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

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ERRATA AND ADDENDA.

Page 53, line 10, *for* "*Pupilio*" *read* "*Papilio.*"
„ 53, „ 37, } „ "*Mycaleris*" *read* "*Mycalesis.*"
„ 55, „ 27, }
„ 58, „ 20, „ "*Shibochiona*" *read* "*Stibochiona.*"
„ 94, „ 1, „ "the upper molar" *read* "the last upper molar."
„ 95, lines 10 and 12 from bottom, *for* "the anterior lower molar" *read* "the anterior upper molar."
„ 103, line 18 from top, *for* "are added (2) as" *read* "are added (2). As."
„ 121, „ 21 from top, „ "received" *read* "viewed."
„ 121, „ 5 from bottom *for* "molars" *read* "molar."
„ 137, „ 3 from top, *after* "mil." *insert* "and Conch.-Cab. II, Pl. 26, figs. 16-17."
„ 137, „ 4 from top, *dele* "or Conch.-Cab. II, Pl. 26, figs. 16-17."
„ 168, „ 3 of foot note, *for* "1886" *read* "1866."
„ 196, „ 23, *for* "*kingianam*" *read* "*kingianum.*"
„ 209, „ 1, „ "*rhombicas*" „ "*rhombicus.*"

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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part II.—PHYSICAL SCIENCE.

No. I.—1881.

I.—*Report on a visit to the Nongyang Lake, on the Burmese Frontier, February* 1879.—*By* S. E. Peal, Esq.

[Received November 11th;—Read December 1st, 1880.]

(With Plates.)

Last year, I prepared a short note on the old Burmese route over Patkai, *viâ* Nongyang, viewed as the most feasible and direct route from India to China,* and, having a month's leave in the cold season, I determined to proceed, if possible, to the pass over the Patkai leading to Upper Burmah, report on the same, take altitudes, &c., and explore the Nongyang Lake, in the valley of the same name beyond, on the Burmese side of the water-parting.

Permission to travel east and to cross the frontier was kindly given to me by the Chief Commissioner of Assam, in time to enable me to start from Jaipur, on the Dihing river, by the end of January 1879.

Hitherto, on this line of route considerable delay and inconvenience have always been caused to travellers from the want of a sufficient number of trustworthy load-carriers; parties have been detained eight and ten days while the necessary men were collected, and *en route* exorbitant demands have often been made. At times, as in the cases of Major Sladen's, and Mr. Cooper's parties, it completely frustrates all attempts at progress. I therefore secured enough men whom I could rely on as porters before starting. The party consisted of seven picked Bengali coolies, an Assamese

* Journal, A. S. B., Vol. XLVIII, Part II, 1879.

orderly and his mate in charge of my arms and instruments, &c., a cook used to camping, a Khampti boatman and his Duania mate, and, subsequently a Singphú guide,—as small a party as possible.

Among us all we could manage to speak English, Hindustani, Bengali, Sonthali, Assamese, Khampti or Shan, Singphú, and Nága.

The *lingua franca* of the party was Assamese, though as we went east Singphú and then Nága of the Namrup was chiefly spoken to outsiders.

Three Alpine tents, 7 ft. × 7 ft., weighing about 8 lb each, poles included, enabled us at any moment to camp comfortably and very quickly; at the same time, when rolled up they served as padded poles on which to tie baggage. Six small and extremely light boxes, measuring 10 in. × 12 in., × 18 in. and provided with locks and hinges, served to carry stores, presents and sundries securely, a great object being to avoid bulky and heavy or open packages. As it was desirable to explore the Namtsik river and Nongyang lake, a small dug-out (*Rob Roy*) was also taken slung on a bamboo between two men, with bedding stowed inside. A Snider carbine, a double-barrelled central-fire No. 12 shot-gun, a revolver, and a Deringer were the arms.

Our first day's march was east to Jaipur, at the junction of the Dhodur Ali with the Dihing river, formerly a place of considerable importance, and likely to become so again. Large steamers can reach it from the Brahmaputra in the rains, and small ones during about eight months of the year. Coal, petroleum, and timber are also to be found in large quantities not far off. It is also the point at which a route from Burmah would practically emerge. Government has wisely reserved large tracts of forest up-stream, and already some teak has been planted.

The first care on arrival was to secure a good boat for the heavy stores to go by water up the Dihing, and, this done, an application in person to old Turkong, of the Phakial or Khampti village, secured me a good boatman named Múng, a Khampti who has piloted many up and down this river, who knows all the people, villages, and folk-lore of these parts, and is withal intelligent and communicative. By noon all supplies of rice, tobacco, salt, opium, cloths, sugar, &c., were stowed, and six of the men started lightly laden, by land, the rest of us in the large canoe.

Soon after leaving the station of Jaipur we passed up some very beautiful reaches of the river, where the water, deep and still, slowly winds among wooded hills (the gorge in fact), with huge bedded sandstone rocks along the flanks covered by ferns, bamboos, wild plantains, canes, and other products of a sub-tropical jungle. Towering above all, here and there, rose the great bare branches of dead rubber-trees, once so plentiful and now so rare, a silent protest against reckless tapping.

Some of the reaches are nearly a mile long, water 30 and 40 feet deep, though here and there becoming more shallow and rapid.

At one spot a picturesque pile of rocks, capped by forest trees, divides the stream equally, and is called "Hita Tatol, from *Sita's tat-hal*, the weaving-hall in which Sita was found by Ram.

Here and there we passed camps of people who were cutting bamboos to raft down to Jaipur for building, also native boats of the usual small dug-out pattern. Having the *Rob Roy*, I was enabled to paddle ahead or stay behind sketching, and at one place made a small careful memo. of a huge dead rubber-tree that had fallen over into the river,—the trunk and branches resembled a huge dragon.

As rain appeared to be coming on, we camped early at a large high sand-bank, near a rapid called Digoli Gagori. In a very short time we were all comfortably housed, fires blazing under the cooking-pots, and a pile of dry logs got in ready for the night-fire. Our three tents and the boatmen's bivouac were generally so placed as to form a cross, the openings facing a log-fire in the centre, that was at once light and heat for all. The assembling round this camp-fire every evening after dinner was generally looked forward to all day. Here we met strangers, heard the local news or stories, the inexhaustible Múng generally giving us the traditions, often illustrated by very creditable maps in the sand. Villagers, if near, always joined our circle, enabling me to collect a large amount of information, or explain the objects of my trip, which is an item of some moment in cases of this nature.

The monotonous rush of the rapid at last was the only sound heard. The night turned out cold and foggy. Once the echoing bark of the little hog-deer roused me, and I put the logs together that had burnt apart. In the early morning the dew-fall was sufficiently heavy to be audible several hundred yards off, the moisture condensed on the higher foliage falling like a steady slow shower on the dried leaves on the ground. Ere starting at 9 A. M. I made all the people cook and eat their breakfasts. At 10 A. M. we passed the mouth of the Namsang river on our right (but the left bank of the river). It rises among the hills of the Namsang Nágas, and near its mouth is a small tea-garden.

More or less scattered up and down the river Dihing, there are names and traditions that unmistakably indicate this as the old Ahom route to and from Burma,—a highway of the past. The earlier portions of the "History of the Kings of Assam," detailing the Ahom invasions, clearly enough point to the Dihing river as the line of entry, and Nongyang as the part of the Patkai where they crossed, the name Patkai having originated there.

About 11 A. M. we came to *Noralota*, a tree-covered ridge jutting into the Dihing river, which derives its name from Nora-ulota, *i. e.*, Nora's returned. In November 1228 A. D. Sukapha Rája coming to Assam from Munkong with 1,080 men, 2 elephants and 300 ponies, brought also "Chum Deo" (unknown to the owner) Noisanpha Nora Roja of Munkong, Noisanpha

missing Chum Deo, sent men after him for its recovery who followed to the Dihing whence they returned, this spot being now called "Nora-ulota," a Nora's returned.

The following is a copy of the passage in the History of the Kings of Assam.

শকাব্দা ১১৫০ শকর ১৯ আঘোন ইংরেজি ১২২৮ সনে চুকাফা রজা দেও আহোঁতে লগত অনা মানুহ ১০৮০, দঁতাল হাতি ১, মাখুন্দি হাতি ১, ঘোরা ৩০০, খাও মুং ফ্লিং লুন্ মাং রাইবুরা গোহাই ও খাওমুং কানঙ্গন বর গোহাই, এই খনি সহিতে চোম দেওক লৈ আহিল। এনেতে দৈবাত মুংকং দেগর নইচানুফা নরা রজাই চোম দেওক বিচারি নেপাই, চুকাফাই নিলে জেন ভাবি, চুকাফা রজাক ধরিবলে মানুহ পাঠালে। সেই মানুহে খেদি আহি চুকাফা রজার লগ নে পাই; ঝি ঠাইরে পরা উলটি গল, সেইখনি ঠাইকে নরা ও লটা বোলে।

As we went up the river, the hills on either flank gradually subsided, and gave place to level land, covered with mixed forest, the waterway became shallow and wider, several Duania villages were passed, built more or less after the Singphú pattern, *i. e.*, long sheds of bamboo, the floor raised on small posts. These people are the descendants of Assamese carried off by Singphús some 80 or 100 years ago, and reduced to slavery. Many escaped from Hukong during and after the Burmese wars, and are now located about the Dihing river, speaking both Assamese and Singphú,—dressing like the former, but having the gross superstitions of the latter.

During the day the Namsang Purbot, or hill, was a conspicuous feature in the landscape, generally forming a fine background to the views on the river. Its outline is good, and the colour at times dark green to blue, or even purple, is seen reflected beautifully in the long still reaches of water, with, at times, a wooded island in mid-stream, and a foreground of snags piled in picturesque confusion.

We were in no great hurry, so camped at the *Juglo* Duania village, the ten or twelve houses of which were placed end on, at a few yards back from the edge of the bank of yellow clay 30 feet high.

Selecting a clean stretch of sand by the water, under the cliff, we soon pitched our tents, and were visited by the headman, who brought the usual little present of fowls, eggs, and some rice. The *Rob Roy* caused some amusement, and one of the young men paddled it about very creditably, considering it was rather crank, and the stream strong. As usual, great interest was taken in my journey, and routes discussed after dinner. My kerosine wall-lamp, revolver, and guns were duly wondered at, and a tiger happening to announce himself by a loud whistle on the opposite bank, I was enabled to gratify them by a shot from the Snider to frighten it away, the echo rolling through the forest on each side for a long way, and sounding unusually loud and prolonged in the still night. At 9 P. M., the thermometer stood at 65°, and we had a fine night.

In the morning there was a heavy fog, with the usual light west-by-south-west wind, threatening rain; temperature of the Dihing water 68°

and air 63°. After all had cooked and eaten we started up-stream between two islands, the river bed becoming wider up to 400 yards. Extensive shallows over sandy bottom often rendered it difficult to keep to the passage, a line of deeper water frequently ending in a wide shallow that compelled all hands to get out, and by sheer force push and drag the canoe to the nearest channel.

Near Poai Múk there were large islands of dry sand in mid-stream, which are evidently well covered in the rains, thus indicating the large body of water that must then be needed to fill the river bed.

It was about here that some forty years ago a small cannon fell into the river during an expedition, and which is now commonly reported to go off with a loud bang under water once every three years.

About 11 A. M. we reached Mákúm, a village on the right bank, now celebrated for its fort, situated on a clay bluff overhanging the river. A native officer and 20 police are in charge. The plan of the building is a Maltese cross, walls 4 feet thick and 50 high, loopholed in three stories. It was erected by the late General David Reid, R. A., who had long experience on this frontier, and to whom we are indebted for most of the little permanent work of this kind in Eastern Assam. The fort is impregnable to savages like the Nágas. While at Mákúm I saw old Gubor Jemadar, formerly in charge here, but who is now pensioned. He has great influence among the hill tribes about, and by timely tact has on several occasions saved us from political complications with the Nágas.

After hearing the object of my journey, he quite agreed as to its feasibility and safety, giving me also some valuable information regarding the tract I was about to visit, though he had himself never seen it.

At Mákúm the Dihing is 350 yards wide, and at this season runs shallow over shingle. Not far off there are valuable beds of coal up to 20 and even 30 feet thick; there are also petroleum springs. The river here takes a huge bend, the concavity facing the Nága Hills opposite to the south. On a fine day the view from the fort, across the river and low forest and lower ranges of hills, is very fine, the higher ranges bordering the basin of the Tirap running behind, as at Rangatu, 3,500 feet. Beyond these again lie the hills near Yungbhi and Yugli, and the Patkai in the extreme distance at 5,000 and 6,500 feet, rising here and there to 8,000.

Having made the necessary arrangements as to parcels and letters, we started next morning at 11 A. M., reaching Insa, or Bor Phakial, in the afternoon, and camping on the huge sand below the village. The inhabitants are mostly Khamptis, or Shans, a race from the south-east, who are scattered more or less about near here, their head-quarters being at Manchi or Bor Khampti, on the Mli Kha branch of the Upper Irawadi. They speak and write Shan, using the Burmese character, and are Buddhists.

They dress in white or dark blue cotton jackets, have, like the Singphús, a sort of kilt of plaid pattern, dark blue, green, and yellow, the prevailing mixture, and round the shoulders wear a large thin *chudar*, or wrap, 10 feet by 3 feet, of some bright red and white check pattern, and a white *pugri*, generally worn in a conical form, covers the characteristic knob of hair on the tops of their heads; their cloths are home-made, like their rude pottery, the manufacture of each can be seen going on daily here and there. Amber ear ornaments are common to both sexes, and the men generally have the so called Khampti *dáo* worn in or on a sheath, slung under the left arm by a cane-loop passing over the right shoulder.

The women now wear clothes more or less like the Assamese, though now and then a Shan costume of dark blue can be seen, skirt and jacket, the latter having a close row of silver buttons, the head covered by a dark blue *pugri*, laid on in close coils,—a remarkable and pretty *tout ensemble*.

In colour these Khamptis are paler than the Assamese, though at times with a yellowish tinge, the hair and eyes black, and faces clean; the moustache, if worn at all, is generally a failure; high cheek-bones, small eyes, and wide flat noses are the rule, giving the well-known Mongolian cast of features. Both sexes are rather short and stout in build.

After dinner, the elders paid me a visit, and, having been there some ten years before, recognized and welcomed me, and made many enquiries after "Jenkins Saheb," whom they all remembered. As usual, they were greatly taken with the guns and revolver, the fitting and finish being well appreciated by men who are more or less naturally workers in metal.

The ability to raise and lower rapidly the light from the strong kerosine wall-lamp struck them all as something quite new, and they were equally astonished to learn that the water-like oil was simply their dark petroleum purified.

One and all showed considerable interest in my trip, though, as it was through the Shingphú country, no one would join me. I found that Khamptis do not often travel east or south in small parties. At the same time, though none of them had, as far as I could learn, been to Nongyang, some of the old men gave me information regarding those parts that was more correct than that which I obtained from those who should have known far better. This I partly attribute to most Shans being able to read and write, and their being possessed of manuscripts handed down for many generations. As a *finale* to a pleasant evening, I amused the big and little boys by burning a piece of magnesium tape.

Next morning, while the men were cooking, I was shown all over the village, and the *Chang*, or sacred house, containing their books, pictures, images, offerings, gongs, &c., and into which I believe no females are allowed. It is a building raised some 7 feet on wooden posts, measures

some 35 feet by 50 feet, and with six of the central posts continued up to carry a second central raised roof; the caps of these six columns were carved, and under this raised portion was the shrine with some different sized images of Buddha. At one end hung a large cotton *pardha*, with horizontal rows of very well painted figures, about 8 inches high, illustrating their idea of the earth and its inhabitants; near the lower edge there was one group inverted and said to represent the people who lived below us, with their feet upwards! The whole picture was in fair preservation, but from all I could learn, not very old, and executed by a Shan from Burmah, who travelled on to Bor Khampti.

The houses of the people in the village were ranged more or less in lines, and, though long, were parallel, leaving room enough for a road in between each. They were invariably raised platforms with the Jengo roof coming well down over the sides, an arched and rounded end in front, beyond which the platform always projected, so as to enable the people to put things out in the sun and yet be safe from the inevitable pig; it also serves as a sort of semi-public reception place. It seems also a feature of all Nága houses, though not seen among Singphús.

These houses run from 20 feet wide to 100 feet long, contain one family, and, unless large, are often built or re-built in a remarkably short time. While at Bor Phakial the *Gáonbúrá's* house was being re-built, and he told me that it would be done in two days by the able-bodied men and lads of the entire community, who during the erection are fed at the owner's expense,—a custom which prevails more or less all over Eastern Bengal, Assam, and the hills adjacent.

Passing up the Dihing now again after an absence of several years, I was struck with several changes. The *Bapu*, or Khampti yellow-robed priest of Bor Phakial used to teach all the lads to read and write. He had now gone to Burmah, might not return, and the boys could not all read. Again, Nágas are now seen in numbers, and have boats, villages, and lands on the Dihing, where there were formerly none. These people and the Duanias, indeed, seem to be getting more mixed up as time goes on. Kaiyas, or Marwari merchants, or their agents, are now seen at every place of importance, they exchange opium, brass-ware, and cloths for ivory, rubber, and such like. Indirectly, they have been the cause of the extermination of the rubber-trees over large tracts; the ready sale for ivory has also added to the natural tendency among the Nágas to hunt and kill elephants for the sake of their flesh. Not long ago eight elephants that crossed the Patkai were so carefully watched and hunted that only one escaped.

There is now a great want of blacksmiths up the Dihing and, dáos cost double what they did in 1870, which is generally attributed to Govern-

ment purchasing too indiscriminately. At Bor Phakial, ere I left, some twelve Singphús from Hukong came in *en route* home from Assam, having sold all their amber. Happening to ask if they knew certain villages, Mbon and Nmphin, I found they were from the first one I named, and I at once had pressing invitations to go and see them ere my return, they offering to guarantee my safety. The advantages of our rule to Assam was here, as on some other occasions, dilated upon; security to life and property here contrasting favourably with the insecurity there, where there was no paramount authority.

After breakfast the whole village lined the bank to see me off in the *Rob Roy*, which seemed to amuse old and young, boys and girls alike.

Passing Bhaigirot, we were joined by a Singphú and his wife and family in a small dug-out, the woman and an infant in the centre under a little bit of curved roof, the man paddling as he steered, while a boy of 10, and a girl of 12 poled at the bows, keeping pace with us easily and crossing shallows we dared not venture near. By 4 o'clock we reached the Tirapmúk, whereat is situated the village and residence of Kherim Gam, the young chief of the nearest Singphús, whom I knew well, but who was now up at the Namtsik elephant stockade.

The Tirap river falls in on the left bank of the Dihing, after a long course, draining a huge valley along the northern flank of the Patkai, which is densely populated by the Nágas.

A route from this point enters the hills, passing Wadoi, Hongtam, Rangnem, and Yungbhi, crossing the Patkai at 5,000 feet elevation, and afterwards other ridges of similar height, including the Gedak Búm, to emerge at Namyung village in Upper Hukong. It is a long and tedious route, crossing great elevations, and was taken by Griffiths in 1837, there being no carriage *viâ* Nongyang, From the Tirap to Namyang takes twelve days generally. In the morning I visited the Gam's houses, a collection of dilapidated sheds, having raised floors, beneath which the pigs luxuriated in unlimited mud. The Gam's mother complained to me, through an interpreter, that the *Nats*, or evil spirits, tormented her with pains, so I gave her a small present of opium and departed.

As a race, the Singphús are more rude and headstrong than the Khamptis, and would make remarkably good soldiers, like most of these hillmen; the pity is they are not utilized.

Kherim Gam's brother paid me a visit ere I left in the morning, and said he knew the Gam would be sorry that he had missed me.

En route we had some fine views of the hills to the south and of snowy peaks to the eastward, the river bed was still very wide, shallow, and full of snags above Tirap; how some of the little canoes that shot past downstream filled with Singphús escaped a capsize was a wonder.

At Ntem we came to the first rapid since leaving Namsang, and a little above it camped on a wide sand, whence a Singphú, a Duania, and a Nága village were visible at once, all quite small and unfortified, showing the security of these parts. Here, again, a tiger came out at night, and prowled about a good deal, as we saw by his tracks in the morning.

By 9 A. M. we were off, after breakfast and a visit to the Duania village, and landed at Saiko at noon, finding the village of six houses nearly deserted. I here saw some very pretty silk ornaments being woven for a bag, but the price, (Rs. 10 for 2 square feet) was more than I cared to pay; the loom was a rude little contrivance 2 ft. by 2 ft. by 2 ft., made of some sticks and bamboos.

