apparent growth: again, the intermediate strata contain fossil shells and deposits of a diluvial nature: those in the lower beds being of a marine origin, and those of the upper strata apparently once the inhabitants of fresh water; circumstances all conspiring to impress us with the idea, that they must have been deposited by a slow and quiet process, probably extending through long periods of years.

IX. Let us take one more view of the subject, and suppose that the alleged reduction of temperature with its consequences, and the attending volcanic formations, were but gradual in their progress, occupying the period from the Fall, when the curse began to be fulfilled, up to the time of the deluge, a period of about 1650 years: granting that the strata of the transition and secondary formation were deposited gradually during this interval, or a greater part of it; this hypothesis also is by no means confirmed by any organic remains hitherto discovered in those deposits, they being almost entirely of an aquatic description; the animals almost universally so from the humble mollusc to the gigantic saurians: "the only terrestrial mammalia," says Buckland,† "yet discovered in any secondary strata are the marsupial quadrupeds allied to the opossum." Now had these ante-diluvian animals been, as the theory under consideration would make them, contemporaneous with the "cattle," "the beasts of the field," and the sheep which we find distinctly mentioned from the very commencement of the period in Genesis iv. 2, surely some remains of the latter description would be found also entombed in those strata.

X. The absence of any well-authenticated evidence of fossil human bones, or any trace of human nature throughout the geological formations, though negative evidence indeed, is still a strong argument against the opinion of the structure of those formations since man began to "increase and multiply and replenish the earth."

* Section of the strata from Newcastle upon Tyne to Crossfell in Cumberland.

† Bridgewater Treatise, p. 64.

XI. So many of the objections to the probability of the events attending the first revolution, as above advanced, being equally applicable to the second revolution, a recapitulation thereof as arguments against the latter is considered unnecessary.

I intend to advance no geological system of my own in this place; but, in conclusion, I would beg leave to draw the attention of all amateur geologists to the following passage of Professor Buckland, which speaks for itself:—

> "The disappointment of those who look for a detailed account of geological phenomena in the Bible, rests on a gratuitous expectation of finding therein historical information respecting all the operations of the Creator in times and places with which the human race has no concern; as reasonably might we object that the Mosaic history is imperfect, because it makes no specific mention of the satellites of Jupiter or the rings of Saturn, as feel disappointment at not finding in it the history of Geological Phenomena, the details of which may be fit matter for an Encyclopœdia of Science, but are foreign to the objects of a volume intended only to be a guide of religious belief and moral conduct."

And thus we find, that all the attempts made to compress the events of many thousand years previous to the creation of man into the comparatively small portion of eternity which has elapsed since that event, and to make them accord with any authentic record we can have of the last named period, has always proved, and must always prove, abortive.

*Jessore, 6th December,* 1841.

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## *Polynemus Sele, or Isinglass Fish at Arracan. Communicated by Captain* Bogle.

The Polynemus Sele, or Suliah fish, is called in Arracan the *Lakwah,* it is from three to four feet long; it is caught in a large net, which is made in a manner peculiarly calculated to take this fish, besides other kinds. It appears about the beginning of January, and is to be found in very large quantities in all the estuaries of Arracan, until the month of April, when it disappears. It is said that 10,000 of this fish, great and small, are yearly caught. The Mughs split and clean them, extracting the principal bones; they then dry them in the sun, without salting or otherwise preparing them, and when dried, sell them at the rate of four or five for the rupee. The value of the air-vessels has only lately become partially known to the fishermen of Arracan, consequent on the settlement of a few Chinese in this province. Until within the last six or eight years, they always threw them away; but they now preserve them, and sell them to petty merchants, at the rate of from sixteen to eighteen for the rupee: which would be eight rupees per maund for the very largest size usually obtained, but about twenty for the average description. These merchants again sell them to the Chinese, as the latter say, at the rate of thirty rupees per maund, but it seems questionable if they ever pay more than twenty-five.

Three or four years ago, the air-vessels sold at thirty to forty for the rupee; but the demand has increased, and the price risen, and it will increase still more, for a few Mughs have recently taken them to Calcutta, and there obtained thirty to thirty-five rupees a maund for them.

The Chinese export the dried air-vessels, which sometimes weigh about eight ounces, but more generally about four or five ounces, to Penang and other eastern settlements, where they are in great request. It is not possible to ascertain the quantity exported, but it is believed that full 5000 ℔s. might annually be collected in Arracan, at an outlay of not more than 1500 rupees. In the course of a few years, the supply might of course be increased to an incalculable extent. The Chinese sell them at Penang for forty or fifty dollars per maund, or about 400 per cent. profit.

NOTE.—In the April Number of the Calcutta Journal of Natural History, we hope to be able to offer further information on this subject. To enable us to do so, we trust that correspondents will favour us in the meantime with the latest results.—ED.

*Meteorological Register, kept at the Surveyor General's Office, Calcutta, for the Months of* OCTOBER, *and* NOVEMBER, 1841.

| October. Day of the Month. | Moon's Changes. | Observed at 9 H. 50 M. | | | | | Observed at 4 P. M. | | | | | Rain Gauges. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Barometer. | Temperature. | | | Wind. | Barometer. | Temperature. | | | Wind. | | |
| | | | Of the Mercury. | Of the Air. | Of an Evapg. Surface. | Direction. | | Of the Mercury. | Of the Air. | Of an Evapg. Surface. | Direction. | Upper. | Lower. |
| 1 | | ,623 | 80,6 | 82,0 | 78,4 | W. S. W. | ,590 | 81,6 | 82,1 | 78,4 | WSW. | 2.49 | 2.72 |
| 2 | | ,725 | 79,6 | 81,2 | 77,6 | W. .... | ,677 | 80,5 | 80,6 | 78,0 | NW. .. | | |
| 3 | | ,741 | 80,8 | 84,0 | 80,2 | W. .... | ,700 | 84,0 | 87,3 | 81,8 | W. .... | | |
| 4 | | ,869 | 82,0 | 84,6 | 82,2 | N. E. .... | ,823 | 81,9 | 83,0 | 80,2 | NE. .. | | |
| 5 | ☾ | ,929 | 82,9 | 90,0 | 84,2 | N. W. .. | ,875 | 84,5 | 90,5 | 83,8 | NW. | | |
| 6 | | ,945 | 83,2 | 86,0 | 81,8 | W. S. W. | ,874 | 85,0 | 91,0 | 84,0 | W. .. | | |