I here also measured a peculiar kind of bamboo, 22 inches in girth, with close joints, and from 70 to 80 feet high. I hear they are not known wild, and the internodes are made into mugs, jugs, boxes, and such like. The stem is of a bluish white colour.

Later in the day we reached the Kherim Páni, or old bed of the Dihing, now more or less silted up. There are two other passages through which the Dihing comes in the rains, *i. e.*, the Mganto and Kasán; from this upwards, the river is called the Namrup.

Selecting a dry sandbank, where there was plenty of fuel, we pitched our camp and made all extra taut and snug, expecting a storm at night, which duly visited us; the thin waterproof sheets, however kept everything dry, notwithstanding a strong gust or two. At dawn we were all astir. While some of the people cooked, I went with the others to Bisa, about a mile up the Dherim Páni, a place celebrated as the headquarters of the Singphús of our side of the Patkai, and the residence of the late head Gam, Banká. There was little to distinguish it from other Singphú villages,—the same long shed-like houses, traces everywhere about of the depth of the mud in the rains, pigs and children. Very few men were to be found, as most of them were out hunting for rubber.

In exchange for some opium, I secured 300lb of clean rice, a few fowls and eggs, also a few chillies. Chautong, son of the late Chief, a smart lad of 10 or 11, was pointed out to me, and Chauing, his nephew, a lad of 17 or 18, was a very fair sample of a Singphú, tall, quiet, and obliging. His father, Latua, about 16 years ago having determined to raid some villages in Hukong, on the Upper Dinoi, departed with his men, saying that, if successful, he would return. As he was not successful, he has not done so to the present time, though he has been frequently asked to come back.

On the way to the boat and camp we found the funeral pyre and monument of the late Chief, a small square enclosure, railed 6 ft. by 6 ft., with pillars at the corners, and long bamboos with strips of cloth dependent, a highly ornamental post in the centre with a kind of carved gilt cap or

mitre, split bamboos also at the corners to hold offerings, and a long rich red silk Burmese cloth hung on a bamboo some way off, strips of red and white cloth hung all about on sticks, and waved with a curious effect, the jungle forming a background.

On reaching the canoe I gave Chauing a dozen rounds of Snider ammunition to shoot a tiger which was killing their cattle, and started on up the Namrup, finding that the rapids at once became more frequent and difficult. At places we had to clear out a track or passage by rolling the boulders aside ere we could drag the canoe up, a work that we became pretty expert at, and these same passages were again very useful on our return.

At the Singphú village of Sambiang, or Gogo, we landed and secured a guide named Lah, who was known to Múng, our boatman, and was reputed to have influence among the Tkak Nágas. He owned a gun that he desired to fire off "for luck" ere starting, so sitting on shingle he pulled the trigger several times in vain, as the hammer stuck at half-cock. I advised a hard jerk and turned to go to the canoe. Hearing a fearful bang, I returned and saw the guide's feet and gun pointing skywards through the smoke. He assured me, though in a nervous way, that it was all right, and usually did that when he put in six fingers of powder and two balls!

From hence to Tkak we had three other Singphús travelling with us, and at starting most of us walked over the shingle, gravel, and sand near the river to lighten the boat. I noticed these three men at one place busy catching some insects, and found that they were bugs an inch long which lay under the stones, and which had an unmistakable odour. On enquiry, one of them said they were going to eat them as they were a capital substitute for chillies! and asked me to give them a fair trial!

By 4 o'clock we found a good camping-ground near the Nmbai Muk, on the wide dry sands of an "*ora hute*," open on each side and with high forest behind and in front. Fires were soon blazing, every one felt comfortable, and dinner was over by sunset. Gradually the moon rose over the tree-tops and lit up the entire scene. While I enjoyed a cigar, the Bengalis did justice to their *tamaku*, Múng and the Singphús lit up their little brass bowl pipes, and we enjoyed the long evening. There seemed few birds or beasts about, the ripple of the rapid not far off yielded the only sound. Then we discussed Nongyang and the routes: none except Lah had been there. Queer stories abounded, such as that the island in the lake floated about and shifted its position with a change of wind. I heard also that the valley had once been densely peopled with Khamongs or Kamjangs, Aitonias, and Turong Turai, who had all left in consequence of raids by the Singphús.

Some of these same Aitonias being now near Golághát, and the Kamjangs gone to the east, the valley is now-a-days utterly destitute of

people. Múng drew some creditable maps on the sand, and seemed to thoroughly understand the relative positions of the various countries, routes, passes, rivers, and mountains, with their inhabitants. From all he could learn, the Singphú track *viâ* Sitkha was difficult mainly on account of the want of supplies *en route*, and at best not so easy as that over Patkai. All agreed that the line over Dopha Búm to Manchi from the Upper Dihing was reported both long and difficult, and people very seldom traversed it. After a while, the moon sank, leaving the line of forest opposite strongly marked against the sky. One by one we went to sleep, and all was quiet.

About 6 A. M. we were all astir, boxes packed, camp-chair folded and stowed, tents rolled up, and for once we pushed on before breakfast. A cup of hot coffee and milk with a biscuit was my *chota hazri*. This same prepared coffee and milk is a most useful item, and can be made almost in a moment and milk cannot be procured *en route*. Here and there we occasionally saw some fine mahsir, 20- and 30-pounders, and I regretted not having tackle.

Fine views of the snow-capped hills to the east were seen ere the mists rose, and Dopha Búm looked beautiful in the early light, the shadows sharp and blue, while the snow was of that peculiar creamy white, so difficult to get out of any colour-box, the sky colour behind all being a clean pale grey. A good telescope, to one travelling eastward is a necessity; without it he misses half the "sights" of these parts.

About 11 A. M. we passed the Mganto Múk, one of the three old channels of the Dihing, and saw there some huts of elephant-catchers and rubber-cutters. After passing it, we again found the Namrup perceptibly smaller, several long shallows so bad indeed that the men had all to carry their loads ahead and return to drag the canoe over. My Rob Roy, drawing only two inches of water, of course experienced no such difficulty. Later in the day we passed the entrance to the Nmbai, or Lumbai as some call it, for at times they seem careless which it is. This is not really a river, but a loop from the Namrup which leaves it here and rejoins the main stream above Kherim Páni.

Still later we passed the third channel of the Dihing called the Kasán on the same (right) bank, reaching Namtsik before sunset, and camping on a sand below the huts of the elephant-catchers employed by Mr. Vanquelin. He was encamped close by, and paid me a visit, giving some information in reference to routes, and kindly lent me a smaller boat to assist me in getting up the river Namtsik. I was here induced to take the Namtsik and Tkak route *viâ* Sonkap, instead of the one straight on *viâ* the Namrup, or, as it is here called, Namhúk, the route by which Mr. H. L. Jenkins and my brother travelled in 1869.

Next morning we re-arranged the baggage, leaving some needless items till our return, and taking only loads which the men could easily carry in the hills. At first the Namtsik was a succession of deep clear pools, among wooded hills, with rapids at every bend. The timber was remarkably fine, the best I had ever seen. Huge *nahars* (*Mesua ferra*), *mekahi* and *goudserai*, rising here and there to immense heights, certainly 100 feet to the first branch, being 10 and 12 feet, or even 16, in circumference at the base. Large tree-ferns and wild plantains rose above on either side, and creepers hung in profusion everywhere, long lines often hanging down into the water, as a rule everything was beautifully reflected in the still clear water. Eventually we reached a rapid towards 4 o'clock, where an immense rubber-tree overhung a deep pool, but with a ledge of shingle intervening, on which there were remains of some huts made by the ubiquitous rubber-cutters, these we speedily demolished, and after levelling the ground, pitched our tents in a line. Somehow this evening, in consequence of the gloom, the weird look of the whole place, queer hootings, and a slight drizzle, the party all seemed inclined to the superstitious, and I had to compel them to cook and eat. After they had done so, I issued a small "tot" of grog to all who would take it, which served to rouse them up. During the night it rained, but, as before, our waterproofs kept us dry.

About 9 A. M. next morning, after all had eaten, we started on, passed some long rapids and shallows, where I had even to get out and tow my *Rob Roy*. At one place I was ahead looking for deer, and enjoying the beauties of the gorge. Some of the tree-ferns I estimated at 30 feet high. Dead rubber-trees were also seen here and there, the dead arms standing out conspicuously against the clear blue sky overhead or fallen over bodily into the river bed.

Suddenly, on turning a corner, I came on some Nága men and women who were out for jhúming, they were all nearly naked, the men wearing a narrow strip of cloth and the women a series of fine cane strips, so girdled as to look like a miniature crinoline that hung down about a foot below the waist, and to which a narrow strip of dirty cloth was fastened horizontally. The women also wore nose-studs (which covered the nostrils) made of pewter, and the size of four- or eight-anna pieces. A profusion of glass beads, as usual, made up for the scantiness of the costume in other ways, and brass wire rings were worn through the upper part of the ear, from which the red and green skins of a small bird depended. Brass wire bracelets, a bead coronet, large red cane loops in the hair, two bone skewers, and shin-rings seemed to complete the outfit. Two lads of 16 or 17 were quite nude.

None of them could speak a word of Assamese, and seeing me alone they were considerably astonished, especially as but one or two of them

had ever seen a white person before (when the surveyors were there). Though taken aback, they evinced no distrust, and by signs I called the lads to haul my canoe up the top rapid; soon after my followers came up, and my guide could talk to the lads. They were from a village up on the northern flank of the Patkai. The dress and general appearance of these Nágas was almost precisely the same as of those found up the Tirap valley, twenty miles west.

As we ascended the Namtsik it maintained its picturesque look, a succession of deep still pools, often overhung by rock and trees, shallows and rapids here and there blocked by fallen trees, at times long ledges of dark slippery rock with narrow channels, through which the river rushed, making it difficult to get the canoes over. In places the gorge was almost in twilight, in consequence of the masses of foliage all around and above, where it was not always possible to see much sky. The large whitish trunks of immense trees (*hulong* and *mekai* more especially) here and there rose very conspicuously against the darker background; there were also many large trees that seemed new to us. *Húláks*, or Hylobates, the black gibbon, were very common, and made the forest echo with their hallooings. The great hornbill, too, was seen in flocks of twenty and thirty at a time, and could easily be heard, as their wings seemed to rasp the air, from a quarter to half a mile off. Otters were common, and made off with a great fuss; no doubt, from the signs we saw, they have a nice time of it.

At one place we came to a huge *mekai* stem hanging or projecting out in the air from the jungle on the left hand; after passing under I got out of the canoe and scrambled up on it, the stem was fully four feet thick, and projected about thirty. On walking back on it, and dividing the jungle with my knife, I found it was poised on its centre on an island, and that an equally large portion overhung the other branch of the stream,—it had evidently been carried along and lodged there during some big flood.

Towards the afternoon we began to get glimpses of dark green and blue forest-covered hills not far off to the south, the group of Sonkap Búm on which there were several Nága villages. The highest peak of the ridge is about 3,000 feet, and as it stands well out north of the main range of Patkai, it affords some magnificent views.

At 5 P. M. we arrived at the mouth of a small dark gully, which the guide said was the route to the Tkak Nága villages. Here we camped, and in the early morning arranged all the loads carefully. Three men were then left in charge of the boats, while the rest of us went up to the village.

For some way the path led up the rough and slippery stream bed, subsequently over a level spur, through clearings, where we had to scram-

ble from log to log and walk along large and small tree-stems at all angles of inclination, the ground being as a rule completely hidden under a thick mass of creepers, foliage, and smaller lopped branches, all drying so as to be ready for being set fire to about March.

How the leading men kept the *path* under such circumstances was wonderful, for no trace of a track of any sort was visible. In some forest beyond we met a Tkak Nága and his young wife, who were rather taken aback on seeing our party. A palaver ensued as to which of the two villages we should go to, and during it we suddenly saw a long string of Nágas advance in single file, and, the path being very narrow and in dense undergrowth, they had to pass us closely. As they went by many spoke to our guide, and some stopped and gave him some tobacco, asking who we were and where we were going, many had flint guns, and all carried the Khampti dáo. Generally, they passed me hurriedly and seemed more comfortable when they had got by, then turned round, and stared. Those who had loads carried them in a conical basket (the Nága húra) by a strap over the forehead; more than half had spears, and all wore the little cane crinoline and small strip of cloth passed between the legs which forces the testes into the abdomen, a usual custom among these Nágas (East). They were not tattooed, and hence looked much paler in the face than do the tribes who live further west. I found they had all been summoned by a Singphú Chief to assist in building him a new house.

After passing through another *Jhúm* we reached Tkak, a village consisting of ten houses on a spur facing the Nambong valley, where the guide made arrangements for us to stay in the outer end of the headman's house. After an hour's rest, the carriers went back to the boats for the other things, and the whole party came up. While they were away I had breakfast. It was no easy matter communicating with these folks, as the only language they knew besides their own was a little Singphú. Lah, the guide, and Múng, the boatman, however, were generally somewhere at hand to interpret.

The village was evidently not more than five or six years old, as I saw the stumps of the forest trees everywhere about, and often the stems as large logs. The houses were not arranged on any plan, but just built where the owner had a fancy, on a fragment of level eked out by posts, not over 30 or 40 yards apart, no two houses consequently were on the same level or faced the same way. They were more or less on the same pattern as are all the houses of the hill tribes in or about Assam except those of the Gáros and Khásias, *i. e.*, a long bamboo shed, with floor raised on posts some 4 or 5 feet.

It is singular how this custom survives even among people who have left the hills and been resident in the plains for some 500 or 600 years, as

for example the Deodhaings, who came in as *Ahoms* in 1228, and are now seen occupying a few scattered villages not far from the Disang river, in the Sibságar district. The Aitonias and the Miris also afford other examples. The custom in all cases seems due to the necessity of keeping the floor out of the reach of pigs and goats.

It may be called the "Pile platform" system, and to some extent marks a race distinction between Aryans and non-Aryans. It is probably the same system which occurs throughout the Malay peninsula, and has latterly been traced in the Swiss lake-dwellings, and present Swiss châlet.

Among the Nágas, where houses have been built on a declivity, I have seen one end of the house only a foot or so raised from the ground, while the other end, supported on bamboos 30 feet long, overhung a fearful gully,—the little platform at the extremity, on which the people sit out and sun themselves and their children, having no rail or protection of any kind.

The people seemed very quiet and civil, but were more or less curious to see our things. While they were examining them we heard a loud wail raised in a house not far off, that made all mute, soon after another, and they all went there in a hurry, gradually joining in the chorus. It turned out most unluckily that the old *headman*, who had been very ill for some time, took it into his head to die *just* after our arrival. It made my guide and Múng and the three other Singphús look serious for a while Guns began to go off, too close to sound pleasant, and were pointed about promiscuously; I began to think matters were getting serious, as the son, a grown man, rushed about demented, yelling and slashing and cutting everything within reach of his dáo,—floor, walls, baskets, all got a fair share of his fury, an unlucky cock that ran past lost his head, and dogs kept aloof.

Guessing that a good deal of the rumpus was "a form of sorrow" in these parts, I kept our party as unobtrusive as possible, and in about half an hour the bereaved son came to me, quiet, but crying, and asked for some caps, as they had a nipple-gun which they desired to use in the row. On giving him a few, I remarked that had I known the old gentleman was so nearly dead, I should have gone to the upper village, but he explained that his death had been daily expected for some time, and I must not be put out at the noise and fuss, which was their custom. He turned out afterwards to be a very decent and intelligent fellow, and rendered me good assistance.

The row still going on, I took my note-book and strolled out by the path towards Patkai. A fine view which I had of the Namtsik valley shewed it to be wide, and filled with low rolling hills and undulating land, and not nearly so steep or high as I had anticipated from the shading on the Government maps, which extends as far as this village.

Patkai here at least presented a high and tolerably level ridge to the south at 3,000 feet up to 6,939 feet at the Maium peak, all seemed deep blue, instead of green, forest-covered to the top, and at some five or ten miles off, the Nambong river below, dividing it from Sonkap, and receiving the drainage from both sides, to flow east and join the Namrup. The six or seven large spurs from Patkai are all included in the prospect.

Early in the evening the men arrived with the remainder of the loads, and I pitched the tent in the usual form on a clear little flat just at the outer edge of the village. After dinner we had a large audience as usual of Nágas, men and women, the latter being in the outer circle. The object of my visit (*i. e.*, to see Nongyang lake) was explained, and routes in various directions discussed. There was but one to the lake from hence, *i. e.*, *viâ* the Nambong to Núnki, a stream between two of the large spurs, then across Patkai by the regular and only pass. They made many enquiries regarding "rubber," and I was able to show it to them in various forms, as waterproof sheet, coat, air-pillow, elastic rings, &c. It was little wonder that they were interested, inasmuch as till about a year ago any enterprising Nága could earn 2 to 4 rupees a day by its collection, and both the inhabited and uninhabited tracts on each side of Patkai had been explored.

Here, as before, remarks were freely made in favour of our Ráj, which was favourably contrasted with the state of insecurity known to exist in Upper Burma, and here also before our arrival in Assam. They spoke of the visit of the Survey party some years before, to which they made no objection. A good many of them had been as far as Lisa or Mákúm and Tirap, but few to Jaipur, and very few indeed to Dibrugarh. They seem to work pretty hard, the men and boys in clearing the forest (*jhúming*) and house building, while the women plant and weed the crops, reap, look after the family, cook, &c., though the carrying of water in the bamboo tubes, often for considerable distances from some gully below, is no joke. They also bring in immense loads of firewood from the clearings, but as a rule the women and girls are remarkably sturdy, and think very little of carrying 150 or 200 pounds on their shoulders and backs, slung by bands across the forehead.

Like most Nágas, they have no special agricultural implements, but use the ever handy dáo, which is also a weapon. Spears were pretty common. They were iron-headed and of the elementary form common all over the world, the other or butt-end often having an iron spike to help in climbing; the young men also seemed fairly expert with the crossbow.

Old flint muskets of English make, were not uncommon, the powder being made on the spot by the Nágas, nitre collected from the sites of old

cow-houses; where the sulphur came from I could not ascertain. The charcoal was made of the wood of citron-trees, *jaura tenga* of the Assamese. This powder is not granulated or very strong, so large charges are necessary.

At 9 A. M. the boiling-point thermometer showed 209°. 60, the temperature of the air being 64° F.

After a fine cool clear moonlight night we were up at dawn, and our party had an early breakfast, the loads were carefully arranged, and I prevailed on five Nágas to carry extra rice for us.

Leaving the village at 11 A. M, we at once passed through the last year's *jhúm* towards the south-east, and down a long spur, towards a tract of low wooded hills, on one of which we passed the last Nága village in this direction, a small one of some five or six houses. There are no Nágas east of the Dihing and Namrup. Thence through their *jhúm* partly felled, and on down to the bed of a stream, along which we travelled a little way, coming out on the Nambong, a small river that carries the northern-drainage of the Patkai east to fall into the Namrup and Namphúk. There was not much water in it, though here and there we saw pools; the bed was rock, boulders, gravel, and sand alternately. How they kept to the path it was not easy to see, for we often cut off bends by suddenly parting the jungle and finding a rude track below,—at times even this was not to be seen, as it was over boulders and rock. Still, the faculty of keeping or finding the track is part of the savage nature all over the world, and when studied and understood is not at all wonderful. On opening their eyes anywhere in the jungles, these savages can read the surroundings like a book, it is their book in fact, though sealed up, or the signs invisible, to the civilized intelligence.

Near the mouth of the Núki, which drains a valley between two of the large spurs of Patkai, we camped at a clear spot, where there was also plenty of firewood, and wild plantains, for the guide, Múng, and the Nágas to make a hut of.

Bedded rock, laminated shale, was passed frequently inclined at 60° or 70° dipping south.

At dusk, when cooking, the stones under the fires, or supporting the various pots, frequently exploded, so that the operation became rather exciting, and it was agreed by the Bengalis that the Nambong Deo, or spirit, had objections to it; however, it was all over ere long, as we were hungry, and, on the moon coming out, we spent a very pleasant evening. Stories and jokes abounded; now and then a general howl was raised to warn off a tiger that prowled about, though none seemed much afraid of him (his tracks were fresh and plain on patches of sand not far off in the morning). At 9 P. M. the thermometer stood at 60° F.

After breakfast, at 9 A. M., we again started on and soon struck

the Núnki, up and beside which we travelled for some hours, and which in places is anything but easy walking, and, though bare-legged, I found shoes were necessary. Here and there a man had an ugly fall, and it was well the things were well packed, as the loads had rough usage. Gradually it began to rain, which was a damper in every sense, as where we went on the banks leeches abounded, and in the river bed the rocks and boulders and the smaller shingle became very slippery. A small lean-to shelter or old hut marked where the path left the Núnki bed to ascend the spur, and here I made the men halt. The Nágas and Singphús and Múng at once pulled out pipes, so I made my fellows all take a little rum "medicinally." We then started on and found the first 1,000 or 1,500 feet pretty steep, the path being unmistakeably visible, both by the track below and the blazes on the tree stems of all ages, from one to ten years; a peculiar feature of the path was that it very seldom varied from a dead level for perhaps two miles or so, and never descended anywhere as much as 30 feet, and was in the main fairly straight. Vegetation began to vary a little, not only trees, but plants and herbs of new kinds were seen, and after about a couple of hours' pretty easy walking the track got steeper and steeper, where the long spur joined the main range. At last the climbing became no joke, to the men who had wetted loads especially, and we had frequently to rest; half an hour or so of this work brought us through some *kuko* bamboo to the crest of the ridge, which was quite narrow and densely wooded, the views either way being simply of clouds and mists.

At about fifty yards from the path we camped on a small level, and the rain left off in time for the people to hang out and dry their clothes, blankets, &c. The only thing now needed was what we had too much of already, *i. e.*, water.

Some of the Nágas, however, went away to the bamboos, getting about a gallon from the joints, which sufficed for cooking my dinner and brewing tea for all the party.

I repeatedly told them there was a spring of good water some 400 yards down the path on the east side, in a gully off the same, but both Lah and the Nágas denied it, and said it was useless to go. Subsequently, when at Bor Phakial, I heard that it was true that there was water there. At 9 P. M. water boiled at 205°. 75, air being 57° F. Considering our wetting and fasting, the people were all in very good spirits, and we were anxious to see through the veil of mist to the south,—but no such luck, the night proved foggy too. In the early morning I put my orderly to watch for the view at a part of the crest where there was a patch of grass some two acres in extent. At about 8 A. M. he reported by shouting to me that the clouds were clearing and mountains showing beyond. I at once went up with my prismatic compass, and now and then the driving white

mists or clouds that swept up showed signs of parting. Suddenly below us, and some way out among the clouds, we saw a patch of bright yellow, and another to west, of blue, both for the moment a mystery. It turned out the yellow was dead grass on the plain in sunlight, and the blue was the lake.

In a little time it had so far cleared that I secured bearings of the most conspicuous features, including the peak of Maiúm, to the south-west, which is just 7,000 feet high. While I made a hasty outline sketch, the men struck the camp, and by 9 A. M. we were off down the path that leads to the Nongyang ford and from thence *viâ* the Digum Búm and Loglai Kha, to Namyong villages in Hukong.

After a short time, having first consulted with the Nágas, we left the path and struck south through the jungle, down across deep khuds and over little hills, where the load-carriers had a job to get along, especially those in charge of the canoe, the incline in many places being 50° and 60° from the horizontal. But Nágas are at home in the jungles, and soon piloted all of us down to the level, which we reached far sooner than we expected, but found it so soft and swampy that it was too dangerous to go on, and we had to return to the flanks of the smaller hills trending towards the lake. After about an hour's walk we came to where the bottom was more firm and sandy, and we crossed to the low wooded hills that run along the northern edge of the lake, passing among which we suddenly emerged on it and had a splendid view. Giving directions to pitch the camp on the little hill-side facing the lake, where there are some large *hingori* trees, we crossed a patch of reeds and stood on the actual margin.

The Nágas, Singphús, and Kamptis at once began some sort of puja, each after his own fashion muttering away, bowing, and touching his forehead with some of the water. I then had the canoe launched, but they all begged me so hard not to take the gun, that I left it, and the wild fowl which I saw out on the lake's opposite shore got off. One and all said we should be sure to have heavy rain if I fired, or a bad storm, as the Deo of the lake would be certain to be offended. So I turned the *Rob Roy's* bow out, and felt the peculiar pleasure of being the first who had paddled on that sheet of water, certainly the first who had done so in a *Rob Roy*. As I went out I saw the margins were low all around, and no forest near, except where I had started from.

The basin of hills, beautifully reflected in the smooth water, swept right round in a green-blue curve, the valley of Nongyang extending south some six or eight miles as a dead flat covered with grass and scrub. The whole bottom of the valley was flat, except where three small tree-covered hills stood like islands in the sea of grass east of the lake. The banks were so low and flat all around that I could see a considerable way inland from

the canoe. Turning westwards, I began the circuit of the lake at some 100 yards from shore, and soon found little bays and headlands, though no sign of out- or inlet. When half round, I looked across and saw the smoke of the camp fires rising blue against the foliage. The water-fowl had apparently crossed over there. Towards the south-east corner I passed up a channel, separating banks barely a foot high, covered by a small sedge, and found I was rounding the island, a very low flat patch of an acre or two in extent, with some very scrubby trees on it.

The water was here so shallow, being often barely two inches deep, that had not the silt been soft I must have stuck. This silt, however, was so soft and light that the paddle, held upright in it, sank in 2½ to 3 feet from its own weight. Of course I got out of such a dangerous corner as quickly and quietly as possible,—an upset there meant certain death.

I was surprised to see neither stones, sand, nor clay, all was silt and peat, except a little sand where I had started, the outlet was from the south-east corner not far from the island. After about an hour's paddle I returned for breakfast, made all snug, took some observations and memo. sketches, and in the evening went out again, going nearly round, and finding several inlets. The number of wild fowl must be considerable, as the edge of the lake was almost everywhere denuded of sedge or vegetation for a couple of feet in, and had plenty of feathers trampled in. At one place I saw marks made in the bank by the two tusks of a large elephant at water-level, evidently one which had got in and could not easily get out, of which there were other signs beyond. Report says there are large numbers of tusks in the silt everywhere. Other tracks were very common, though no game was visible, but no deer, buffalo, nor indeed any large game tracks except those of elephants.

In the evening we had some strong puffs of wind, and we made all taut for the night, after dinner settling with the men who were to take turns at watching. The Nágas also drew creepers and some dead branches and leaves about us outside, so that anything approaching would at once be heard, then we turned in and slept soundly.

In the morning I started the five Nágas to their homes they were not wanted and wished to be off, and then prepared to sketch the lake and hills and get bearings. This occupied me all day, and we prepared to start next morning for the Nongyang ford, where I desired to search for the inscriptions in Ahom cut some 500 years ago near the ford, where the road crosses. The men, however, whom I had sent ahead to find a path, returned in a great mess, and declared it utterly impossible to cross the valley, as the peat, or *pitoni*, was too soft and deep to bear their weight. This was most unfortunate, and a second attempt, backed by a good prize if successful, failed equally, so there was nothing for it but to return to

Patkai at any rate. I then determined to lash my canoe in the large arms of a big *hingori* tree, and did it so as to prevent its being blown, or shaken down, resting it bottom up on three boughs; being of a very lasting timber, it may remain safely for some years to come, unless elephants can reach it, which I doubt, or the Nágas hear of it from Lah.

We therefore, instead of crossing for the Nongyang ford, started back by the road we had come, and found the return to the pass comparatively easy, it took but 2 hours or 2½. There being no water on the crest, I had made the men cook and carry extra rations and water in my kettle. From the crest, it being a fine clear day, I made a sketch and took bearings again, also by boiling-point thermometer at 4 P. M. and 9 P. M., and again at 9 A. M., secured the altitude, which was worked out for me by Mr. H. F. Blanford, to whom all the observations were submitted. Apparently, the crest of the Patkai at the pass is about 3,500 feet above mean sea-level, probably 3,000 above the bed of the Nambong on the Assam side, while the Nongyang lake and valley stand at about 2,200 feet, showing, say, nearly 1,300 feet difference in the levels. The valley of Assam, in fact, being much the lowest, and the Nongyang lake lying about on a level with the Sonkap villages.

From the pass, looking southwards, the valley extends as an irregular triangle for some eight or ten miles north and south, by three or four in width, the lake being near the Patkai end where broadest, and being itself, say, three-fourths by half a mile. Apparently the lake once filled the entire valley, the junction of the level with the hills all around being a well marked line; the surface also mainly consists of grass and scrub jungle, and showing very few trees, is apparently all swamp. The three small conical and wooded hills east of the lake, and at, say, one-fourth to half a mile distant from it, look precisely like islands, the exit from the lake passes close to them.

Later in the day I attempted to get along the crest eastwards, but it was an interminable succession of gullies or saddles and ridges, which would need a whole day to explore, and the dense forest precluded a view in any direction. At a mile east a peak rises which dominates all around and beyond. While we were camped on the summit a party of Singphús crossed from Assam *en route* to Hukong for buffaloes. Starting from the Nambong that morning about 9 A. M., they intended making the Nongyang ford ere dusk, thus crossing from water to water *in one march*. Three or four of them had guns.

Early on the 14th we struck the tents, and started back down the northern slope, seeing the tracks of cattle which had crossed since we did. In about three hours we reached the Núnki, where we had breakfast. I here caught some orange coloured butterflies which seemed new to me, and

measured a *mekai* sapling which was 10 inches diameter at foot and 5 inches diameter at the first branch, 60 feet from the ground.

It was a lovely morning, and, excepting for one or two bad falls, we got down to our old camp easily and quickly, finding three Tkak Nágas there. At dusk we heard a barking-deer not far off, a Nága took his gun and quietly disappeared, a loud report soon after told us he had succeeded, though, being dark, he could not trace it; by dawn, however, he was out and returned with it on his shoulders. I gave him some beads for a leg. These men knew the country pretty well, and had cut rubber on the Upper Loglai. They said large numbers of Nágas from our side go east on the side of Burma, taking food for twenty days, and in parties of thirty and forty or more. It is a large tract of country, and totally uninhabited.

After breakfast, about 9 A. M., we all started on together up the Nambong, thence over the undulating forest land and low hills, *jhúms*, &c. One of the Nágas we dropped at the first Tkak Nága village, and soon reached the one we had camped in at night, where we rested an hour and waited for the guide, who had loitered behind. In the *jhúm* close by I observed each person's little store-house of yams, chillies, pumpkins, &c. quite open and exposed, often without doors, yet I was told on all sides that the contents were quite safe. So close to the path were the things, and so very tempting, that I had to collect and warn my people against innocently supposing they might stoop and take what they saw, or there might have been no small row. While resting in the Tkak village, a Nága woman came and presented me with a large basket of *moad*, or rice-beer, which, after tasting, I passed round; it was not so good as that of the Nágas living west near me. Like the Singphús, these people make very neat wicker-work baskets, and line or plaster them with rubber-juice, so as to be not only water but spirit-proof. They also make pretty bamboo mugs, with two handles in loops, some of them absurdly like Dr. Schliemann's early Greek pottery.

When the guide joined, we went on and climbed another 500 or 600 feet to the Upper Sonkap village of some ten or twelve houses. Several women and big girls at once, and without a word from us, brought out and handed over bundles of firewood for nothing. It was done so quietly that I take it to be a regular custom, and one form of welcome. Water, however, was at a premium. Some for present purposes was given us in huge bamboo vessels, but I had to get the Nága boys and girls to bring more at a pice per tube. Even then, there was a short allowance, till the spring filled, or they found a lower one next day. I went to see it, and how they managed to get down and up in the dark surprised me. The want of water has a perceptible effect on the complexions of these people,—the older women seem especially partial to charcoal dust and ashes.

We pitched our tents in a row, on a clean piece of ground offered us among the houses, and after dinner a most motley crowd of people came round our fire, to whom I had more or less to show myself, my clothes, guns, lamps, &c.

The imperceptible effect of custom was curiously seen in many very trivial things here, as elsewhere: for instance, though more or less all prepared for wonderful guns, I found that whenever I opened the D.-B. B.-L. suddenly and the barrels dropped, there was an instantaneous "Awa! he's broken it," the idea of a joint at the breech being the last to occur naturally. At last we got to sleep, after telling them all I would remain over the next day, perhaps two, and there was plenty of time to see everything.

Early next morning I was up, but the range of Patkai all along was invisible. In the dark, however, I must mention the Nágas were up and the women and girls at work and going for water. The muffled tread of many feet and tinkling of the many shin-rings awoke me, and they came back in the dark; meantime, the dull "bump, bump" of the rice husking went on in every house till dawn.

I took a turn to the upper few houses of the village, some 300 yards east, while my man was getting *chota hazri* (little breakfast) for me, and on my return in half an hour, failing to make a sketch east on account of the mist I found a lot of the women and girls squatted about weaving, and "got up regardless," in beads, red hair, red cane, and such like in lieu of costume, the *tout ensemble* when some of them stood up was certainly most remarkable. The long and in some cases profuse straight black hair was secured on the poll of the head by two large (engraved) bone hair-pins, from the projecting ends of which, behind, beads depended, round the head or over the hair some twenty rings of scarlet cane were fastened, and over the forehead a bead coronet. A large brass ring hung from the upper edge of each ear, a bright green bird's skin dangling below to the shoulder; the peculiar nose-studs, or nostril-plugs, completed the head. A profusion of large small bead necklaces hung from the neck, some close, others long and reaching to the waist. Pewter armlets, bright and dull, on the arms, and wristlets of brass of various sorts, from plain wire to a curious piece of casting, were on the arms, now and then red goat's hair being attached in a fringe or bunch. Round the waist was the curious series of cane rings, some fifty or sixty, more or less attached to each other, or long strip coiled round and round, but generally worn as a little crinoline, very much too short, and which was helped out by a strip of native-wove cloth, going all round, but ends not joined,—the whole contrivance barely decent. Red cane bands were often worn round the leg below the knee, as is the custom with the men, and then the remarkable pewter shin-rings, four or five on each leg

placed on edge in front and tied round the leg in some way that prevented them all from slipping down. In walking or running these made a pretty loud tinkling as they touched each other.

To-day the belles of the village came out strong, they seemed for once to have washed themselves and donned all the finery available. As I went about with an interpreter, looking at the weaving and little sticks used as a loom, and asking all sorts of questions, they seemed as much amused as we were, and when laughing, the whole costume seemed to join in, the nose-studs in particular. I could hardly help every now and then thinking what a sum one would realize as a model at the Academy life-class, especially some of them who were remarkably well made and not bad-looking. The children, as a rule, were not at all prepossessing, and had heads and faces round and uninteresting as a turnip, the nose a little round knob, and little eyeholes as in a mask, utterly destitute of modelling. The men's costume was limited to the cane crinoline and a jacket without arms, occasionally a necklace and topi with hair or feathers; but they do not dress themselves as gaudily as the women, or as the Nága men further to the west.

The looms I saw were simply two little upright sticks of any sort driven into the ground, and one loosely tied across the offside, to which the woof was wound, another similar one being in front and looped to a band, against which the weaver leaned back to pull it tight. A huge flat paper-knife seemed to complete the arrangement, being some four inches wide it, when placed on edge, opened out the strings enough to allow a little ball of thread to pass through; letting the said paper-knife lie flat seemed to open the strands the other way, and the little ball was rolled back again: with this they wove cloths with a simple pattern, which were from a foot to eighteen inches wide. Several were weaving men's cloths of the strong *bourhea*, 5 feet long by 3 inches wide, and with ornamental ends.

After an early breakfast at 9 o'clock I started with several men for the summit of the hill, and after a steep climb reached it and found it had been *jhúmed* about two years before, so we set to work and in an hour cleared off a good deal, enough to enable me to see round and get bearings. The view was a fine one, bounded on the north by the Mishmi Hills, north-east by Dupha Búm 15,000 feet, well snowed down to 2,000 feet or so from the summit; east the Phúngan Búm, 11,000 feet, was well seen, but had no snow on it, the distance about 53 miles; thence round towards the south I saw the eastern prolongation of Patkai, with the depressions in the range where the old Burmese route crossed, at probably 1,500 or at the least 1,000 feet lower elevation than the present pass of 3,500 feet. Over and beyond this marked depression could be seen a rather high group

of hills,—a feature visible here alone, as elsewhere the range of Patkai hid them from view.

The hills seen beyond were expressively called the "Loglai Patkai" by the Nága headman, who caught me making an outline and taking bearings. They may be the group that lie between the Loglai and Turong rivers. From this point west, the entire line of the Patkai crest was visible, but slightly undulating till near Maium, where there seemed to be several depressions, before the rise to the 6,939 feet of that peak. The seven large spurs, running north and more or less at right angles, were very distinctly seen with their intervening valleys, all, like the main range, densely wooded, the Nambong draining all that was lying in this direction. Some of the more western spurs of Patkai were sufficiently high, and form the sky-line, as Longvoi Pipoi, and Nongya Sapon, projecting into the Namtsik valley, which lay west, and seemed filled with low rolling hills, one behind the other, for a long way. Towards the north-west at some miles off, and seen more or less on end, were the ranges dividing the Namtsik from the Tirap basins, some peaks, as 'Mung phra,' Kongtam, Rangatu, and Yungbhi, were from 2,500 to 4,000 feet high; further west again about Makum, the hills gradually sank to the level of the plains, in a sea of forest. I observed that the mists in the early part of the morning, or before noon, poured for hours over the lowest part of Patkai above indicated, like milk from a jug, and the phenomenon was repeated daily during our stay, thus marking it unmistakeably as the lowest part of the range. East of this part (which seemed the Upper Namrup on our side and Loglai on the other) the range rose again, though not to any great height. Between Patkai and Dupha Búm, beyond Dihing, rose a fine group of hills called by these people Miao Búm, and between Miao and Sonkap, on which we stood, were the small hills called Nan-nan and Tantuk, between which Pemberton says the old route lay and the Namrup flowed, under the name of the Nam-huk or Namhok, and near the village of Namphuk; the alternative route to the Núnki, *viâ* Nambongmúk, passed hence also, it was taken by Mr. H. L. Jenkins and my brother some years ago, in 1869.

Towards the afternoon we descended through a clearing, where we saw boys lopping the tree branches that overhung a gully, seemingly a very perilous job and needing some nerve, as the branches fell quite 500 feet. In the evening, an old Nága gave many particulars about the Nonyang lake and valley, and the previous inhabitants, routes to Burma, &c. He gave the length of the valley as one day's journey, and says he lived with other Nágas once on the hills overlooking the western end of the lake, where there are now no villages. The original inhabitants were, he said, Khamjangs, Aitonias, and Turong Turai, confirming what I had

heard before, and that Nágas inhabited the hill ranges around on the west.

At night we had again a large audience, the men and boys seated round the camp-fire, the women and girls in a circle standing outside. I was asked all sorts of questions about my country and people, the Queen, railways, and steamers, on which Múng had been dilating more or less.

Next morning after *chota hazri*, I started eastwards with my orderly and a couple of Nágas, and got into a *jhúm* on the eastern flank of our hill, from whence I obtained a fine view. At noon we returned and had breakfast and after a rest, I made an outline sketch of the Namtsik valley, and then saw a fine sunset. I also fired a few rounds from my revolver, at a mark, to the delight of the young men, who cut out all the bullets at once from the old stump. Some eight or nine Kessa* Nágas came to the village from the other side of Patkai, and were pointed out to me. They were, I could see, in various ways somewhat different to the Nágas I was among. Paler in colour, more ugly and sinister in looks, destitute of arms or of ornament, and each wore a large wrap of bourhea cloth. They also did not tattoo. It was difficult to communicate with them, as only one or two knew a few words of Singphú, and their "Nága" was also very different. The Sonkap headman and others told me they belonged to a tribe who sacrificed human beings, and, as this was news to me, I took some pains to get it confirmed by them. The Nágas replied by explaining that it was done as an old custom, to secure good crops when there was likelihood of failure, and not through wantonness, and that they explained this to the victims, men and women, captured or bought, who were tied to a stake, and killed, as far as I understood, by a cut across the abdomen transversely in some way. It would be very desirable to verify this on the spot, and, if it proved true, endeavour to suppress the practice of such a custom at our doors.

The entire Nága question must be taken up sooner or later and properly settled, or it will be a source of constant trouble to us. We have had very fair success with the Aryan populations of India, but seem to fail signally among non-Aryans. Dr. Hunter's remarks regarding such races are worthy of the most careful attention. They seem to need a combination of the autocratic and patriarchal,—an essentially *Personal* as distinguished from a *Departmental* Government, with its cloud of Babus, a race mortally detested by the Nágas and such like tribes (and with reason). This indispensable element of personal regard our Government seems to systematically ignore, the most potent tie which can connect us with these people is frequently and recklessly severed, with results that

* Nágas on our side of Patkai are called "Hijud Nágas," or cooked, *i. e.*, civilized, those on the Burmese side are Kessa = Kutcha, or raw.

act disastrously on them. Yet, instead of blaming ourselves, who should know better, we blame the savage, and wonder at the result. In time no doubt these people might be educated and understand us and our institutions, but in the meanwhile they need an intelligent "Chief" over them, rather than a department, and one not changed for every little frivolous pretext, but one who will elect to live and die among them and work for them. From being a set of treacherous and turbulent races, they would become a prolific source from which our Indian army could recruit most valuable and trustworthy material. They are particularly susceptible to personal kindness. It is to be lamented that with the opportunity and power to govern them successfully, there should be deliberate blundering through thoughtlessness. Such men as Captain John Butler are needed, they are few and far between perhaps, but are still to be found with a little trouble.