| 7 | | ,925 | 83,3 | 88,4 | 82,0 | W. .... | ,869 | 86,2 | 92,5 | 85,0 | NW. .. | | |
| 8 | | ,977 | 83,6 | 91,0 | 81,3 | N. E. .... | ,900 | 85,0 | 92,0 | 82,1 | NW. | | |
| 9 | | ,957 | 83,8 | 89,8 | 81,6 | N. W. .. | ,866 | 85,1 | 90,6 | 80,4 | NW. | | |
| 10 | | ,893 | 83,9 | 90,0 | 82,0 | W. .... | ,814 | 86,6 | 91,5 | 81,6 | W. .... | | |
| 11 | | ,865 | 83,3 | 89,9 | 83,0 | E. .... | ,800 | 85,5 | 91,8 | 81,9 | N. .. | | |
| 12 | | ,922 | 83,1 | 80,1 | 82,0 | E. .... | ,850 | 84,8 | 90,4 | 82,1 | NE. .. | | |
| 13 | ● | ,898 | 83,3 | 88,6 | 80,7 | N. E. ... | ,830 | 84,5 | 90,3 | 82,3 | N. .. | | |
| 14 | | ,873 | 83,1 | 89,0 | 81,0 | N. W. .. | ,798 | 84,7 | 88,9 | 81,2 | W. .. | | |
| 15 | | ,854 | 83,9 | 90,3 | 82,0 | W. .... | ,778 | 84,6 | 90,4 | 82,7 | W. .. | | |
| 16 | | ,878 | 84,0 | 90,2 | 82,4 | W. .... | ,809 | 85,7 | 89,8 | 82,0 | W. .. | | |
| 17 | | ,900 | 84,5 | 91,0 | 82,0 | E. .... | ,850 | 87,3 | 91,2 | 82,0 | W. .. | | |
| 18 | | ,914 | 84,0 | 90,5 | 80,7 | S. .... | ,866 | 85,5 | 90,0 | 81,8 | WSW. | | |
| 19 | | ,913 | 84,1 | 87,5 | 81,6 | W. S. W. | ,841 | 85,5 | 89,3 | 82,0 | WSW. | | |
| 20 | ☽ | ,874 | 83,7 | 87,5 | 81,8 | W. S. W. | ,817 | 85,0 | 89,4 | 82,5 | WSW. | | |
| 21 | | ,857 | 83,0 | 90,0 | 82,2 | N. W. .. | ,810 | 84,1 | 90,0 | 80,6 | WW... | | |
| 22 | | ,885 | 83,4 | 88,7 | 81,0 | W. .... | ,822 | 84,4 | 90,5 | 82,0 | W. .. | | |
| 23 | | ” | ” | ” | ” | ” | ” | ” | ” | ” | ” | | |
| 24 | | ,930 | 82,8 | 90,0 | 80,5 | E. | ,858 | 84,0 | 90,0 | 80,2 | N. .. | | |
| 25 | | ,953 | 83,0 | 87,9 | 79,0 | N. E. .... | ,873 | 86,4 | 90,2 | 81,4 | E. .... | | |
| 26 | | ,917 | 83,0 | 90,7 | 82,8 | E. .... | ,830 | 84,0 | 88,5 | 81,7 | NE. .. | | |
| 27 | ○ | ,894 | 82,6 | 86,1 | 80,8 | N. .... | ,802 | 83,8 | 88,6 | 81,9 | SE. .. | | |
| 28 | | ,857 | 82,1 | 84,3 | 80,5 | N. .... | ,765 | 83,5 | 88,0 | 82,2 | W. .. | 0.39 | 0.44 |
| 29 | | ,894 | 83,5 | 88,1 | 81,9 | S. E. .... | ,822 | 82,4 | 82,0 | 78,3 | NW. | | |
| 30 | | ,906 | 82,4 | 88,0 | 81,9 | N. N. .... | ,853 | 84,1 | 89,7 | 80,8 | NW. | | |
| 31 | | ,898 | 82,5 | 90,0 | 80,0 | N. N. .... | ,817 | 84,4 | 89,0 | 80,0 | W. .. | | |
| | | [illegible] | [illegible] | [illegible] | [illegible] | | ,814 | 84,5 | 89,0 | 81,5 | | 2.88 | 3.16 |