But to return to these Kutcha Nágas; what they were like in their houses I can't say, but here they wore a sinister truculent look, and there was more difference between them each individually than is usual, though the colour was somewhat uniform; they wore the hair cropped to a horizontal line across the forehead, as is so common among all Nágas. They spoke very little, and in undertones, to each other, their numerals, like those of all the races in Eastern Assam, being on the same basis, with minor variations.

At last we got to sleep, and after a pleasant night were up at dawn. I asked the Nága headman to assist me in procuring some *curios*, personal ornaments, costumes, &c., but it proved to be no easy matter. They might give away, but how could they sell such things? Of course, if *given*, a present was expected in return of, say, at least double value.

At first they quite failed to see why I wanted their costumes and ornaments, unless for some unstated purpose, not a good one,—to perform magic with, perhaps; but gradually I got them to see it as a harmless and laughable peculiarity of mine, and I secured a few of the things, though at exorbitant rates. I got them to see it best and easiest by selecting a girl well got up, and saying I would like to take the "lot" as it stood, bar the girl. Nága-like, they could not resist the temptation to palm off bad things for good. Eventually, we got what we wanted, had breakfast, and, while packing, I showed them all another village through the telescope. Their astonishment was considerable, and, as usual, they thought the village had been brought near by magic.

Ere midday we were off down for the Namtsik, where, meeting a young Nága I secured some samples of his gunpowder in exchange for some bullets, on which he set a high value. The powder was kept in dry bamboo tubes, with a stopper and bit of cloth. I also made him sell me

his jacket and crinoline, or at least three-fourths of it, for he said if he went up home without it, he would be a laughing-stock to all the girls, even though he had his cloth on. Our men soon appeared emerging from the gully, and we shipped everything and got off, the dropping down stream being very pleasant work, and the rapids giving very little trouble. At one place, a long deep pool shaded by overhanging rocks and trees, we found a party of Nágas fishing; their mode was to stake the shallows above and below, and set a series of traps, then to hoe or dig in by stakes or dáos a lot of the bright red fine clay of the bank at that place, which renders the water like pink cream, whereupon the fish in the pool clear out, and in so doing all get caught. They go about, too, on bamboo rafts, and beat the water, to scare the fish; generally each person gets two or three big fish to take home. We shot along pretty quickly, and at last camped on a bed of shingle at the river side, where there was plenty of grass to sleep on, and firewood. Here the *dam-dums*, or *moans*, small flies on silent wing, tormented us. Their bites or stings itch the next day and often cause bad sores.

Next morning we got off early, and shot some rapids in a way that made us all hold our breath. The river had risen somewhat. At one place we came to a huge rock that rose out of the Namtsik, in a deep pool, and it had four large sculptured circles on it in contact, each about a foot in diameter, and containing an eight-petalled rose,—whether a Hindu or Buddhist emblem I cannot say. It is, however, well known to the people about, who declare it a work of the Ahom Rájas many years ago; a part of two circles which is missing is said to have been struck off by lightning.

By 4 P. M. we reached the mouth of the Namtsik and the elephant-stockade, having taken in our remaining stores we pushed on to the Nmbai múk the same evening. I had seen the young Singphú Chief, Kherim Gam, at Namtsik, and he agreed to meet me at Tirap.

Next day we pushed on, passed the Kasam, Mganto and Kherim Pani, into the Dihing river, landed at Gogo and saw some peculiar men, said to be Eastern Singphús, from far up the Dihing; the headman wore a peculiar Chinese-looking cap, jacket, &c., and had a most celestial look about him, he proved kindly and intelligent, and made some shrewd remarks. I also saw here a huge pair of *jungphais* or amber ear-plugs, worn by a very old but remarkably good-looking woman. She would not part with them, though I offered a large sum, their full market value in Assam.

Again we started on and shot some very bad rapids in a way that astonished all on board, in some places we went for fully 300 yards at about ten to twelve miles an hour flying over the boulders only *just* below us, and which seemed to pass like bands of colour,—to have caught in

one would either have split the canoe in two, or sent us and it rolling pell-mell into the deep water below.

Múng, however, seemed to know his work, and only once showed a little weakness, when in shooting down a rapid with a bend in it, and that seemed to end in a huge pile of snags and branches, the leading paddlers jumped overboard, and I had just time to jump forward and give six or seven hard side-strokes with my large-bladed *Rob Roy* paddle, which served to convert a frightful upset into a hard bump. We reached the bend above Tirapmúk about 3 P. M., and most of us got out and walked across the chord of the arc on the sand and grass; five or six of the men, who had gone on foot and carried light loads, here joined us, and we got to Tirap itself about 4 P. M., camping where we did before, on the sands, just above where the rivers joined in the fork, and opposite the end of Kherim Gam's village. They soon had the tents up, firewood in, and were hard at it cooking, when my dák by two men turned up, it had been waiting a week. They also brought a few acceptable stores. Kherim arrived at night, and in the morning came over and we had a long talk together on many matters. He seemed much pleased to see me, and asked after Jenkins Saheb and my brother, with whom he had gone to Hukong in 1868-69. He particularly wanted me to promise to repeat my visit next cold season, and offered to go anywhere with me I liked,—especially Hukong, where he was well known, and has two sisters married to Chiefs. One of these two, over on a visit to Assam came as soon as Kherim was gone and interviewed me. She is married to Dubong Gam, on the Turong, and asked me to visit them, guaranteeing my safety. She was a smart, intelligent little woman, and it was now twenty years since she had been home to Assam. She had her four children with her. Through an interpreter we had a long conversation. She seemed thoroughly to understand the relative positions of the Singphús on our side and hers, and declared the keeping of slaves not so bad after all, and in some cases necessary; at the same time, they all admired the peace and security to life and property seen on our side. As usual, she came with a small present,—fowls, rice, milk, &c.,—and in return I gave her an assortment of strong needles, some threads, tapes, and handkerchiefs for the children. She was soon to return to Hukong, and several of their slaves had come to take her and the children back, a ten days' journey *viâ* the Nága villages and Namyong. As far as I could see, the system of slavery in force in Hukong is not the curse John Bull so often supposes it to be, and seems particularly well adapted to the state of society prevalent there. The slaves, often either Assamese or their mixed descendants, are treated more or less as part of the family, a proof of their happiness being that they do not run away and join our side when possible. Leaving the Tirap, we went down to the small Khampti village of Manmo, where I saw and

sketched a pretty little Buddhist chang and school-house with very fair carving about it. For some reason, the Bapu, like the one at Bor Pakhial, has gone to Burma, and they did not know whether he would return. It seems a great pity if Buddhism is doomed to die out here among these people; theoretically and practically it seems infinitely better than what they are getting in lieu of it, *i. e.*, a mixture of the dregs of several superstitions.

We reached Bor Pakhial about 3 P. M. and camped this time up on the bank near the houses and some bamboos, and soon had a collection to learn of our success. A little before sunset I fixed up the telescope pretty firmly, and showed them several canoes full of people in the distance; there was great excitement over it, for, though very far off, the boys kept calling out the names of the girls and women in the boats, and were able to recognize them. As they came nearer it was a pretty sight, and they made the boats travel, as most of them had oars and were paddling. As the canoes were too small to sit down in, all were standing in a row, five or six in each long and narrow dug-out, then they all ran up to see us. Several old men reiterated the story about the people who had originally inhabited the valley of Nongyang, and who were driven out by the Singphús. They also indicated the difficulties of a route east *viâ* Manchi or Bor Khampti, up the Dihing, of the Sitkha; of this latter route, they could only speak by repute.

Taking the configuration of the whole country and the ranges around, in regard to the countries beyond, it seems that the only feasible in or outlet is *viâ* the Namrup basin and Nongyang or Loglai; eastwards the Patkai not only rises, but the approaches from either side become more and more difficult and traverse an uninhabited country. Westwards, again, though inhabited by Nágas, the hills are also more difficult, and the actual water-parting at a much higher elevation, the tract of mountainous country on either side becoming much wider.

The discovery of the actual route where it crossed the Patkai in olden times is not now very difficult, its locality is known, and exploration on the spot is all that is necessary.

It is not unlikely that in ascending some one of the several gaps in the lower part of the range east of the present pass, and not more than two or three miles distant, the path may be found to debouch almost at once on the level, or but little above it, rendering a route anything but difficult to open there.

Certainly, the elevation cannot be over 600 or 800 feet above the tributary of Loglai first met, that river itself probably running at about 1,000 feet below the crest. Nongyang is but 1,200 feet below a much higher portion. There are reasons for presuming that this old route was in use as the "Doi bat" in 592 A. D. by the earliest Shans from Mogong.

In illustration of this paper see Plates VIII to XIII.

II.—*On the Identification of certain Diamond Mines in India which were known to and worked by the Ancients, especially those which were visited by Tavernier. With a note on the history of the Koh-i-nur.*—*By* V. Ball, Esq., M. A., F. G. S., *Geological Survey of India.*

(*Two woodcuts.*)

[Received 26th January:—Read 2nd February, 1881.]

Having recently published a general account of Indian diamond deposits* in which I unfortunately allowed myself, in more than one instance to be misled by untrustworthy authorities and having still more recently had an opportunity of consulting original works not available to me when I wrote, I am anxious, on this the first opportunity to correct, as far as possible, the errors to which I have given currency and to place on record some of the more important conclusions at which I have arrived.

Undoubtedly the best general account of Indian diamond deposits published up to within the past few years is that by Karl Ritter in his *Erdkunde Asien* (Vol. VI, 1836). This most careful and assiduous compiler has been quoted and misquoted, generally without acknowledgment, by a host of subsequent compilers, none of whom have supplemented his account by reference to the modern researches published by the Geological Survey of India. I am compelled to add that one of the latest writers on Indian Diamonds,† has by not having had recourse to this last source of information, misled his readers as to the positive amount of knowledge possessed at present regarding the mode of occurrence of Indian Diamonds. He has rehabilitated several long exploded theories as to their age. In his identification of the localities visited by Tavernier he has been rather wide of the mark while other parts of his paper especially his table of diamond weights are internally inconsistent with one another.

Tavernier's visits to India took place in the middle of the 17th century. He describes the mines at three localities, namely, Raolconda in the Carnatic, Gani or Coulour in the kingdom of Golconda and Soumelpour.

The identification of these three localities, has, so far as I can ascertain never been successfully made out. It is the object of this paper to describe the result of my investigations and also to draw attention to the fact that the Diamond mines mentioned in the Ain-i-Akbari as being situated at Beiragarh‡ are known to have been at a spot where traces of the mines are still to be seen.

* Scientific Proceedings of the Royal Dublin Society, 1880.

† Quarterly Journal of Science, N. S. Vol. VI, 1876.

‡ Vide Gladwin's Translation, Vol. II, p. 58.

It is not within the scope of this communication to describe the mines themselves, that I have done already elsewhere and hope to do so again more fully hereafter. It is from the historical point of view alone that they are discussed at present.

I. Gani-Coulour *not identical with* Gani-Partiál *Lat.* 16° 39′ *Long.* 80° 27′ *but with* Kollur *Lat.* 16° 42′ 30″ *Long.* 80° 5′. (Atlas Sheet No. 75.)

The mines at Gani called also Coulour by the Persians were situated, according to Tavernier, seven days' journey eastwards from Golconda.* In a subsequent chapter† to that in which the above statement is made he adds some details regarding the route. The itinerary being as follows :

Golconda to Almaspinde,	3½	Gos (? 2½)
Almaspinde to Kaper,	2	„
Kaper to Montecour,	2½	„
Montecour to Nagelpar,	2	„
Nagelpar to Eligada,	1½	„
Eligada to Sarvaron,	1	„
Sarvaron to Mellaserou,	1	„
Mellaserou to Ponocour,	1¼	„
From Ponocour you have only to cross the river to Coulour or Gani.		
Total	14¾	Gos.

The total of these items amounts to 14¾ *gos* and in the English edition of the Travels‡ amounts to 15¾. But it must be concluded that both tables contain misprints since Tavernier expressly says that the distance was 13¾ *gos* or 55 French leagues the *gos* being equal to 4 leagues. Taking this league to be equal to 4,444½ metres its value expressed in English miles would be 2·78 and therefore the *gos* (2·78 × 4) would be equal to 11·12 English miles,§ or rather less than the modern Indian stage distance of 6 coss or about 12 miles. The distance of Coulour from Golconda was therefore, by the route taken by Tavernier, 153 miles (11·12 × 13·75.) It is impossible to identify all the names of stages mentioned in the above list, some of them as Almaspinde and Montecour have a very

* Voyages, Liv. II, Chap. XVI, p. 304, Paris, 1677.

† *Idem.*, Chap. XVIII, p. 316.

‡ Lond. fol 1684, p. 142.

§ Heyne (Tracts, p. 94) mentions the *Gow* as a term in use in his time (1795). It was, he says, equal to eight miles.

un-Indian sound about them; but Eligada seems to be Oorlagondah of Atlas sheet 75 (Lat. 17° 15′ Long. 79° 55′) and Sarvaron and Mellaserou may very possibly be represented by the modern Singawarum and Maillacheroo, they being separated from one another and from the crossing of the Kistna river to certain diamond mines, by distances which correspond, nearly, to those given by Tavernier.

If the diamond mines of Coulour were situated south of the Kistna and that was the river crossed and not its tributary the Moonyair then they were wholly distinct from those of Partiál. In favour of this there is much to be said. On the south bank of the Kistna west of Chintapilly in Lat. 16° 42′ 30″ and Long. 80° 5′ there is a diamond locality which on the oldest engraved map I have seen, that by Thomas Jefferys, (London, 1768) is called Kalur or Gani. This it may be thought would finally settle the question, but as I shall have to say when speaking of Raolconda both this authority and Rennell evidently took their information, from Tavernier, and not from independent sources.

Fortunately a manuscript map by Col. Colin Mackenzie, of the Nizam's dominions, which is dated 1798, indicates this locality as Coulour and marks it as a diamond mine. Partiál is written *separately* in its proper place as Gani-Purtial and so also is a well known intermediate locality at Istapully and both are marked as having diamond mines. I think on the whole we are bound to conclude therefore that Tavernier's Gani Coulour was not identical with Gani Purtial the modern Partiál but with the modern Kollur as it is written on the Atlas Sheet No. 75. So far as can be seen from the map its surroundings are not inconsistent with Tavernier's description, he says the mine is close to a large town on the same river (Kistna?) which he crossed on the road to Raolconda, and that a league and a half from the town there are high mountains which are in the form of a cross. In the intervening plain the search for diamonds was carried on. The locality too, it may be added, is in the middle of presumedly diamond bearing rocks.

Now as regards this word Gani there is still a remark to be made. Its recurrence in the titles of two mines which I have shewn were distinct, suggests that it was not a proper name, and that in fact it really meant 'mine of' being only a corruption of *Kan i.** We know that the letters G and K are interchangeable in some Indian languages and therefore no particular effort is required to accept the view that Gani Coulour meant simply the mine of Coulour, *i. e.*, the modern Kollur. So that to speak of, the mine of Gani, as is often done, is meaningless tautology.

* I am indebted to Mr. Baden Powell, C. S. for this interpretation, vide 'Punjab Manufactures', p. 197.

Identity of the Great Mogul Diamond with the Koh-i-nur.

As the identity of the Great Mogul or Kollur diamond has been the subject of much controversy I think it well to include the following note here since it properly comes under the head of Gani-Coulour or Kollur. Tavernier states that not only it, but many other large stones were produced there, and he adds, that, in his time the miners still continued to find large stones in the same mines.

I shall first quote *verbatim* and then analyze what Tavernier has written regarding this diamond. Having gone to take leave of the Great Mogul (Aurangzeb) on the 1st of November 1665, he was invited to return on the following morning to see the Emperor's jewels. He says,* "The first object which Akel Kan (the Custodian of the Jewels) put in my hands was the great diamond, which is a rose, round, very convex (? haute) on one side; at the edge of one side there is a small notch (cran) with a flaw in it. The water is perfection and it weighs 319½ *ratis* which are equal to 280 of our carats the rati being ⅞ of a carat. When Mirgimola who betrayed the king of Golconda, his master, made a gift of this stone to Sháh Jehán from whom it is descended it was uncut and weighed 900 *ratis* which are equal to 787½ carats and it had many flaws. If this stone had been in Europe it would have been differently treated, for some good pieces would have been taken from it and the stone left much larger, as it is it has been almost polished away. It was *Sieur* Hortensio Borgio, a Venetian who cut it, for which he was badly paid. They reproached him with having spoilt the stone which ought to have remained heavier and instead of paying him, the Emperor made him pay a fine of 10,000† (rupees) and would have taken still more if he had possessed it. If Hortensio had known his work better he might have taken some good pieces off without doing injury to the king and without having expended so much trouble in polishing it, but he was not a very accomplished diamond-cutter."

It is now believed by some authorities that very large pieces, including the Orloff diamond were as a matter of fact cleaved off from the original Great Mogul. Certainly cleavage had as much to do with the shape of the Koh-i-Nur as polishing.

In the chapter on his visit to the mines at Coulour,‡ he says that the Great Mogul diamond was found there. If this be true and also that the mine was only discovered about 100 years before his visit, which

* Voyages, Vol. II, Livre, 2, p. 249. Paris Ed. 1677.

† Even this item is variously stated by compilers who seem to have been the cause of much of the confusion that exists about the weights &c., of this historical gem.

‡ l. c., p. 305.

took place between the years 1665 and 1669, then this diamond cannot have the great antiquity claimed for it by some of those who consider it to be identical with the Koh-i-nur.

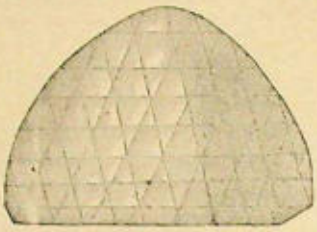
Tavernier's third mention of this diamond which is accompanied by a figure is as follows: "This diamond belongs to the Great Mogul who did me the honour to show it to me with all his other jewels one sees the form which it received on being cut. On my being permitted to weigh it I have found its weight to be 319½ *ratis* which are 279$\frac{5}{16}$ of our carats. In its rough state it weighed as I have said 907 *ratis* which are 793$\frac{5}{16}$ carats. The stone has the same form as if one cut an egg in two."

He gives us therefore two different accounts of its weight in the rough, 900 ratis or 787½ carats and 907 ratis or 793$\frac{5}{16}$ carats. It is obvious that there is a mistake as the two do not agree in any respect even the equivalent values calculated at 1 *rati* = $\frac{7}{8}$ of a carat should be 787½ and 793⅜. I have already pointed out strange and unaccountable defects in Tavernier's arithmetic.

Different weights and measures appear to have been used in different parts of the country in his time, the mangelin = 1¾ carats or 7 grains at Raolconda and Coulour; the *rati* = $\frac{7}{8}$ of a carat or 3½ grains at Soumelpour. If we could with approximate accuracy fix the value of the *rati* mentioned by Tavernier we might succeed perhaps in instituting a fair comparison between the Great Mogul and other diamonds. It seems to be difficult to believe that it equalled 3½ grains as he states. In Nagpur in the year 1827 according to Mr. Jenkins the *rati* was only 2·014 grains. The French grain was equal to about ·77 of a troy grain, therefore since the *rati* contained 3½ of these, its value would have been 2·695 or say 2·7 troy. This fact seems to have been overlooked by some who have endeavoured to reduce the weights given by Tavernier: non-experts too, appear to have forgotten that the diamond grain is not identical with any other grain, though our English carat contains 4 of these grains it only consists of 3·174 troy grains.* So calculated, the weight of the Great Mogul would be $\frac{319{\cdot}5 \times 2{\cdot}7}{3{\cdot}174} = 271{\cdot}78$ English carats. If in this equation we could see our way to putting the value of Tavernier's *rati* at 1·84 instead of 2·7 then the exact weight of the Koh-i-nur when brought to England would be obtained but for this there is perhaps no necessity. Another system of calculation is used by the writer of a note in the Great Exhibition Catalogue of 1851, in which he adopts the known maximum weight of a *rati* at 2$\frac{5}{16}$ grains (? what grains) and thence deduces 175 carats as the weight of the Great Mogul. This is somewhat short of the 186$\frac{1}{16}$ carats of the Koh-i-nur while the other is too large. Supposing the Koh-i-nur to be identical with the Great

* *Vide* Encyclopædia Britannica, Art. Diamond.

Mogul it may have been mutilated during its travels and this may account for the loss in weight 271·78—186·06 = 85·72 carats, and for the difference in its shape when brought to England from the sketch given by Tavernier.



THE GREAT MOGUL
(From sketch by Tavernier).

THE KOH-I-NUR
(Before recutting).

It is probable moreover that Tavernier's sketch or diagram as it might be called, which is here reproduced for comparison, was from memory and was therefore more regular in outline than the original. The name Great Mogul was, of course, not of native origin but was probably first conferred by Tavernier. By the natives, it was in all probability originally known as the Kollur diamond. In reference to this I was quite accidentally informed by a native jeweller of Calcutta that it has been suggested, if not absolutely stated by some native writer that the title Koh-i-nur really owes its origin to a change in the originally meaningless name Kollur. Such changes, in which, while the sound is more or less retained, a meaning is acquired are not by any means rare in Oriental languages while they sometimes occur in those of Europe. Thus English surnames in the mouths of natives become changed into words of similar sound which have a meaning in Hindustani or whatever the language spoken may be.

From the above I think it will be admitted that there are good reasons for believing in the identity of the Great Mogul or Kollur diamond of Tavernier with the Koh-i-nur. In spite of the slight differences in weight in his two statements we cannot suppose that he saw two distinct diamonds, and the hypothesis that the Great Mogul diamond still exists in Persia under a different name is wholly without foundation.

II. RAOLCONDA, *identical with Rawduconda, Lat.* 15° 41′ *Long.* 76° 50′.—*District of Mudgul in Haidrabad.*

It has hitherto been supposed by all the authors to whose writings I have had access that Tavernier's Raolconda can no longer be traced and certainly the investigation presents some difficulties, but I venture to believe that the following affords the right clue to its identification.

According to Tavernier* Raolconda was situated in the Province '*Carnatica*'† five days' journey from Golconda and eight or nine from Visapour (Bijapur). Remembering that he states that he crossed the river separating the kingdoms of Golconda and Visapour, *i. e.*, the Kistna or its tributary the Bhima and fixing the rate of travelling at 20 miles a day which seems to have been Tavernier's average, we should arrive at the conclusion that Raolconda was situated somewhere in the angle between the Kistna and Toongabudra rivers and not far from their junction; but as in the case of Gani-Coulour, Tavernier gives a route list of the stages between Golconda and Raolconda which, on analysis, proves to be quite inconsistent with the above stated distance between them. This list is as follows:—

1.	Golconda to Canapour, ...	1	*Gos.*	
2.	Canapour to Parquel, ...	$2\frac{1}{2}$	„	
3.	Parquel to Cakenol, ...	1	„	
4.	Cakenol to Canol-Candanor, ...	3	„	
5.	Canol-Candanor to Setapour, ...	1	„	
6.	Setapour to the river, ... (This river is the frontier of the kingdoms of Golconda and Visapour, *i. e.*, the Kistna).	1	„	
7.	The river to Alpour, ...	$\frac{3}{4}$	„	(?)
8.	Alpour to Canol, ...	$\frac{3}{4}$	„	(?)
9.	Canol to Raolconda, ...	$2\frac{1}{2}$	„	
	The total of these items would be	$14\frac{1}{2}$		

Here again there is something wrong in the arithmetic since Tavernier gives the total as being 17 *gos.* probably the items 7 and 8 are misprints for 3 each. To begin with there are here given 9 stages and the distance 17 Gos. or 68 French leagues must have been, according to the method of calculation adopted above in the case of Gani-Coulour,‡ about 189 miles. If Gani-Coulour 150 miles distant from Golconda was a seven days' journey it follows that Raolconda must have been much nearer nine than five, and therefore it seems probable that Tavernier really meant to write exactly the converse of what he did write, and that we should transpose the distances given respectively of Raolconda from Golconda and from Visapour.

This being done and these new indices of position being applied to the map, we are led unhesitatingly to identify Tavernier's Raolconda with the

* Voyages des Indes, Paris, 1867, Ser. II, Chap. XV, p. 293.

† This term or rather Karnata was an ancient Hindu geographical division which comprehended the tableland of South India *above* the Ghats. See Hamilton's Hindustán, Vol. II, p. 247. Also Ferishta's History by J. Scott, Vol. I, p. 45.

‡ *i. e.*, one league = 2·78 English miles.

modern Rawduconda in Lat. 15° 41′ and Long. 76° 50′. That Raolconda was not *on* the Kistna or its tributary the Bhima as some writers have supposed is evident from the fact that Tavernier states that on his return journey from Raolconda the governor gave him an escort of six horsemen in order that he might traverse in safety the tract under his government up to the river separating the two kingdoms and which was, as shewn above, at the 6th of 9 stages on his outward journey.

Rawduconda, as the crow flies, is situated 165 miles south-west from Golconda and by road it must be quite 189 miles. From Bijapour (or Visapour) it is about 110 miles or some five days' journey to the south-east. The town is 6 miles distant from the western bank of the Toongabudra river one of the principal feeders of the Kistna. From the station of Raichúr on the Madras Railway Rawduconda is about 50 miles distant in a south-westerly direction.

I believe it will be admitted by all who care to investigate the question that the above is a legitimate conclusion. Tavernier's two statements as they stand are clearly contradictory, but the first being amended as I have suggested their united testimony seems to compel the conviction that we have at length identified his Raolconda.

Tavernier describes the neighbourhood of Raolconda as being sandy and full of rocks and thickets somewhat similar to the environs of Fontainebleau.* I have not seen any recent account of the locality and the geology can only be guessed at. All round at no great distance crystalline rocks are known to occur, but Tavernier's account of the matrix seems to indicate a rock other than any belonging to the crystalline series. However, it is no part of my present object to enter further into this question nor is it necessary to reproduce Tavernier's account here.

Captain Burton† who appears to have located Raolconda on the Bhima as he certainly did Gani (*i. e.*, Coulour) relates that he heard of diamonds in Raichúr and that Sir Salar Jung offered to arrange for his going there, but that he gave up the idea on hearing that there were only crystalline rocks there. It is possible that a tradition of diamonds at Rawduconda in the Mudgul Circar adjoining Raichúr may still linger at Haidrabad.

I let the above stand without alteration though since it was written I have had an opportunity of examining a number of old maps at the Surveyor General's Office, for which my thanks are due to Mr. James.

* This description is very similar to that given by Newbold of the opposite or eastern bank of the river where granite rocks rise from a wide expanse of furrowed sand. *Vide* Madras Journal of Literature and Science, Vol. XI, p. 126. Unfortunately Newbold never mentions Rawduconda though he passed within a few miles of it while on two of his traverses.

† *Vide* Quarterly Journal of Science, Vol. VI, 1876.

Thomas Jefferys' engraved map of India, dated 1768 gives Tavernier's stages to Raolconda which is placed in the angle between the Bhima and Kistna with such accuracy that it is impossible not to conclude that the route was laid down to fit Tavernier's supposed line and not from independent evidence, there is too, other internal evidence that Jefferys took some of his localities from Tavernier.

Rennell's map of 1788 is open to precisely the same criticism. But a manuscript map of the Nizam's dominions by Col. Colin Mackenzie, dated 1798 largely drawn from actual surveys, does not represent any similar route terminating at Raolconda, but it does give Rawduconda in its right place. A village called Alpour situated south of Raichúr on this map may be identical with the locality, two marches from Raolconda, which is mentioned by Tavernier. Similarly Boorcull another village near Golconda may be Tavernier's Parquel. Heyne it is true in a map published with his tracts calls Karnul, Canoul and Canúl in the text, these are almost the same words as Tavernier's Canol.

In conclusion if Raolconda be not identical with Rawduconda I can only suggest that it may be Ramulkota a known diamond mine in Lat. 15° 34′ Long. 78° 3′ 15″ but being 120 miles as the crow flies from Haidrabad and 150 miles from Bijapur, two rivers, the Kistna and Tungabudra having to be crossed to reach it, *en route* from the former, it does not fit so well with Tavernier's description. Ramulkota is only about 19 miles south of Karnul whereas Rawduconda must have been 30 miles from Tavernier's Canol.

III.—Soumelpour *of Tavernier situated in Chutia Nagpur and not identical with Sambalpur as has been supposed by some authors. Possibly represented by the modern Simah in Palamow, Lat.* 23° 35′ *N. Long.* 84° 21′ *E.*

When writing of Ptolomey's *Adamus flus* in the paper already quoted I pointed out that though doubtless it was intended for the Mahanadi its upper reaches are represented as passing through a region called Cocconage which is supposed to be identical with Chutia Nagpur. Though this is not exactly the case still one of the principal tributaries of the Mahanadi, namely, the Ebe, which is itself believed to be diamond bearing, passes through a large portion of Chutia Nagpur.

Although I included Tavernier's description of Soumelpour under the heading of Sambalpur I recognised that the facts did not seem to fit which I attributed to defective geographical knowledge on his part. There can be no question, however, that the Soumelpour which was visited by him was situated far to the north, being if not identical with, at least not very far removed from, the localities in Kokrah or Chutia Nagpur which

were discussed in a paper by the late Mr. Blochmann* who states that the Generals of Akbar and Jahángiri were led to invade Kokrah and attack the Rája on account of the diamonds which it was believed they would find there. Mr. Blochmann believed the river to have been the Sunk and I mention in my paper that a spot is still shown in that river where diamonds are said to have been found.

Tavernier's list of stages from Agra to this mine as in the other cases presents some perplexing items. It is as follows with the real distances in miles added for comparison.

	Costes.	*Actual distance in miles.*
Agra to Hulabas (Allahabad), ...	130	276
Hulabas to Benarous (Benares), ...	33	95
Benarous to Saseron (Sasseram), ...	4	70
Saseron to Great Town, ...	21	
Great Town to Rodas (Rhotas), ...	4	24
Total	192	465
Rodas to Soumelpour, ...	30	

There are several manifest inaccuracies in the above. The distance between Allahabad and Benares is in reality about one-third of that between Agra and Allahabad yet Tavernier makes it only one-fourth. The 'Great Town' mentioned, probably lay between Benares and Sasseram not between Sasseram and Rhotas. The items 4 and 21 should be transposed.

If Sasseram were 8 *costes* from Rhotas then since the distance is 24 miles, the *cost* would equal 3 miles and the same result would be obtained, nearly, from the distance between Allahabad and Benares, but by dividing the above totals of the table, *i. e.*, 465 by 192 we only get 2·4 as the value of the *cost*. If again we strike the average between these, 2·4 and 3, we get 2·7 as a final approximate value. Now multiplying the 30 costes which are stated to intervene between Rhotas and Soumelpour by this we obtain 81 miles as the distance between these places. The next question to determine is what locality at this distance from Rhotas answers to the following description of Soumelpour, "The Rája lives half a league from the town in tents set upon a rising ground at the foot whereof runs the *Gouel* descending from the southern mountains and falling into the Ganges." Just 80 miles from Rhotas at the foot of the Neturhat plateau there are the remains of an ancient town called Simah Lat. 23° 35′ Long. 84° 21′ rather more than a mile from the left bank of the Koel where it enters the Palamow subdivision from the highlands of Lohardagga.

* J. A. S. B. Vol. XL. pt. 1, p. 11.

Simah I take to be the same as *Semul* the name of the silk cotton tree (*Bombax malabaricum*) which attains an enormous size in that particular region, and Simah or Semul-púr might have very probably been written Soumelpour by Tavernier. That the name of the river, Gouel, is identical with Koel, under the circumstances, admits of no doubt whatever as the Koel runs northwards to join the Sone and so reaches the Ganges; but it is perhaps open to question whether the present Koel or its tributary, the Aurunga, may have been intended.

Tavernier states that the diamond searchers worked up to the sources of the river in the hills 50 *costes* distant to the south. This though an exaggeration as applied to the length of the Koel would be wholly inapplicable to the Aurunga, but on the maps by Rennel of a century ago the name Koel was applied to the Aurunga while the present Koel, above the junction, bore the name Burwah or that of the region where it takes its rise. The highlands separating Palamow from Lohardugga proper form part of a water-shed between the rivers of the Ganges basin which flow northwards, and those of the Brahmini and Mahanadi basins which flow to the south. Among the former the Koel and the Aurunga are the principal and among the latter the Sunk and another Koel both of which, flowing southwards, combine to form the Brahmini.

If there were really two sets of diamond mines, one in each basin, it is probable that the sources of the diamonds were identical being situated in these ranges of hills which form the water-shed, unfortunately we do not know much of the geology although neighbouring areas have been pretty closely worked, but it will be interesting to see whether future research will prove the existence of an outlier of Vindhyan rocks—representatives of the formation being rarely absent from the vicinity of diamond mines in India. On Jeffery's map to which allusion has been made on a previous page, Soumelpur is placed on a river (doubtless the Koel) south of Rhotas and 15° north of a town called Jounpur. As no other towns save Soumelpur are given in the same region, it is clear that Jefferys took his data from Tavernier. Rennell, however, in his map of this region marks diamond mines south of the water-shed, *i. e.*, on the Sunk river.

There is still another point of interest to be mentioned with reference to the identification of these mines. A large picture, representing the attack upon the fort of Palamow in 1660 by Daud Khán, which has been described by the late Col. Dalton* contains a figure of the *Zamindar i Kán i almas*, or lord of the diamond mines, in the back ground. He is considered by Col. Dalton to be a Kol (Nagbunsi) Rája but why should he not be regarded as being precisely what he is described. He was probably the very

* J. A. S. B. Vol. XLIII. pt. I, 240.

person whom Tavernier found living in tents on a rising ground only five years later.

I have reason to believe* that the late Mr. Blochmann was somewhat perplexed by the statement in the *Tuzuk-i-Jahángiri* that the presence of diamonds was indicated at particular spots by the hovering (?) over them of insects called *Jhinga*. Might not this term *Jhinga* have been a technical one meaning the same small pebbles which Tavernier calls 'thunder stones' and by the occurrence or absence of which the skilful miners, he says, knew whether the sand contained diamonds or not. They are believed to have been small spherical masses of iron ore.

IV.—Beiragarh—*mentioned in the Ain i Akbari identical with Wairagurh in the Chanda District C. P.* Lat. 20° 26'. Long. 80° 10'.

In the Ain i Akbari† which was written towards the close of the 16th century it is stated that there is a diamond mine at Beiragurh which had been conquered lately by Bubjeo otherwise called Chanda who was the zemindar of an ancient city in Subah Berar called Kullem.

An earlier notice of the locality occurs in Ferishta's History‡ from which we learn that the diamond mines at Kullem in Gondwara, where stood many temples, were taken possession of in the year 1425 by Ahmed Sháh Wali Bhamuni.

Again in the '*Brhat Sanhita*,' in the chapter on Trying of Diamonds, the peculiarities of stones from the following localities are described. Vena river, Koçala, Surashtra, Supara, Himalya, Matanga, Kalinga Pundra. The second of these is I find from Genl. Cunningham's Ancient Geography probably Berar with Chanda for its capital town. Possibly, however, it here indicates quite a different place, namely, the modern Chicacole on the East Coast which might very possibly have been a mart for the sale of diamonds; but the Vena river is believed to have been the Weingunga.

It is needless to enumerate the various suggestions as to the identity of Beiragurh by Rennell, Karl Ritter and others. It has now been clearly established that the ancient Kullem was identical with the modern Chanda and that Beiragurh is to-day represented on the maps by Wairagurh on the Sath river a tributary of the Kophragurce which is itself a tributary of the Weingunga.

The exact position of the town is Lat. 20° 26' and Long. 80° 10'. On the opposite bank of the river the map shews a town called Hirapur. The existence of ancient excavations long since deserted and which are locally asserted to have been made for diamonds is attested to by Messrs.

* Vide J. A. S. B. XL, pt. I p. 114, note.

† Gladwin's Translation, London, 1800, Vol. II, p. 58.

‡ Ed. J. Briggs, London, 1819, Vol. II, p. 406.

Jenkins and Wilkinson, residents at Nagpur,* by Messrs. Hislop and Hunter† and more recently by Mr. Beglar of the Archæological Survey. The fact is also recorded in the Central Provinces Gazetteer under the heading of Wairagurh where, however, there is no mention of the identity of Beiragurh with Wairagurh although it is fully set forth in the historical account of Chanda in the same volume; but this I did not see until I had independently come to the same conclusion.

As not improbably referring to this last locality it may be of interest to add the following from the account‡ of the Travels of Nicolo Conti in the early part of the 15th century. I cannot agree with the writer of the Introduction to the volume which contains this account that Golconda was intended. Nicolo Conti says that at 15 days' journey north of Bizengulia (by which Vijayanagar the modern Bijapur is intended) there is a mountain which produces diamonds called Albenigaras. Now Beiragarh, the modern Wairagarh, is as the crow flies about 324 miles north-eastwards of Bijapur and therefore within a possible 15 days' journey though, as the actual distance traversed would be greater it would require very hard travelling. However *Al*benigaras looks so like Beiragarh with the Arabic prefix *El* or *Al* that I am inclined to believe that it was the place intended. He goes on to say that the mountain being infested with serpents it is inaccessible, but is commanded by another mountain somewhat higher. "Here at a certain "period of the year men bring oxen which they drive to the top, and "having cut them into pieces, cast the warm and bleeding fragments upon "the summit of the other mountain by means of machines which they "construct for the purpose. The diamonds stick to these pieces of flesh. "Then come vultures and eagles flying to the spot, which seizing the meat "for their food, fly away with it to places where they may be safe from the "serpents. To these places the men afterwards come, and collect the "diamonds which have fallen from the flesh." Nicolo Conti continues with an account of how other less precious stones are obtained, and his description is that of ordinary Indian diamond mining. The travels of Sindbad the Sailor and of Marco Polo whose account apparently refers to localities in Golconda on the Kistna, have made this tradition of throwing pieces of meat in order that the diamonds may stick to them familiar to most people; yet an adequate explanation of the origin of the myth does not appear to have been offered hitherto. I believe the following to be a probable one.

Heyne in the account of his visit to the mines at Kadapah (Cuddapah) states that they were under the particular protection of Ammawáru (the

* Vide Calcutta Journal of Natural History, Vol. III, p. 290.

† Journal of the Geological Society, Vol. XI, p. 355.

‡ India in the 15th century. Hakluyt Society, p. 29.

sanguinary goddess of riches, *i. e.*, Lakshmi) and the miners objected to his riding on horseback up to the mines for fear of offending her. Now what can be more probable than that the miners, before opening a new mine, in order to invoke the aid of this sanguinary goddess made an offering to her of cattle or buffaloes. Bloody sacrifices are known to be offered to Lakshmi in one of her forms.

The opening up of new mines was and is we are told by several authorities preceded by various rites and ceremonies. The miners were probably never Hindus, and the custom of offering up cattle in sacrifice by the aboriginal tribes from the Todas to the Sontals is too well known to require special illustration. If it be admitted that the opening of a mine was preceded by the sacrifice of cattle and the throwing the fragments of the flesh to be devoured by the fowls of the air, we at once arrive at the foundation of fact upon which this superstructure of fable has in all probability been erected.

Casual spectators and travellers may very easily have supposed that the slaughter of cattle and the subsequent throwing about pieces of meat was an essential part of the operations. Any one with experience of how Oriental imagination can erect a tale of fiction on a small substratum of fact will find no difficulty in conceding that in the above supposition there is a sufficient explanation for the origin of the whole story.

It may be added that this propitiation of malefiant spirits was and is by no means limited to mining operations connected with diamonds. In the Journal of this Society* will be found an account of one of the richest gold bearing tracts in Assam which had been deserted by the indigenous gold washers in consequence of the expense connected with the propitiation of the evil spirits who guarded the mineral treasures, being greater than they could afford to pay.

III.—*List of* Mollusca *from the Hills between Mari and Tandiani.*—*By* W. Theobald, *Deputy. Supt. Geological Survey.*

[Received Nov. 25th;—Read Dec. 1st, 1880.]

The following list, which embraces three new species, was drawn up during a five months' residence at Tandiani, the hill station of Hazara. It will give a good idea of the molluscan fauna of the region, but is most unquestionably not exhaustive, and I trust to some of my younger colleagues taking up the work, which I regard as here only begun.

* Vol. XXII, p. 511.