| November. Day of the Month. | Moon's Changes. | Barometer. | Observed at 9 H. 50 M. | | | | Barometer. | Observed at 4 P. M. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Temperature. | | | Wind. | | Temperature. | | | Wind. |
| | | | Of the Mercury. | Of the Air. | Of an Evapg. Surface. | Direction. | | Of the Mercury. | Of the Air. | Of an Evapg. Surface. | Direction. |
| | | Inches | o | o | o | | Inches | o | o | o | |
| 1 | | 29,829 | 82,5 | 87,0 | 80,8 | W. .... | 29,742 | 84,7 | 88,5 | 83,0 | WSW. |
| 2 | | ,809 | 83,3 | 87,7 | 82,0 | W. .... | ,765 | 84,2 | 88,9 | 82,7 | SW. |
| 3 | | ,900 | 82,6 | 84,1 | 81,8 | NNW. | ,830 | 83,9 | 88,0 | 84,1 | W. .... |
| 4 | | ,875 | 82,8 | 87,8 | 82,5 | W. .... | ,805 | 84,0 | 89,0 | 83,2 | NW. |
| 5 | | ,886 | 81,6 | 86,4 | 78,3 | NE. | ,813 | 82,8 | 87,8 | 78,5 | NW. |
| 6 | ☾ | ,873 | 80,4 | 85,9 | 76,4 | NE. | ,800 | 82,3 | 86,7 | 80,0 | W. .... |
| 7 | | ,821 | 81,6 | 86,0 | 80,2 | WSW. | ,742 | 84,0 | 88,0 | 78,2 | W. .... |
| 8 | | ,854 | 81,1 | 83,5 | 79,3 | W. .... | ,741 | 82,8 | 89,5 | 82,0 | WSW. |
| 9 | | ,835 | 80,4 | 85,1 | 78,0 | W. .... | ,749 | 82,4 | 91,8 | 82,7 | W. ... |
| 10 | | ,826 | 81,8 | 85,0 | 80,0 | SW. .. | ,742 | 82,9 | 90,2 | 80,6 | SW. |
| 11 | | ,818 | 81,0 | 84,8 | 79,2 | W. .... | ,746 | 82,2 | 88,0 | 81,0 | NW. |
| 12 | | ,841 | 80,5 | 85,7 | 76,1 | NE. .. | ,770 | 82,4 | 85,5 | 75,0 | N. .... |
| 13 | ● | ,842 | 78,0 | 80,5 | 71,7 | N. .... | ,790 | 79,5 | 80,5 | 73,4 | NW. .. |
| 14 | | ,830 | 76,3 | 79,0 | 72,5 | N. | ,778 | 79,6 | 83,0 | 75,0 | N. .... |
| 15 | | ,818 | 75,5 | 74,2 | 70,5 | N. W. | ,725 | 78,1 | 81,0 | 74,4 | N. .... |
| 16 | | ,800 | 74,9 | 77,3 | 70,0 | NW. | ,742 | 78,0 | 84,0 | 73,7 | NW. |
| 17 | | ,882 | 75,0 | 81,5 | 72,0 | NW. | ,825 | 77,0 | 82,6 | 73,0 | NW. |
| 18 | | ,882 | 74,2 | 79,0 | 69,2 | SW. | ,826 | 76,9 | 84,2 | 73,1 | W. .. |
| 19 | | ,869 | 73,4 | 78,5 | 70,6 | W. .... | ,821 | 78,0 | 84,7 | 75,2 | NW. |
| 20 | | ,910 | 74,8 | 80,0 | 72,8 | W. .... | ,845 | 76,6 | 88,0 | 80,2 | NW. |
| 21 | ☽ | ,930 | 74,0 | 81,6 | 74,0 | WSW. | ,861 | 78,8 | 86,2 | 77,0 | W. |
| 22 | | ,970 | 75,5 | 82,4 | 74,0 | E. .... | ,888 | 78,8 | 87,0 | 78,5 | NW. |
| 23 | | 30,025 | 75,2 | 82,0 | 74,5 | NE. .. | ,929 | 79,0 | 83,9 | 77,5 | N. |
| 24 | | ,017 | 75,9 | 82,0 | 74,8 | N. .... | ,941 | 79,1 | 84,2 | 77,9 | N. |
| 25 | | ,009 | 75,2 | 80,2 | 74,0 | N. .... | ,929 | 78,8 | 83,4 | 76,4 | N. |
| 26 | | ,010 | 75,0 | 78,8 | 73,7 | NW. .. | ,925 | 78,4 | 83,9 | 77,2 | NW. |
| 27 | | ,002 | 73,8 | 78,2 | 72,0 | N. .... | ,906 | 76,8 | 80,8 | 74,9 | N. |
| 28 | ○ | 29,958 | 72,8 | 77,8 | 71,0 | NW. | ,894 | 76,2 | 80,3 | 73,8 | NW. |
| 29 | | ,962 | 71,7 | 75,8 | 70,5 | NW. | ,889 | 74,5 | 81,0 | 74,2 | NW. |
| 30 | | ,950 | 72,3 | 79,0 | 72,8 | NE. .. | ,881 | 75,6 | 81,4 | 76,0 | NW. |
| Mean. | | 29,895 | 77,4 | 81,6 | 75,2 | | 29,821 | 79,9 | 85,4 | 77,8 | |

*Meteorological Register, kept at the Surveyor General's Office, Calcutta, for the Month of* DECEMBER, 1841.

| December. Day of the Month. | Barometer. (9 H. 50 M) | Temperature. Of the Mercury. (9 H. 50 M) | Temperature. Of the Air. (9 H. 50 M) | Temperature. Of an Evapg. Surface. (9 H. 50 M) | Wind. Directions. (9 H. 50 M) | Barometer. (4 P. M.) | Temperature. Of the Mercury. (4 P. M.) | Temperature. Of the Air. (4 P. M.) | Temperature. Of an Evapg. Surface. (4 P. M.) | Wind. Direction. (4 P. M.) | Rain Gauges. Upper. | Rain Gauges. Lower. | Moon's Changes. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inches | o | o | o | | Inches | o | o | o | N. | Inches | Inches | |
| 1 | ,957 | 72,7 | 78,5 | 73,0 | NW. | .912 | 75.8 | 82,1 | 77,0 | NW. | | | |
| 2 | ,957 | 72,5 | 78,7 | 72,8 | NW. | .902 | 76.4 | 84,2 | 78,2 | NW. | | | |
| 3 | ,022 | 73,0 | 76,1 | 70,2 | N. | .929 | 77.7 | 82,2 | 76,0 | N | | | |
| 4 | ,993 | 71,0 | 73,3 | 67,8 | N. | .906 | 74.7 | 77,2 | 71,0 | N. | | | |
| 5 | ,968 | 69,2 | 74,8 | 68,9 | N. | .874 | 73.5 | 78,5 | 75,0 | NW. | | | |
| 6 | ,953 | 71,2 | 75,8 | 70,7 | NW. | .874 | 74.4 | 80,5 | 74,7 | N. | | | ☾ |
| 7 | ,957 | 70,8 | 77,2 | 72,0 | NE. | .890 | 74.4 | 81,0 | 73,8 | N. | | | |
| 8 | ,958 | 71,1 | 77,5 | 71,0 | NE. | .889 | 75.4 | 82,2 | 75,8 | N. | | | |
| 9 | ,957 | 72,7 | 78,5 | 72,0 | NE. | .873 | 75.0 | 84,0 | 76,2 | N. | | | |
| 10 | ,913 | 73,0 | 78,5 | 72,2 | NE. | .834 | 76.7 | 83,2 | 76,9 | NE. | | | |
| 11 | ,873 | 72,0 | 76,0 | 70,5 | E. | .809 | 76.1 | 84,3 | 76,5 | NW. | | | |
| 12 | ,893 | 73,4 | 80,2 | 73,0 | NE. | .822 | 84.5 | 85,0 | 76,8 | NE. | | | |
| 13 | ,842 | 72,6 | 76,2 | 71,5 | N. | .742 | 77.2 | 84,3 | 77,5 | N. | | | ● |
| 14 | ,841 | 70,8 | 72,2 | 68,5 | N. | .781 | 75.1 | 79,8 | 73,9 | N. | | | |
| 15 | ,874 | 69,7 | 70,0 | 63,8 | N. [sharp] | .798 | 72.0 | 74,2 | 67,7 | | | | |
| 16 | ,857 | 67,0 | 69,0 | 63,3 | N. [sharp] | .794 | 71.0 | 75,0 | 68,4 | NW. | | | |
| 17 | ,902 | 65,5 | 68,0 | 61,2 | NW. | .858 | 69.3 | 72,8 | 65,0 | NW. | | | |
| 18 | ,918 | 66,0 | 68,8 | 63,0 | N. [sharp] | .858 | 69.4 | 75,1 | 68,0 | NW. | | | |
| 19 | ,909 | 66,4 | 73,0 | 66,0 | N. | .849 | 69.7 | 76,0 | 67,5 | NW. | | | |
| 20 | ,918 | 66,0 | 74,2 | 66,5 | NE. | .870 | 69.3 | 77,0 | 68,9 | N. | | | ☽ |
| 21 | ,941 | 66,4 | 73,8 | 65,8 | NE. | .869 | 70.0 | 77,5 | 69,0 | N. | | | |
| 22 | ,917 | 66,2 | 73,0 | 65,7 | NW. | .848 | 71.0 | 80,3 | 73,8 | W. | | | |
| 23 | ,922 | 68,2 | 73,0 | 66,0 | N. | .845 | 70.5 | 78,5 | 69,0 | W. | | | |
| 24 | ,934 | 67,5 | 72,0 | 64,8 | N. | .861 | 69.8 | 77,4 | 70,2 | NW. | | | |
| 25 | ,, | ,, | ,, | ,, | ,, | ,, | ,, | ,, | ,, | ,, | | | |
| 26 | ,913 | 65,1 | 70,0 | 62,2 | NW. | .845 | 67.9 | 74,6 | 67,8 | NW. | | | ○ |
| 27 | ,889 | 64,5 | 68,8 | 61,0 | NW. | .810 | 67.8 | 74,4 | 65,7 | NW. | | | |
| 28 | ,900 | 63,8 | 68,0 | 61,9 | NW. | .830 | 68.5 | 76,2 | 68,1 | NW. | | | |
| 29 | ,905 | 65,5 | 71,0 | 64,8 | N. | .854 | 69.8 | 78,0 | 69,2 | NW. | | | |
| 30 | ,926 | 66,4 | 73,1 | 65,5 | N. | .865 | 72.2 | 79,0 | 71,0 | N. | | | |
| 31 | ,909 | 67,8 | 75,7 | 67,1 | W. | .850 | 74.0 | 80,8 | 72,5 | NW. | | | |
| Mean. | ,921 | 68,9 | 73,9 | 67,4 | | .852 | 72.9 | 79,2 | 72,0 | | | | |