The work of the naturalist should resemble in its method, no less than in the devotion bestowed on it, that of Bees :—

> "Ergo ipsas quamvis augusti terminus aevi
> Excipiat, neque enim plus septima ducitur aestas
> At genus immortale manet, multos que per annos
> Stat fortuna domus, et avi numerantur avorum."

Fam. ZONITIDÆ.

Helicarion Fleminoi, Pfr.

This species is extremely abundant at Tandiani though not of quite so large a size as specimens obtained by Stoliczka at Mari. My largest shell measures diam. max. 36, min. 27 alt. 16, whereas a Mari shell measured 40 mills.

To judge by Mr. Nevill's measurements (40 × 23 × 12) his measurements are taken somewhat differently to mine. My 'diam. maj.' or length, 'min.' or breadth and 'alt.' (or *axis* of Mr. Nevill) are all measured at right angles to each other and with a *straight limbed* measure, like a shoemaker's, not curved callipers, whence my 'alt.' or axis' is larger than Mr. Nevill's, though the shell is a trifle smaller.

H. Austenianus Nev. (Mollusca of the Yarkand mission).

This species is scarce at Tandiani. The animal is furnished with a large mucous pore behind, and carries a long linguiform process of the mantle, capable of extension to the apex, and is one of those species which though so provided does not possess a polished shell. The texture of the shell (epidermis) is during life delicately sericeous, from the fine striation of the epidermis. Mr. Nevill correctly describes it, as 'glossy,' that is like silk.

My largest specimen measure diam. maj. 16· min. 13·1, alt. 8 mills.
The animal is rather more depressed than *H. Flemingi*.

H. Stoliczkanus, Nev. (Yarkand mollusca).

This species abounds on the north-east flanks of Sirban hill opposite Damtour in a grove, frequented by picnic parties from Abbottabad. My largest specimen measures :

Diam. maj. 27·5, min. 21, alt. 14·5 mills.

The colour of the body whorl is greenish, of the earlier whorls rusty. The shell is transversely rugous above, crossed by fine, above almost microscopic lines, giving it above a sericeous lustre; beneath the shell is smooth or sub-polite.

Macrochlamys prona, Nev.
(Mollusca of the Yarkand mission).

This species occurs not unfrequently at Tandiani, though it does not quite correspond with the Naini Tal type. The spire of my specimens is convex not 'flat,' and my largest shell is rather larger than Mr. Nevill's type, but the shells are I doubt not identical.

An unusually large specimen of 6 whorls measures, diam. max. 15, min. 13·4, alt. 7·8 mills. Adults are rare, as I have only two. The animal is long and slender, and dark slaty above, with long tentacles. A stout dwarf form measures diam. max. 11·8, min. 10·3, alt. 5·9 mills.

Bensonia monticola, Hutton.

This species is not rare at Tandiani and the shells are usually of a dark rich chesnut colour, though pale individuals also occur. The abundance of dead shells in the surface soil in sheltered spots among rocks, suggests here, as in Kashmir that the species was formerly more abundant than now.

I adopt M.. Nevill's generic name as a convenient one for this species, but I am disinclined to refer to it (as Mr. Nevill does in his Yarkand memoir) *Macrochlamys splendens*, Hutton, with its lustrous, highly polished shell which would seem to fall more naturally into the '*vitrinoides*' section of the genus, (*Nanina*).

Microcystis Nevillianus, Theob.

This pretty little species is not rare at Tandiani. I do not describe it here as I have furnished specimens to Col. Godwin-Austen for his forthcoming work on the genus; it is a very snug little form of 6 whorls, of a pale brown colour, warmed with orange towards the mouth.

My largest specimen measures diam. max. 8, min. 7·4, alt. 4·6 mills.

Trochomorpha Tandianensis, n. sp.

Testâ trochiformi, carinatâ, anguste umbilicatâ, tenui corneâ; Anfractibus sex, lente crescentibus, transverse rugose striatis. Aperturâ parum obliquâ, lunate-quadratâ. Margine simplici, columellari juxta brevissime reflexo.

Lat. maj. 9·6, *alt.* 6·7 *mills.*

Habitat ad Tandiani (in sylvis) montibus Hazaræ, ad pedes 8500 alt.

The animal has a distinct overhanging mucous pore. The nearest ally of this shell is perhaps *T. hyba*, B. which is found from Chamba to Kashmir, but like the present is a somewhat rare shell and of limited distribution.

Kaliella fastigiata, Hutton.

Three individuals of this widely distributed, but not common shell were taken by me at Tandiani.

Fam. HELICIDÆ.

VALLONIA HUMILIS, Hutton.

Not very rare, on trees at Tandiani.

Fam. LIMACIDÆ.

ANADENUS ALTIVAGUS, Theob.

This large slug is not uncommon at Tandiani, though only seen abroad after heavy rain.

Mr. Nevill doubts if I am correct in writing with this, the *A. giganteus*, Haynemann, which Mr. Nevill thinks is a larger and distinct species, of which he has seen specimens from Nipal.

NAPÆUS DOMINA, B.

A dextral form of this shell is very common on the hills between Tandiani and Abbottabad, from 4000 to 6000 feet. It is identical with the form found at Mari and typical (sinistral) forms also occur.

Long. 26, Lat. 9·6 mills.

A small variety is found in places and in the Pakli valley north of Abbottabad. It is dextral and varies rather in form. Two specimens of this var. minor measured.

a. Long. 20, Lat. 9 mills.

b. Long. 19, Lat. 7 mills.

Specimen *b* is intermediate between 'domina' and 'spelæus.'

N. BEDDOMEANUS, Nev.

(Mollusca Yarkand mission).

This is rather a common species at Tandiani. There are three varieties of it var. *typica* 10 whorls, Long 12, Lat. 2·6 mills.

Var. *turrita* 11 whorls, Long. 12·4, Lat. 3 mills.

Var. *pusilla* 9 whorls, Long. 8·5, Lat. 2·5 mills.

This is the most aberrant species of its genus, and is certainly not very near any of its allies. The flat expanded peristome it sometimes displays, suggests a relationship to some pupas, *P. cænopicta*, Hutton, for example. It is not a little strange too that I have hitherto failed to detect a single *Pupa* at Tandiani though the prevailing rock being limestone, would seem favourable to their presence.

N. MAINWARINGIANUS, Nev.

(Shells of Yarkand mission).

A variety, as I take it of this shell is locally not rare on the hills north-west of the Pakli valley from 4000 to 5000 feet. It has one whorl less than the type (which is described as having 7) but is slightly larger, a difference probably due to the lesser elevation at which my specimens

lived. Shell with six whorls, outer edge of aperture not quite so convex, or full, as in Nevill's plate. In most other respects corresponding with the description of the type. The surface under a lens displays a microscopically decussated sculpture, not mentioned in the type. Two varieties occur.

Var. *major* Long. 15, Lat. 6·2 mills.

Var. *intermedia* Long. 12, Lat. 4·4. This last I do not term 'minor', as it is actually larger than the type from Mari.

N. Smithei, B.

This species was found by me at Mari, rarely.

Peronæus Nevillianus, n. sp.

Testâ turritâ, rimatâ, costaneâ, Anfract. 8 *ad* 9 *convexiusculis, transverse plicatis, lineisque spiralibus leviter decussatis, ultimo brevissime ascendente. Aperturâ oblongâ, verticali. Margine pallido, simplici, expansiusculo, et juxta columellam breviter reflexo.*

Long. 15·7, Lat. 4·1 mills ad Long. 11·9, Lat. 4 mills.

Habitat ad Tandiani, montibus Hazaræ ad 8500 ped, circa radices arborum.

I have named this elegant species after Mr. G. Nevill whose work on the Yarkand mollusca and other Indian *Pulmonata* has so helped to elucidate the synonymy and relations of many species of that order.

Clausilia Waageni, Stol.

This species is tolerably abundant at Tandiani on trees. My specimens vary from 11 whorls (Long. 17, Lat. 4 mill.) to 12 whorls (Long. 21, Lat. 4·75 mills.)

C. cylindrica, Gray.

This species is very abundant in rotten wood.

An undecollated specimen of 11 whorls measured 15·4 mills, a decollated specimen of 5 whorls only 11·8 mills.

Appended is a list of the mollusca known to me from the Mari and Tandiani hills.

T. Tandiani. M. Mari. H. Hazara.

(An asterisk denotes the species is recorded on Mr. Nevill's authority.)

Helicarion Flemingi, Pf. T. M. H.

H. Austenianus, Nev. T.

H. Stoliczkanus, Nev. H.

H. monticola Pfr. H.

Macrochlamys, prona Nev. T.

M. chloroplax, B. M.*
M. Jacquemonti v. Mart. M.*
Bensonia monticola, Hutton T. M. H.
Microcystis Nevillianus, Theob. T.
Trochomorpha Tandianensis, Theob. T.
Kaliella fastigiata, Hutton T. M.
Vallonia humilis, Hutton T. M.
Anadenus altivagus, Theob. T. M.
Napæus domina, B. M. H.
N. Beddomeanus, Nev. T. M.
N. Mainwaringianus, Nev. T. M.*
N. Smithei, B. M.
Peronæus Nevillianus, Theob. T.
Clausilia Waageni, Stol. T. M.
C. cylindrica, Gray T. M.

IV.—*A list of* Butterflies *taken in Sikkim in October*, 1880, *with notes on habits, &c.*—*By* Lionel de Nicéville.

[Received December 12th, 1880; Read 6th April, 1881.]

Part I.

Insects taken on the road between Siligori, elevation 397 feet above the sea, and Chunabatti, 2,260 feet.

1. *Danais melaneus*, Cramer.
   Common in the Terai and the wooded slopes below Chunabatti.
2. *Danais aglea*, Cramer.
   Lower hills.
3. *Danais septentrionis*, Butler.
   One male on lower hills.
4. *Danais chrysippus*, Linnæus.
   Common in the open between Siligori and the Terai forest-belt.
5. *Danais plexippus*, Linnæus.
   Common in the Terai.
6. *Euplæa* (*Trepsichrois*) *midamus*, Linnæus.
   Males only observed in the Terai.
7. *Euplæa core*, Cramer.
   Both sexes very common in the Terai.
8. *Lethe rohria*, Fabricius.
   Very common on the road through the Terai.
9. *Lethe europa*, Fabricius.
   Only one male seen in the Terai.

10. *Mycalesis perseus*, var. *visala*, Moore.

Common amongst grass and bushes.

11. *Mycalesis malsara*, Moore.

Common, settles on the road in damp places.

12. *Yphthima philomela*, Johanssen.

Frequents grass and herbage, where I found it common.

13. *Acræa vesta*, Fabricius.

Excessively common. It has a weak flight, continually settling with closed wings on a flower or the end of a branch.

14. *Cethosia biblis*, Drury.

Common all through the Terai and up to Chunabatti. The rich red of its upper surface with a lovely violet reflection makes this species one of the handsomest insects on the wing I know.

15. *Cirrhochroa aoris*, Doubl. Hew.

Not uncommon: it has a quick flight, and very much resembles an *Argynnis* on the wing.

16. *Cirrhochroa mithila*, Moore.

Rarer than *C. aoris*, and only seen in the Terai.

17. *Cynthia erota*, Fabricius.

Two males only taken just above the Terai. This species has a very bold, strong flight.

18. *Symbrenthia hyppoclus*, Cramer.

Two specimens taken near Chunabatti.

19. *Pyrameis indica*, Herbst.

Flying in numbers round the Chunabatti Dâk Bungalow.

20. *Junonia lemonias*, Linnæus.

Common.

21. *Junonia laomedia*, Linnæus.

Seen only in the Terai.

22. *Junonia iphita*, Cramer.

Only one specimen taken.

23. *Ergolis ariadne*, Linnæus.

Common everywhere in the lower hills and plains.

24. *Cyrestis thyodamas*, Boisduval.

One male only taken. It settled as is usual with this species with its wings wide expanded and touching the ground all round at the edges, the fore-wing being much pushed forward, leaving quite a large space between it and the hind-wing.

25. *Hestina nama*, Doubleday.

Males only taken on the lower hills. On the wing it much resembles *Danais tytia*.

26. *Euripus halitherses*, Doubl. Hew.

I only saw two females of this species, and mistook them for *Euplœa (Salpinx) rhadamanthus* which they evidently mimic, not only in form and coloration but also in the slow flapping flight and the habit of settling in open places so characteristic of *Euplœas*.

27. *Limenitis procris*, Cramer.

One only taken in the Terai. It is a high soaring insect, settling often on the outer leaves of the boughs of trees. If disturbed it always returns to the same spot from whence it is driven off.

28. *Neptis hordonia*, Stoll.

Common in the Terai.

29. *Neptis viraja*, Moore.

One female only taken in the Terai.

30. *Neptis accris*, Lepechin.

Common in the Terai.

31. *Neptis emodes*, Moore.

One specimen only taken.

32. *Neptis cartica*, Moore.

Both sexes taken in the Terai.

33. *Neptis susruta*, Moore.

Two males taken in the Terai.

34. *Athyma leucothoë*, Linnæus.

A single male in the Terai.

35. *Athyma selenophora*, Kollar.

Males common in the Terai.

36. *Athyma inara*, Doubl. Hew.

Seen only in the Terai. The males of this genus are especially partial to settling on damp spots to suck up the moisture.

37. *Apatura parysatis*, Westwood.

Males common along the road below Chunabatti.

38. *Nymphalis athamas*, Drury.

A fine male of the pale greenish-white (almost pure white) variety taken just above the Terai.

39. *Zemeros flegyas*, Cramer.

Very common all along the road through the lower hills.

40. *Polyommatus sangra*, Moore.

The commonest "Blue" amongst the grass in the Terai and toward Siligori.

41. *Lampides ardates*, Moore.

Very common everywhere, settled on damp spots.

42. *Lampides rosimon*, Fabricius.

Also common.

43. *Lampides ælianus*, Fabricius.

A single male taken in the Terai.

44. *Lampides elpis*, Godart.

A Terai insect. On the wing it presents a very curious appearance on account of its alternately completely opening and shutting its wings, the contrast between the brilliant metallic-blue of the upper surface and the dark dull underside being very great.

45. *Lampides puspa*, Horsfield.

Common throughout the Sikkim hills. This species seems to take the place of *L. kashmira*, the commonest "Blue" in the North-West Himalayas, which is apparently not found much further west than Kumaon.

46. *Lampides kandarpa*, Horsfield.

A single specimen only taken in the Terai.

47. *Ilerda epicles*, Godart.

Common in the Terai and lower hills. The genus to which this species belongs is one that is essentially a frequenter of rank herbage, being always commonest where the ground has been disturbed by man, and weeds have sprung up.

48. *Hypolycæna erylus*, Godart.

Males very common all through the Terai and up to Chunabatti. Only one female taken.

49. *Pseudodipsas bengalensis*, Moore.

Common, settled on moist places on the road.

50. *Curetis bulis*, Doubl. Hew.

Males common in the Terai, settled on the road.

51. *Surendra quercetorum*, Moore.

One female taken in the Terai.

52. *Terais hecabe*, Linnæus.

Common between Siligori and the Terai.

53. *Pieris nerissa*, Fabricius.

Papilio amasene, Cramer, pl. 44, A.

A single specimen of this apparently very variable Pierid taken in the Terai. The Sikkim specimens are always much larger than those from other parts of India.

54. *Appias hippo*, Cramer.

Common near Chunabatti.

55. *Tachyris indra*, Moore.

A few males seen near Chunabatti.

56. *Catopsilia pyranthe*, Linnæus.

Common in the Terai and towards Siligori.

57. *Hebomoia glaucippe*, Linnæus.

A single male seen near Chunabatti. It has a very rapid flight; when

settling on a flower it is very inconspicuous, the mottled hind-wing and the apex of the fore-wing which is also much mottled and which alone is left uncovered by the hind-wing, render it difficult to see on account of its close resemblance to a dead leaf.

58. *Ixias evippe*, Drury.

Very common near Chunabatti. This species has a very rapid, strong flight, but continually settles.

59. ? *Ornithoptera pompeus*, Cramer.

Three specimens seen, sailing high amongst the trees.

60. *Papilio helenus*, Linnæus.

Not uncommon in the lower hills.

61. *Papilio polytes*, Linnæus.

One or two seen in the Terai.

62. *Papilio androgeus*, Cramer.

A female, second form, taken just above the Terai, where the road commences to ascend the hills.

63. *Papilio aristolochiæ*, Fabricius.

I took several battered specimens in the Terai.

64. *Papilio philoxenus*, Westwood.

Not uncommon near Chunabatti. I took several specimens, but all except one, a female with an expanse of 5·9 inches, were much broken. It sails about in the open, often high up amongst the trees, and apparently quite safe from the attack of birds, its strong scent, perceptible a couple of yards off even now, three months after it was caught, being probably most distasteful to insectivorous birds.

Part II.

Butterflies taken on the road between Chunabatti, 2,260 feet, and Kurseong, 4,840 feet.

(1.) *Danais melaneus.*

Common just above Chunabatti.

(2.) *Danais aglea.*

One only taken.

(8.) *Lethe rohria.*

Common along the road.

(11.) *Mycalesis malsara.*

One male only taken.

65. *Mycaleris gopa*, Felder.

A single male. This species is new to the Museum collection.

66. *Yphthima sakra*, Moore.

Common by the roadside.

67. *Yphthima nareda*, Hewitson.

Less common than the preceding.

(13.) *Acræa vesta.*

The larvæ and pupæ of this insect covered the weeds all along the roadside. In the North-West Himalayas it is a local and rare species, in Sikkim it is the commonest butterfly seen.

(14.) *Cethosia biblis.*

Many seen.

68. *Cethosia cyane*, Drury.

A much rarer insect than the preceding, a few specimens only seen.

(18.) *Symbrenthia hyppoclus.*

One only taken. It is a very rapid flyer for so small an insect, but it frequently settles.

69. *Junonia asterie*, Linnæus.

70. *Precis veda*, Kollar.

A water-loving insect, I have never taken it except in beds of streams, up and down which it flies keeping to a regular beat, and occasionally settling on a leaf, darting off in pursuit of any intruder venturing near, only to return to the same resting place. It is a wary insect and not easy to capture unless waited for in the line of its flight when a quick stroke of the net may secure it.

(25.) *Hestina nama.*

Males only met with commonly.

(39.) *Zemeros flegyas.*

Very common, settled on the road and pathways.

(41.) *Lampides ardates.*

(45.) *Lampides puspa.*

All the females that I have seen of this species have been smaller than the males.

(54.) *Appias hippo.*

Both sexes seen, males common. The intensity of the crome-yellow apical spot on fore-wing and the ground-colour of the hind-wing seems variable, some specimens being much darker than others.

71. *Pieris canidia*, Sparrman.

Common near Kurseong.

(57.) *Hebomoia glaucippe.*

An occasional one seen.

72. *Hesperia eltola*, Hewitson.

One specimen only.

73. *Satarupa bhagava*, Moore.

One taken near Chunabatti.

Part III.

Butterflies taken on the road between Kurseong, 4,840 feet, and Darjiling, 6,885 feet.

On both occasions, both going to and returning from Darjiling, I had no sunshine when traversing this piece of road, which accounts for the small number of Butterflies observed.

74. *Lethe sidonis*, Hewitson.

Males excessively common all along the road from about 5 miles above Kurseong to Darjiling. I only took one female, it hardly differs from the opposite sex.

(66.) *Yphthima sakra.*

A few specimens seen.

75. *Limenitis daraxa*, Doubl. Hew.

Only two specimens seen. It is a very pretty insect on the wing, very rapid in its movements. It always settles with its wings wide outspread.

(15.) *Lampides puspa.*

Not uncommon, settled on the road in moist places.

76. *Ilerda androcles*, Doubl. Hew.

Three males taken, many others seen.

Part IV.

The Butterflies enumerated in this part were taken on the road between Darjiling and the Badamtan Tea Estate; the greater portion between elevations of from 5,000 down to 3,500 feet.

(3.) *Danais septentrionis.*

Very common at the lower elevation.

(6.) *Euplœa* (*Trepsichrois*) *midamus.*

Many specimens of both sexes on flowers in the garden at Badamtan.

77. *Lethe kansa*, Moore.

A single male.

(10.) *Mycaleris perseus* var. *visala.*

Common along the pathways.

(14.) *Cethosia biblis.*

Both sexes very common.

78. *Neptis amba*, Moore.

A single male.

(38.) *Nymphalis athamas.*

A single male of the green variety.

79. *Abisara fylla*, Doubl. Hew.

A fine male of this rare species.

80. *Dodona ouida*, Moore.

One male.

(49.) *Pseudodipsas bengalensis.*

Common, only males observed.

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81. *Pieris nadina*, Lucas.