Quantity of Rain fallen in each Month of the year 1841.

| | Inches |
|---|---|
| January, | 0.89 |
| February, | 0.24 |
| March, | 0.76 |
| April, | 3.26 |
| May, | 5.31 |
| June, | 7.03 |
| July, | 14.09 |
| August, | 13.96 |
| September, | 11.59 |
| October, | 3.16 |
| November, | .00 |
| December, | .00 |
| Total Fall of Rain, | 60.25 |

*On Becquerel's new method of Analysis of Ores. Communicated by Dr.* E. T. Downes, *Deputy Assay Master.*

I have great pleasure in forwarding for publication in your next number, (if it comes within the description of articles likely to suit your pages,) a very interesting and highly valuable paper having reference to a new process for the assay of ores; introduced to the world by such high authority as Becquerel, will I am sure add very much to its value and importance. The advantages to be derived from this new mode of analysis are many; one in particular which will strike every one's attention at all conversant with the subject, is the cheapness in conducting the process; a second, the detection and recovery of very small quantities of the precious metals in ores, which previous to the discovery of this electro-chemical power as applied in the analysis of these compounds were thrown aside as being of too poor a description to be worked at a remunerating price; this difficulty has been overcome by the labours and talent of Becquerel, and the advantages likely to accrue to science can scarcely be estimated at so early a period of its introduction, as it is yet in its infancy.

I have been detained sending it to you at an earlier period, with the hope of being in possession of more facts regarding the plan being more matured; my Paris correspondent having promised to forward me all the information regarding the progress of the discovery as it was made public by its very able and indefatigable originator; but I shall wait no longer, and whatever details may reach me at a subsequent period, I will send you as a continuation of the present notice.*

*Calcutta, 7th Dec.* 1841.

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*Important Discovery in Metallurgy.*

At a recent sitting of the Academy of Sciences of Paris, M. Becquerel read, in the presence of a numerous auditory, a paper relating to one of the most important discoveries of modern times, namely, the application of the electro-chemical power to the art of metallurgy, especially as regards gold, silver, copper, and lead. After a few preliminary remarks, explaining the various services which this force can render to natural sciences, to arts and manufactures, the learned academician alluded in particular to the refining of the precious metals; and it will be seen in the course of this analysis the great advantage he has derived from the new methods introduced by him into different branches of industry. It will also be gratifying to learn, that one of the poorest departments of France possesses a gold, silver, and lead mine, and that the happy results already obtained, hold out a still more flattering prospect. The following is an analysis of the memoir presented by M. Becquerel:—The experiments relative to the application of the electro-chemical power to refining *(métallurgie)* of silver, copper, and lead, without the aid of quicksilver, and with little or no fuel, have been continued by M. Becquerel with constant success: his operations were conducted upon a large scale, and embraced considerable quantities of ores derived from Europe, Asia, and America. The object of these researches was in the first place the immediate separation *(reductio)* of the metals one from the other, and especially of silver and of lead from galena; this operation was effected with so much rapidity, that at the preparatory foundry in Paris four pounds weight of silver can now be drawn off in the metalled state from silver ore in the space of six hours; secondly, the preparation which the ore is to undergo, so as to render each metal capable of being withdrawn by the electric current. This preparation varies according to the nature of the ore, presents no obstacle when the silver is in the

* We need not add that we shall await with interest, the further particulars kindly promised by Dr. Downes.—Ed.

metallic state, or in the nature of a sulphate, as usually occurs in Mexico and Peru, but it becomes more complicated when the silver is mixed with other substances; the use of a small quantity of combustible matter is then indispensible in order to effect the roasting at a low temperature. Ores are generally found in great quantities in those countries, but are for the most part abandoned, owing to the want of sufficient fuel for effecting their amalgamation, or to their being found at too great a distance from the sea to transport them to Europe, unless at an enormous expense. In Columbia, where large masses of gold and silver are found mixed with zinc, the richest are sometimes exported to Europe to be fused, whilst the poorest and those of a medium quality are either rejected altogether, or used to so little advantage that the mining companies lose by them. Exertions are now in progress for introducing the new methods, which are equally applicable to amalgamation and to the electro-chemical process. The silver ores which are most difficult of amalgamation, are those which contain a large portion of copper and arsenic. Ores of this description are found in considerable quantity, especially in Chili, where the inhabitants frequently offer them to Europeans, by whom they are sometimes taken for ballast for want of freight, and without any certainty of turning them to advantage. The great difficulty was to be able to treat these substances in Europe so as to obtain, in separate portions, and at little expense, all the silver, copper, and arsenic they contained. This problem has just been solved in a satisfactory manner, and so as to secure immense advantages to new speculators, who will no longer have to contend with the obstacles met with by their predecessors. On enquiring into the causes of the delay experienced in working the mines in America, it will be seen that the principal ones arise from the high price of quicksilver, and the great difficulty of draining the water by which the mines are inundated. This is not the case in Asia, in the Russian possessions, which are rich in mineral productions, and yield larger profits from day to day in consequence of the introduction of the improvements lately adopted in Europe for reducing metallic ores. In the silver mines of Altaie the expenses for extracting the ore, process of reduction, and of the establishment, do not amount to a quarter of the rough produce, although the ore in general is of slight tenacity. These advantages are owing to the moderate price of labour, the abundant supply of combustible matter and substances required in the fusing, and which are not to be had in America, especially in Mexico, and the Cordilleras. The electro-chemical process can be easily applied to the ores at Altaic; however in countries where sufficient fuel is at hand, and salt cannot be procured, the fusing operation will be always preferred, except in cases of complex ores, which often exercise the ingenuity of metallurgists. There are but few silver mines worked in Russia. The only ones of importance are those of Altaie, Nertchinsk, and those of the Caucasus and the Ural; but the great source of mineral riches in that kingdom consists principally of the gold and platina dust, sands,) the washing of which engrosses the chief attention of the government. This process, though methodically conducted, is very imperfect, for a large quantity of the gold contained in the sand is lost; the proceeds, however, are considerable; during the last year no less than 12,200lbs. were obtained, upwards of 800,000*l.* value. The argentiferous and auriferous galenæ which have been subjected to the electro-chemical process are perfectly fit for the extraction of gold and silver by washing. This method requires that the ores should be pulverised and roasted so as to separate the metal from the pyrithes and other compounds which detain it. The silver and lead being removed, the ore, thus reduced to about half of its weight, can be washed with the greatest facility, and one man can wash several hundred pounds per day. This method was tried with the galena (very argentiferous) discovered a few years since at St. Santin Cantales, in the department of Cantal, and which yield not more than 2½ grains of gold in every 200lbs. of ore, with 30 per cent. of lead. But upon adopting the electro-chemical process, the same quantity of ore produced something more than three drachms of gold. From this important result it is supposed that the rocks in that part of the country are auriferous, as might also be inferred from the name of the place, Aurilac, *(auri lacus.)* Another great advantage of the electro-chemical method is; that it enables the metallurgist to separate those portions of ore which contain gold, silver, &c., from those which contain none. M. Becquerel then alluded to the other uses to which electricity might be applied in the manufacture of metals, especially in the art of gilding silver and copper, as also for taking impressions in copper of medals, bassi relievi, and engravings. The learned academician concluded by observing that this new and highly important power was only in its infancy, and that it would be impossible to foresee the immense services it was likely to render to the arts.