One female. A most rapid insect on the wing, reminding one much more of a *Tachyris* than a *Pieris*.

82. *Papilio paris*, Linnæus.

I took several males hovering over moist spots on the bank of a rivulet which crosses the road near Badamtan.

PART V.

All the Butterflies referred to in this last part were obtained in the valley of the Great Runjeet, at an average elevation of about 1,000 feet only. The road follows the course of the river, and passes through a magnificent forest with an almost impenetrable undergrowth of bamboo, rattan-cane, &c. The road is often crossed by small streams of water running into the Runjeet, and it was on the moist ground bordering these streams that I took most of the butterflies mentioned below. In places they were so abundant that when approached, they actually rose like a cloud presenting the most varied colours, forms and sizes. All along the road, however, butterflies were in wonderful profusion, never in my life before have I seen such numbers together belonging to so many species.

83. *Lethe chandica*, Moore.

Males common.

84. *Lethe mekara*, Moore.

Males settled on damp spots on the road.

(8.) *Lethe rohria*.

This appears to be the commonest *Lethe* in Sikkim.

85. *Neope bhadra*, Moore.

I found this most beautiful Satirid very common all along the road, settled with closed wings in damp places. On being disturbed it immediately flies off into the jungle, where, settled amongst dead leaves it is completely hidden.

(10.) *Mycalesis perseus* var. *visala*.

Males plentiful as usual.

(11.) *Mycalesis malsara*.

Also common.

86. *Mycalesis anaxias*, Hewitson.

A single male taken.

(12.) *Yphthima philomela*.

Common amongst the grass.

87. *Zipaetis scylax*, Hewitson.

Common. It has the habits of a *Mycalesis*.

88. *Elymnias undularis*, Drury.

A few males only seen.

89. *Dyctis patna*, Westwood.

A single male which I thought was a specimen of *Euplæa* (*Trepsichrois*) *midamus* (an insect I did not see at all in the Runjeet valley) when on the wing and captured as such, so admirably does this insect "mimic" the *Euplæa*.

90. *Discophora celinde*, Stoll.

Males common all along the road settled with closed wings on damp spots. When they fly they are particularly handsome, the deep indigo-blue of their uppersides glistening beautifully in the sun-light.

91. *Thaumantis diores*, Doubleday.

A single specimen seen of this lovely insect.

(14.) *Cethosia biblis*.

Common.

92. *Kallima inachis*, Boisduval.

Three seen, one settled on a damp spot, the other two flying along the road and occasionally turning off at right angles to it to settle with closed wings and *head downwards* on a stem of bamboo, where of course their close similitude to a dead leaf rendered their detection, unless the actual spot where they settled was marked, almost an impossibility. Their suddenly turning off to settle at right angles to their line of flight is a characteristic I have observed in no other butterfly.

(23.) *Ergolis ariadne*.

Common as usual.

(24.) *Cyrestis thyodamas*.

Not very common.

93. *Cyrestis risa*, Doubl. Hew.

Very common. This species as well as *C. thyodamas* has the habit of suddenly settling, with wings wide outspread, on the *underside* of a leaf parallel to the ground, where it is completely hidden. This feat of gymnastics is confined to this genus alone as far as my experience goes and must be a great protection to it from its enemies, the disappearance of the insect is so rapid that unless one has actually watched it settle on the leaf it seems like magic.

94. *Stibochiona nicea*, Gray.

Very common. It has a bold flight, is very pugnaceous, and always settles with expanded wings on a leaf or similar resting-place only to soar off in pursuit of the first intruder venturing near. It always returns to the same spot.

(25.) *Hestina nama*.

Males common.

(26.) *Euripus halitherses*.

Males only seen. It has a rapid flight, and never settles with expanded wings in conspicuous places as the female does.

95. *Lebadea ismene*, Doubl. Hew.

Common. It has a somewhat weak flight.

(28.) *Neptis hordonia.*

Common.

(31.) *Neptis emodes.*

Common.

(33.) *Neptis susruta.*

One male only taken.

96. *Athyma mahesa*, Moore.

A single pair taken.

(35.) *Athyma selenophora.*

Common.

97. *Adolias kesava*, Moore.

One male.

98. *Adolias sananda*, Moore.

A single male.

99. *Adolias apiades*, Ménétriés.

Both sexes very common. They usually settle with expanded wings like the rest of the genus, but not invariably as some genera (*Cyrestis Shilochiona*, &c.,) do.

(37.) *Apatura parysatis*, Westwood.

The females are evidently very sluggish, out of dozens of males I did not seen one female.

(38.) *Nymphalis athamas.*

Green variety common.

100. *Nymphalis polyxena*, Cramer.

A single specimen of one of the numerous varieties (? species) of this insect.

(39.) *Zemeros flegyas.*

Common.

101. *Lampides malaya*, Horsfield.

Common, settled on moist places. The specimens differ in some minute particulars from the Javan ones described by Horsfield.

102. *Lampides decidia*, Hewitson.

Decidedly common.

103. *Lampides parrhasius*, Fabricius.

One male.

(44.) *Lampides elpis.*

Apparently confined to low elevations.

104. *Aphnæus syama*, Horsfield.

One female only seen. The whole of the species in this genus fly with the greatest rapidity.

(47.) *Ilerda epicles*, Godart.

Common.

105. *Hypolycæna etolus*, Fabricius.

Very common. It is a rapid flyer, and on the wing at once reminded me of one of the common blue-bodied Dragon-flies which abound everywhere near water. Is it possible that a butterfly has "mimiced" a *Libellula*?

106. *Deudorix petosiris*, Hewitson.

One male of this somewhat rare species.

(50.) *Curetis bulis*.

Common.

107. *Arhopala centaurus*, Fabricius.

One male taken.

108. *Pontia xiphia*, Fabricius

I met with many specimens of this pretty, weak-flying species.

(81.) *Pieris nadina*.

One male.

109. *Delias pasithoë*, Linnæus.

Two specimens only of this rich-coloured species.

110. *Delias agostina*, Hewitson.

Two male specimens, both settled on damp spots.

111. *Eronia avatar*, Moore.

One very fine male.

(56.) *Catopsilia pyranthe*.

Common.

112. *Papilio astorion*, Westwood.

Both sexes fairly common.

(60.) *Papilio helenus*.

Common.

(62.) *Papilio androgeus*.

Males common.

113. *Papilio sarpedon*, Linnæus.

Common. This species, as also *P. cloanthus*, Westwood, is particularly fond of imbibing moisture from damp spots on the ground, and will return to the same place however often disturbed.

114. *Papilio agamemnon*, Linnæus.

Common, but all the specimens much worn.

115. *Tagiades dasahara*, Moore.

Common. Always settles, like the rest of the genus, with wings wide outspread.

116. *Pterygospidea menaka*, Moore.

One specimen. Also settles with outspread wings.

117. *Ismene bengaminii*, Guérin.

Two specimens.

118. *Ismene amara*, Moore.

One specimen. The species of this genus as far as I know always settle with closed wings.

119. *Hesperilla* (*? Halpe*) *luteisquama*, Mabille.

One male.

120. *Pamphila* (*? Halpe*) *zema*, Hewitson.

Common, settled on moist spots.

121. *Pamphila augias*, Linnæus.

One male.

122. *Pamphila mæsa*, Moore.

One specimen.

123. *Pamphila gola*, Moore.

One specimen.

(72.) *Hesperia eltola*.

Common.

124. *Hesperia chaya*, Moore.

Common. This is the widest spread and commonest *Hesperia* in North India, met with everywhere from the plains to 8,000 feet elevation.

125. *Hesperia? semamora*, Moore.

One specimen. A new species to the Museum collection.

126. *Astictopterus diocles*, Moore.

The commonest *Hesperia* seen. Settles with closed wings.

127. *Plesioneura sumitra*, Moore.

One specimen. Always settles with expanded wings, is very swift on the wing, and has the habit of executing an aërial patrol up and down a small space.

128. *Plesioneura alysos*, Moore.

Common, both sexes taken, and all with *one* subapical white spot on fore-wing. It has the same habits as the preceding.

129. *Nisionades salsala*, Moore.

One specimen. It is common in shady places amongst trees on the outskirts of Calcutta, and always settles with closed wings.

The above 129 species of Butterflies were all taken under disadvantages. There was but little sun during the five days I collected, and I was obliged to cover a large extent of ground each day, so had no time to pause long in likely localities, having literally to catch as I walked. I only mention this to show what can be done in Sikkim in the way of collecting and how exceeding rich it is in *Rhopalocera*, could I have stopped longer in each place I should probably and without exaggeration have collected at least double the number of species here recorded.

V.—*List of Earthquakes recorded in Assam during the years* 1879 *and* 1880.—*By the* GOVERNMENT OF ASSAM.
(*Communicated by the* METEOROLOGICAL REPORTER TO THE GOVERNMENT OF BENGAL.)

In the following list the earthquakes marked with an asterisk * were ascertained not to have been felt in other localities than those which are mentioned.

Date.	District.	Time of occurrence.	Duration.	Apparent direction.	Extent of damage, if any and general Remarks.
1879.					
Jan. 3rd.	Golaghat, ...	7.15 A. M.	1 minute.	West to East.	None.
" "	*Jaipur, ...	7.30 A. M.	5 minutes.	E. to W.	Severe.
" "	Darrang, ...	7.50 A. M.	30 seconds.	N. W. to S. E.	No damage shock very slight but vibration, after it of unusually long duration.
" "	Lakhimpur, ...	7.51 A. M. end of shock.	About 12 seconds.	From 192° magnetic bearing.	A very smart shock accompanied and preceded by the usual rumbling sound but having a rather sharper tone than ordinary. The oscillations about .8 of a second apart caused some damage, a very slight shock took place about 3 A. M. this morning.
" "	Khasi and J. Hills,	8 A. M.	3 seconds.	S. to N.	No damage, shock slight.
" "	Kamrup, ...	8 A. M.	4 seconds.	S. to E.	
" "	Jorhát, ...	8.30 A. M.	1 minute.	W. to E.	
" "	Sibsagar, ...	8.3 A. M.	2 minutes.	E. to W.	
" "	N. Lakhimpur, ...	8.15 A. M.	2 seconds.	Not recognizable.	Ascertained to have not been felt in Sylhet, Cachar, Goalpárá, Garo Hills, and Nowgong.
April 19th.	*Jowai, K. and J. Hills, ...	5 A. M.	15 seconds.	S. to N.	No damage.
May 10th.	*K. and J. Hills, ...	9 A. M.	10 seconds.	W. to E.	Do.

*List of Earthquakes recorded in Assam during the years 1879 and 1880.—Continued.

Date.	District.	Time of occurrence.	Duration.	Apparent direction.	Extent of damage, if any and general Remarks.
*1879.					
June 5th.	*Nowgong, ...	7.2 A. M.	2 seconds.	N. to S.	No damage.
„ 7th.	*K. and J. Hills, ...	6.30 P. M.	5 seconds.	W. to E.	Do.
„ 10th.	*Garo Hills, ...	7.15 P. M.	1 second.	W. to E.	Do.
„ 25th.	*Darrang, ...	12.20 P. M.	A few sec.	Not apparent.	Do.
Sept. 7th.	*Sibsagar, ...	11.40 P. M.	57 seconds.	N. W. to S. E.	Do.
„ „	*Lakhimpur, ...	11.35 P. M.	2 minutes.	West to East.	Do.
„ 17th.	*Nowgong, ..	12.30 P. M.	3 seconds.	N. to S.	A very slight shock, no damage.
„ 23rd.	*K. and J. Hills,	4.40 P. M.	3 seconds.	Not noticed.	Smart and marked shock no damage.
„ 24th.	*K. and J. Hills,	9 A. M.	30 seconds.	Not noticed.	Smart and marked shock no damage.
Oct. 3rd.	*Naga Hills, ...	12.10 P. M.	2 seconds.	S. E. to N. W.	No damage.
„ 8th.	†Kamrup, ...	2 A. M.	4 seconds.	N. to S.	Do.
„ „	†Darrang, ...	1.45 A. M.	10 to 15 sec.	N. W. to S. E.	Two consecutive shocks.
„ „	†Cachar, ...	12.45 A. M.	2 seconds.	N. E. to S. W.	None. Two smart shocks.
„ „	†Nowgong, ...	1.36 A. M.	2 m. 10 s.	S. to N.	Slight shock. No damage.
„ „	†Sylhet, ...	2 A. M.	30 seconds.	S. W. to N. E.	Smart shock. No damage.
„ „	†K. and J. Hills, ...	1.45 A. M.	30 seconds.	W. to E.	Do. do. do.
„ „	†Garo Hills, ...	1 A. M.	1 second.	W. to E.	Do. do. do.
Dec. 4th.	*Darrang, ...	4.30 A. M.	5 seconds.	Not known.	None.
„ 12th.	*Nowgong, ...	7.35 P. M.	1 minute.	S. to N.	Slight shock. No damage.
„ „	*K. and J. Hills, ...	12.15 P. M.	5 seconds.	N. W. to S. E.	Do. do.
„ 16th.	*Darrang, ...	9.55 A. M.	A few sec.	Not observed.	The shock was very slight but there was a prolonged rumbling noise no damage done.
„ „	*Khasi and J. Hills,	5.30 A. M.	5 seconds.	W. to E.	No damage.

† Ascertained to have not been felt in Goalpara, Sibsagar, Lakhimpur and Naga Hills.

„ 18th.	*Khasi and J. Hills,	5.30 P. M.	15 seconds.	W. to E.	Damage none.
„ „	*Cachar, ...	6.45 P. M.	3 seconds	S. W. to N. E.	Two shocks no damage.
„ „	*Nowgong, ...	6 P. M.	90 seconds.	W. to E.	One sharp shock no damage.
„ „	*Sibsagar, ...	6 P. M.	Less than 1 s.	W. to E.	None.
„ „	*Darrang, ...	5.49 P. M.	A few sec.	N. W. to S. E.	Slight, no damage.
„ „	*Naga Hills, ...	6.25 P. M.	4 seconds.	N. to S.	Nil.
„ „	*Garo Hills, ...	6 P. M.	30 seconds.	S. E. to N. W.	No damage done.
„ 22nd.	*Cachar, ...	6.30 A. M.	2 seconds.	S W. to N. E.	One shock no damage.
„ „	*Khasi and J. Hills,	5.30 A. M.	5 seconds.	W. to E.	Do. do.
„ 27th.	*Darrang, ...	12.6 P. M.	A few sec.	Nil.	The shock was slight but there was a prolonged rumbling noise. No damage.
1880.					
Jan. 2nd.	*Nowgong, ...	10 A. M.	10 seconds.	N. to South.	A slight shock, no damage done.
„ 15th.	*Kamrup, ...	7.5 P. M.	5 seconds.	W. to East.	One slight shock, no damage done.
„ „	*Darrang, ...	7 P. M.	20 seconds.	Not observed.	Do. do. do.
„ „	*Nowgong, ...	7.10 P. M.	3 seconds.	W. to South.	Do. do. do.
„ „	*Sibsagar, ...	7.20 P. M.	About 1 m.	N. W. to S.	Do. do. do.
„ „	*Jorhat Sub-Div.,	7.30 P M.	1 second.	S W. to N. E.	Do. do. do.
„ „	*Khasi Hills, ..	6.30 P. M.	5 seconds.	E. to West.	Do. do. do.
„ 17th.	*Khasi Hills, ...	7.40 A. M.	5 seconds.	S. to North.	Slight shock, no damage done.
„ „	*Garo Hills, ...	7 P. M.	5 seconds.	S. E. to N. W.	Do. do. do.
„ 27th.	*Nowgong, ...	8.40 P. M.	5 seconds.	N. to South.	Do. do. do.
„ „	*Darrang, ...	About 9 P. M.	A few sec.	Not noticed.	Do. do. do.
Feb. 24th.	*Darrang, ...	11.44 P. M.	A few sec.	Not observed.	Do. do. do.
April 4th.	*Kamrup, ...	10.45 P. M.	2 seconds.	W. to East.	No damage done. There was one smart shock preceded by a rumbling noise as of distant thunder.
„ „	*Khasi Hills, ...	6.50 P. M.	5 seconds.	N. to South.	No damage done.

List of Earthquakes recorded in Assam during the years 1879 *and* 1880.—Continued.

Date.	District.	Time of occurrence.	Duration.	Apparent direction.	Extent of damage, if any and general Remarks.
1880.					
May 1st.	*Nowgong, ...	3 A. M.	30 seconds.	N. to South.	One sharp shock. No damage done.
„ 2nd.	*Khasi Hills, ..	1.45 A. M.	20 seconds.	N. to South.	No damage done.
„ „	*Darrang, ...	3 A. M.	5 seconds.	W. to East.	Do. do.
„ „	*Nowgong, ...	2.50 A. M.	30 seconds.	N. to South.	One severe shock. No. damage done.
„ 17th.	*Sibsagar, ...	12 P. M.	2 seconds.	E. to West.	No damage done.
„ 18th.	*Khasi Hills, ...	10.15 P. M.	5 seconds.	N. to South.	Do. do.
June 7th.	*Khasi Hills, ...	10.30 P. M.	10 seconds.	N. to South.	Do. do.
„ „	*Sub-Division Hailakandy, ...	10.25 P. M.	10 seconds.	S. to North.	No damage done. Three very slight but distinct shocks.
„ 30th.	Sylhet, ...	4 A. M.	15 to 20 seconds each.	S. W. & N. East.	4 Shocks at intervals. No damage done.
„ „	Cachar, ...	4 5 A. M.	30 seconds.	E. to West.	2 Smart shocks. No serious damage done.
„ „	Khasi Hills, ...	3.55 A. M.	30 seconds.	N. to South.	2 Slight shocks at intervals. No damage done.
„ „	Kámrup, ...	4 A. M.	2 minutes.	N. W. to S. E.	2 Smart shocks. No damage done.
„ „	Goalpárá, ...	4 A. M.	2 minutes.	E. to West.	First a slight shock followed by a severe one. No damage done.
„ „	Garo Hills, ...	3.59 A. M.	2 minutes.	S. W. to N. E.	This was a double shock of considerable violence, accompanied and followed by a loud rumbling sound. No damage done but small articles were knocked off shelves, tables, &c.
„ „	Garo Hills, ...	7.45 A. M.	2 seconds.	S. W. to N. E.	A very slight shock.

" "	Darrang, ..	4.10 A. M.	2½ minutes.	N. W. to S. E.	Two consecutive shocks the first one was rather severe. No damage done.
" "	Nowgong, ...	4 A. M.	1 minute.	S. to North.	The earthquake lasted a long time, one of the longest felt. Very little damage done.
" "	Nowgong, ...	4.30 A. M.	5 seconds.	S. to North.	A slight shock.
" "	Sibsagar, ...	3.55 A. M.	30 seconds.	S. to North.	No damage done.
" "	Lakhimpur, ...	4.19 A. M.	30 seconds.	E. to West.	No material damage done.
" "	Lakhimpur, ...	4.24 A. M.	2 seconds.	E. to West.	
" "	Lakhimpur, ...	4.50 A. M.	5 seconds.	E. to West.	
" "	Lakhimpur, ...	5 23 A. M.	A few sec.	E. to West.	
" "	Naga Hills, ...	4 A. M.	1 minute.	S. to North.	Vibration was sufficiently strong to throw down decanters and such like articles, but no material damage.
" "	Mangaldai Sub-Div.,	4 A. M.	60 to 80 sec.	N. to South.	Two severe consecutive shocks. No damage done.
" "	Golághát Sub-Div.,	3.55 A. M.	2 minutes.	E. to West.	The outer wall of the treasury building cracked in four places. The shock was very severe and was succeeded by a slighter one about 3 or 4 minutes later.
" "	Jorehat Sub-Div.,...	4 A. M.	30 seconds.	N. E. to S. West.	No damage done.
" "	Karimgunj Sub-Div ,	4 A. M.	1 minute.	N. to South.	There was a second slight shock about 10 minutes after the first. The first shock was a severe one shook the wooden posts of the sub-divisional officer's Bungalow alarmingly. No damage done.
July 1st.	*Nowgong, ...	4.30 P. M.	3 seconds.	N. to South.	Slight shock. No damage done.
" "	*Khasi Hills, ...	3.15 P. M.	7 seconds.	N. to South.	Do. do. do.

List of Earthquakes recorded in Assam during the years 1879 *and* 1880.—Concluded.