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### *Interchange of Seeds between England and India.*

In a late copy of the *Gardener's Chronicle* we observe mention is made of the advantages to be anticipated from an interchange of Seeds between India and England; and we are glad to find Lord Auckland's proceedings, in this respect, in 1839, sanctioning the dispatch of Seed collectors into Kumaoon, the Hill Tracts, Cashmere, and Thibet, have been followed by the best results; as has also the dispatch of Seeds by Mr. Griffith from Affghanistan,—these having not only reached England in good order, but been, nearly all, successfully germinated in the Garden of the Horticultural Society at Chiswick. Many too, of those thus sent, have proved of a beneficial character; and it is worthy of remark, that the Lucerne seed sent by Mr. Griffith from Candahar, although of the same species as is generally cultivated in Europe, was found yet to yield so far superior a crop, that it almost appeared a new race, besides being more valuable as a green crop, from its coming in much earlier than commonly happens with the plant produced from seeds grown in England. The clover sent by the same gentleman from Affghanistan has been pronounced a new species, and as such, named '*Trifolium Gigantium*;' and, in like manner has been found to produce a heavy crop, and to be most useful as fodder for horses. Indeed this plant has been considered so valuable, as a crop, that almost any quantity would find a ready market, and become important as an article of trade. If so much good is derivable to the mother country from the interchange of seeds, how much more might we, in India, not obtain from that source,—especially in our cereal grasses, and other articles of food. Our wheat, of a hard albumen, is deficient in farinaceous particles, hardly usable if converted into flour, and thence obliged to be used half ground or in the state actually known as *soojee;* whilst our potatoe, by constant recurrence to the same stock for seed, is prevented from arriving at that perfection which would give its full value as a crop. Taking these articles alone, therefore, our benefit would be great; but with this advantage, if extended through the immense range of the vegetable world, what an inestimable profit should we not derive from a freedom of interchange, in a country capable of growing every plant in existence, in some part or other, but where the constant growth of the same produce, from the same stock, and from the same ground, deteriorates almost every plant we possess, —*Eastern Star, Dec.* 5.

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## LIST OF PLATES IN VOL. II.

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