Date.	District.	Time of occurrence.	Duration.	Apparent direction.	Extent of damage, if any and general Remarks.
1880.					
July 1st.	*Darrang, ...	4 P. M.	5 seconds.	Not noticed.	Slight shock. No damage done.
„ „	*Cachar, ...	4.30 P. M.	2 seconds.	S. W. to N. E.	Do. do. do.
„ 2nd.	*Khasi Hills, ...	1 30 P. M.	4 seconds.	S. to North.	No damage done.
„ 17th.	*Garo Hills, ...	4 30 A. M.	2 seconds.	Not known.	A very slight shock.
„ 20th.	*Garo Hills, ...	3.30 A. M.	1 second.	Not known.	Do. do
Aug. 2nd.	*Cachar, ...	2 A. M.	About 30 m.	Not known.	No damage done.
„ 5th.	*Khasi Hills, ...	7.45 A. M.	10 seconds.	S. to W.	None.
„ 16th.	Kamrup, ...	11½ P. M.	1 second.	N. W. to S. E.	One shock, preceded by a rumbling noise like distant thunder. No damage done.
„ „	*Khasi Hills, ...	11.30 P. M.	5 seconds.	W. to South.	No damage done.
„ 21st	*Darrang, ...	3.30 P. M.	10 seconds.	W. to East.	No damage, felt only at Mangaldai not at Tezpore.
„ 22nd.	*Garo Hills, ...	3.22 A. M.	3 seconds.	—	Short but rather violent shock. The usual rumbling was succeeded by a shock from below, upwards and then by a lateral shake sufficient to make house posts crack.
Sept. 4th	*Garo Hills, ...	3 A. M.	2 to 3 seconds.	—	None, a very slight shock.
„ „	*Goálpárá, ...	About 4 A. M.	2 seconds.	N. W.	Slight shock.
„ 11th.	*Darrang, ...	12.15 A. M.	10 to 15 sec.	N. E. to S. W.	None. The shock was marked and distinct, it was preceded by the usual loud rumbling noise.
„ „	*Nowgong, ...	12.15 A. M.	3 seconds.	N. to South.	A slight shock. No. damage done.
„ „	*Garo Hills, ...	12.15 A. M.	—	—	do. do.

„ 13th.	*Nowgong, ...	4.15 A. M.	3 seconds.	N. to South.	A slight shock. No damage done.
„ 23rd.	*Darrang, ...	2.17 P. M.	5 seconds.	S. to W.	Very slight No damage done.
„ 27th.	*Khasi Hills, ...	10·40 A. M.	15 seconds.	E. to W.	No damage done.
„ 30th.	*Darrang, ...	7.50 P. M.	5 to 6 seconds.	—	Severe shock followed about a minute later by a second shock not quite so severe. No damage done.
„ „	*Nowgong, ...	7.45 P. M.	2 seconds.	N. to South.	A slight shock. No damage done.
„ „	*Sibsagar, ...	8 P. M.	10 seconds.	E. to W.	No damage.
Oct. 20th.	*Darrang, ...	2.55 A. M.	A few sec.	Not noticed.	Slight. No damage done.
„ „	*Sibsagar Golághát,	4 A. M.	1 minute.	N. W. to S. E.	No damage.
Nov. 21st.	*Nowgong, ...	8 A. M.	3 seconds.	North to South.	A slight shock. No damage done.
Dec. 9th.	*Sibsagar, ...	6 A. M.	30 seconds.	East to West.	Slight. No damage.
„ „	*Lakhimpur, ...	4.30 A. M.	Not observed.	—	Very slight.
„ 12th.	*Khasi and Jaintea Hills, ...	1.45 P. M.	10 seconds.	S. W. to N. E.	Slight. No damage done.

JOURNAL

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Part II.—PHYSICAL SCIENCE.

No. II.—1881.

VI.—*On the relations of cloud and rainfall to temperature in India, and on the opposite variations of density in the higher and lower atmospheric strata.*—*By* HENRY F. BLANFORD, F. R. S., *Meteorological Reporter to the Government of India.*

[Received 25th March, 1881;—Read 6th April, 1881.]

In the Report on the Meteorology of the year 1879, which I drew up last autumn, and which will shortly be issued, I had occasion to discuss the two subjects enumerated in the above title, in connection with the anomalous variations of temperature and barometric pressure, exhibited by the Indian registers during the last two or three years. As, however, they have a much wider bearing than merely in reference to the cotemporary phases of our Meteorology, and indeed may claim to rank among the more important physical operations which influence Indian Meteorology, I have thought that it might be of interest to extract these notices from their original setting in the pages of the Annual Report, and to ask the Society to give them an independent circulation in its Journal.

I have been the more prompted to do this, because, in a recent number of the Journal of the London Meteorological Society,* Mr. Douglas Archibald has discussed at length a nearly cognate subject, *viz.*, the "Variations in the barometric weight of the Lower Atmospheric Strata in India." In this paper, Mr. Archibald refers to certain articles which the late Mr.

* Vol. VI. New Ser. No. 36, October 1880. Mr. Archibald's paper was read on the 19th May 1880.

J. Allan Broun, F. R. S. contributed to "Nature" shortly before his decease, and in which he endeavoured to show, that while air must unquestionably expand and contract according as its temperature rises and falls, the variation in density so produced in no way adequately accounts for the annual variation of monthly mean barometric pressure at the surface of the earth. Mr. Archibald, following a method which I proposed in a paper in the Phil. Trans. in 1874, computes the variations of density, which the atmospheric column below Darjiling undergoes month by month, in consequence of the variations of temperature, humidity and top-pressure; and shows that the lower stratum of the atmosphere, thus subjected to a physical analysis, conforms in its changes, with near approximation, to the indications of theory; and that, of the several causes affecting its density and static pressure, temperature is by far the most influential. This conclusion is also that at which I arrived in the paper above referred to, working on far more restricted data than those discussed by Mr. Archibald, but the best then available to me.

Mr. Archibald has taken as the subject matter of his paper, the normal or average values of pressure, temperature &c., as given by many years' registers at Darjiling and Goalpara. In the latter part of the present paper, I have compared the abnormal variations of temperature with those of the density of the atmospheric column, below the three hill stations Chakrata, Ranikhet and Pachmarhi, and have shown that, in their case also, temperature and density vary inversely, in accordance therefore with the results previously obtained by myself and Mr. Archibald, and in accordance also with the indications of theory.

It seems, therefore, to be fairly established that, as regards the lower stratum of the atmosphere, the anomaly pointed out by the late Mr. Broun does not exist. Observation and theory are here as consistent as the character of the data would lead us to anticipate; and we must therefore look to the condition of the higher strata of the atmosphere, those which lie above the level of our Indian hill stations, Darjiling, Chakrata &c., for the explanation of the apparent inconsistency to which Mr. Broun drew attention. In connection with this enquiry, the facts brought forward in the present extracts from my report seem to me to have much significance.

I may mention that the whole of this was written and in type (for the Report) before I had seen Mr. Archibald's paper above referred to.

Some other general questions of importance are referred to incidentally in the course of discussion, in the extracted passages.

On the mean of all Indian stations, the temperature of the year 1879 was slightly below the average, but it was by no means generally so in Northern India. In the North-West Provinces and Bengal, the mean

temperature of the year was slightly excessive; and in the Punjab, this was the case at as many stations as showed the opposite variation. This excess was due to the preponderance of the high temperatures of the first five months, which were not quite compensated by the depression of temperature which prevailed during the rains, and, more or less generally, in the later months of the year. In the Central Provinces, however, and Rajputana, the great depression of the closing months of the year more than counterbalanced the excess of the earlier months; and in the Dakhan and the Peninsula generally, a depression of temperature characterised the greater part of the year. In Burma and Arakan, only the first three months of the year showed an excess of temperature; that of the remainder of the year being rather below the average.

Thus the progressive increase of the average temperature of India, which, as was shown in the Meteorological report for 1878, had been in progress during the four years 1875-78, reached its climax in the last of these years, and has been followed by a considerable fall. The mean anomalies of the five years are as follows:—

	1875.	1876.	1877.	1878.	1879.
Number of Stations	72	72	74	74	70
Mean anomaly	—0·29°	+0·08°	+0·17°	+0·62°	—0·13°
Progressive variation	..	+0 21	+0·25	+0·45	—0·75

The result, therefore confirms the conclusion which I drew in the Meteorological report of 1878, and shows that the variation is not apparent only and due to any progressive change in the instruments employed. So far, it coincides with that found by Gautier and Köppen for land stations in the tropics generally; since the maximum coincides, approximately, with the recent minimum of sun-spots.

A recent notice by Dr. Köppen, in the July number of the Journal of the Austrian Meteorological Society, gives some highly interesting data of the temperature anomalies of large land areas of the Northern Hemisphere, during the last five years; which indicate that the oscillation of temperature, shown above, was not restricted to India, but was shared by a large portion of Europe and North and Central America. The data are reproduced in the following table, in which the temperature anomalies are reduced from Dr. Köppen's table, to their corresponding values in Fahrenheit degrees:—

	1875.	1876.	1877.	1878.	1879.
Central Europe, ...	—1·06	—0·14	+0·23	+0·59	—2·32
Eastern North America, ...	—2·30	—0·31	+2·02	+3·38	+0·38
San José Central America 10° N., ..	—0·72	—0·67	+1·31	+1·55	—0·47
European Russia South of 55° N., ..	—2·34	—0·72	—0·36	+1·80	?
Ditto ditto North, „ ..	—3·42	—1·08	—0·36	+2·70	?

In another table Dr. Köppen gives the temperature anomalies of the same years for those parts of Europe and Asia which show a departure from this regular oscillation. It is to be observed that these include all those countries which are most directly influenced by the Gulf-stream :—

	1875.	1876.	1877.	1878.	1879.
Scandinavian Peninsula, ..	—0·92	—1·06	+1·96	+0·90	—1·04
England, ...	—0·14	+0·52	+0·11	+0·18	—3·20
Scotland, ...	+0·49	—0·16	+0·74	+0·36	—2·05
Iceland and Faroe Isles, ...	+2·2	+0·9	—0·7	—0·5	+0·4
West Greenland, ...	+1·8	+0·9	+1·8	+3·6	?
Italy, ...	—0·7	+0·2	+0·4	..	?
Caucasus, 4 Stations	—0·7	+1·3	+1·1	+0·4	?
South-West Siberia and Amu Darya, 6 Stations, ...	..	—0·7	—0·5	+1·1	?
South-East Siberia and Pekin, 4 Stations.	+0·2	+0·4	+0·2	—0·02	?

The subject of Dr. Köppen's paper appears to have been suggested by a paper of Mr. Douglas Archibald's in 'Nature' (26th February 1880), wherein it is sought to show that the periodical heat waves, brought to light by Professor Piazzi Smyth, on the evidence of the rock temperatures of Calton Hill, Edinburgh, are dependent on variations in the mean cloudiness of the atmosphere; since the periods of highest ground temperature are those of minimum cloud and *vice versâ*. This view of Mr. Archibald's, *viz*, the dependence of temperature on cloud proportion, appears to be in part identical with that which I put forward originally in my paper, "On some recent evidence of the variation of the Sun's Heat," &c., in the XLVth Volume of this Journal (June 1875),* wherein I endeavoured to show that, the temperature of the lower atmosphere, on the land surface, in India, depends much more on the quantity of cloud and on the rainfall than on that variation of the solar heat intensity, the periodicity of which

was brought out in the data discussed in the paper. As regards India, I go beyond Mr. Archibald, however, in attributing even greater importance to the evaporation of rainfall than to obscuration of the sun by cloud.

In a short paper, written in reply to some criticisms of Dr. Hann and Dr. Köppen, which I have lately communicated to the Journal of the Austrian Meteorological Society, I had given some recent data which bear strongly on these views; since they show that both the ground temperature and that of the lowest stratum of the atmosphere are dependent, in a very high degree, on cloud and rainfall; and that, in India at least, this effect is so great, that it must, in all probability, outweigh and mask any direct influence of variations in the intensity of the solar radiation.

In the first place, I give a comparison of the mean temperatures of the air and ground at Alipore (Calcutta) Observatory, in the first five months of the two years 1879 and 1880. The air temperatures are those recorded under a shed of the usual pattern, consisting of a thatched roof simply supported on posts, and open, therefore, on all sides to the wind, beneath which the instruments are exposed, about 4 feet above the ground. The ground temperatures are obtained with a verified standard thermometer, the bulb of which rests on the ground at the bottom of a wooden tube, 3 feet below the surface, the arrangement being similar to that known as Lamont's. The place of exposure is a grassy surface, (the grass being short and in the dry weather thin), freely exposed to sunshine and rain:—

	Temperature.				Cloud proportion.		Rainfall: inches.		Rainy days.	
	Air.		Ground.							
	1879.	1880.	1879.	1880.	1879.	1880.	1879.	1880.	1879.	1880.
January, ..	65·0	65 8	72·4	72·6	0·39	2·03	*Nil*	0·05	...	1
February, ...	71·7	69 9	74·5	74·7	1·74	3·05	0·21	2·91	1	6
March, ...	79·1	78 6	79 8	78·3	0·79	2·72	*Nil*	0·54	...	2
April,.....	85·2	84 2	86·3	84 1	2·43	2·64	*Nil*	1·91	...	6
May, ...	85·2	83·6	90 2	85·5	4·59	5·21	3·22	4·87	9	12
Mean or Sum	77 2	76·4	80·6	79·0	1·99	3·13	3·43	10·28	10	27
Difference,...	...	—0·8	...	—1·6	...	+1·14	...	+6·85	...	+17

Hence, it appears that, in the month of January, an excess of 1·64 of cloud, with an insignificant rainfall, accompanied an increase of 0·8° of air temperature. But in February, an increase of only 1·31 of cloud and of 2·70 inches of rain lowered the mean temperature 1·3°. In March, an increase of 1·93 of cloud and of 0·54 inch of rain, on only two days, coincided with a reduction of 0·5°. In April, an increase of only 0·21 of cloud and 1·91 inches of rain, on six days, a reduction of 1·0°; and, in May, an increase of 0·62 of cloud and 1·65 inches of rain, on three additional days, a reduction of 1·6° of temperature. But the temperature of the ground, in which

the cooling effects of cloud and rain, (the latter especially,) are cumulative, exhibits their influence in a far more striking manner. As the result of the differences of the five months, the ground temperature of May 1880 was not less than 4·7° below that of the corresponding month of 1879.

That the effect of the cloud and rainfall on the temperature of the air was so much smaller than on that of the ground, is doubtless owing to the fact that, after January, the winds of Calcutta are chiefly from the sea. This too perhaps explains the very striking fact, that on the average of two complete years' observations, the temperature of the ground, at a depth of 3 feet, is not less than 5° higher than that of the air.

Such being the effect of cloud and rain, at a station situated only 60 miles from the sea, and but 20 miles from the broad estuary of the Hooghly, up which much of the sea wind blows to Calcutta, it may be expected that, in the continental climate of Upper India, this influence will be far more pronounced. That such is, in fact, the case, is strikingly shown by a comparison of the temperature, cloud and rainfall of the North-West Provinces in the dry and rainy seasons of 1877 and 1879 respectively. In the former year, the months of March, April and May were unusually cloudy, and the rainfall, although not excessive, was, on the whole, above the average. In 1879, these months were unusually dry and serene. On the other hand, the conditions of the rainy months, June, July, and August of the two years, were relatively reversed; the rainfall of 1877 being very deficient, while that of 1879 was more copious than usual. The result of these variations on the temperature is well shown in the following table, which gives the mean temperature anomaly, the mean cloud proportion, monthly rainfall and number of rainy days deduced from the abstract registers of the five stations, Meerut, Agra, Lucknow, Allahabad, and Benares:—

	Temperature anomaly.		Cloud proportion.		Rainfall: inches.		Rainy days.	
	1877.	1879.	1877.	1879.	1877.	1879.	1877.	1879.
March, ...	—1·4	+0·9	3·85	2·47	0·58	0·18	2·0	1·4
April, ...	—4·0	+3·7	3·22	1·03	0·52	0·07	1·6	0·4
May, ...	—1·3	+4·7	2·63	1·38	0·43	0·02	1·6	0·6
Mean, ...	—2·2	+3·1	3·23	1·63	0·51	0·09	1·7	0·8
Difference, ...	...	+5·3	...	—1·60	...	—0·42	...	—0·9
June, ...	+1·8	—0·8	3·26	4·66	1·40	4·78	3·0	9·2
July, ...	+4·3	—2·0	5·48	7·91	3·00	11·61	6·0	16·2
August, ...	+6·8	—2·0	4·41	8·07	3·21	11·14	4·8	22·6
Mean, ...	+4·3	—1·6	4·38	6·88	2·54	9·18	4·6	16·0
Difference, ...	...	—5·9	...	+2·50	...	+6·64	...	11·4

It must not be overlooked that, both in the dry season and in such an autumnal season as that of 1877, cloudless weather is accompanied by hot westerly winds, while cloudy weather is usually characterised by comparatively cool easterly winds; and it may therefore be objected, that a large part of the temperature difference shown in the above table, is dependent on the wind and not on the local effect of cloud and rain. And this objection may be admitted, in so far, that the temperature effect is not strictly of local origin. But the heat of the westerly wind, itself, is simply owing to the dryness of the adjacent tract For the heaviest rain that falls in the North-West Provinces in July and August is brought by westerly winds, which come from the Arabian Sea. These blow across Rajputana and Central India, the surface of which has then been cooled by the rain already fallen; and under these circumstances westerly winds are cool winds. The supposed objection, therefore, has no real validity.

The above data show that, both in the dry season and the rainy season, the anomalous temperature of the air depends principally on the cloud and rainfall; the effect of both these being to lower the temperature; in the case of the former, by obscuring the sun, in that of the latter, by the evaporation which ensues, and which reduces the temperature of both the ground and the air in contact with it, not only on the days of rainfall, but generally for one or two days afterwards. In November and December, however, when the temperature is falling rapidly, the influence of these agents is relatively less powerful, and the final result is of a different character. In these months, the total loss of heat by radiation from the ground, under a clear sky, exceeds the total gain from solar radiation under similar conditions; and, accordingly, the presence of cloud, which tends to arrest both, results in maintaining the temperature above the average. The winds, which bring the vapour to form the cloud, also contribute to maintain a high temperature; since they come from the seas around India, the temperature of which, at this season, is higher than that of the land. It is true that, in the cold season, as in the hot dry season, a warm period due to southerly winds and cloud, if rain falls, is almost always followed by a few days of excessive cold, as in the dry season; but, on the whole, the former effect is preponderant; and in November and December accordingly, the rule which holds good for the greater part of the year is reversed, cloudy and rainy months having a positive, and clear dry months a negative, temperature variation. This is well shown by the following table, which gives the mean temperature anomaly, cloud proportion, rainfall and number of rainy days of the six Punjab stations, Dera Ismail Khan, Rawalpindi, Sialkot, Lahore, Ludhiana, and Delhi, for November and December, in each of the five years 1875-79:—

Months.		1875.	1876.	1877.	1878.	1879.
November,	Temperature anomaly.	+1·0	+0·2	+4·0	—0·6	—2·5
	Cloud proportion.	2·29	2·19	3·64	0·22	0·61
	Rain: inches.	0·15	0·45	2·08	...	...
	Rainy days.	0·8	0·8	2·7	...	...
December,	Temperature anomaly.	+2·1	+1·0	+0·7	—0·5	—1·0
	Cloud proportion.	2·51	2·23	5·27	0·94	1·80
	Rain: inches.	1·03	0·05	3·90	0·10	0·70
	Rainy days.	2·2	0·2	4·7	0·5	1·8

Hence, it appears that, the months of November and December have a temperature above the average in cloudy years, below it in clear and serene seasons. It is hardly to be expected that the anomalies of temperature and cloud should show a more definite numerical relation than is exhibited in the table, since the actions concerned are somewhat complicated; and

while the influences of cloud and of the wind on which the cloudiness depends, are such as tend to raise the temperature, the evaporation of rain, as already pointed out, tends to lower it. That the preponderating agency is that of nocturnal radiation, receives confirmation from the figures in the following table, which is based on the register of the same six stations in the Punjab. This shows, together with the temperature anomaly of the months in question, the anomaly of the nocturnal depression of the thermometer for terrestrial radiation, and also that of the solar thermometric excess. The signs *plus* and *minus* indicate the magnitude of the effect in each case, *i. e.*, the variations of these temperature differences, as compared with the corresponding respective averages. A + sign indicates a greater nocturnal depression (below the air temperature) than the average, or a greater excess of the solar thermometer (above the air temperature) and *vice versâ*. The comparison is restricted to the last three years, for which alone we have comparable observations of the nocturnal radiation.

Months.	1877.			1878.			1879.		
	Air temperature anomaly.	Nocturnal depression anomaly.	Solar excess anomaly.	Air temperature anomaly.	Nocturnal depression anomaly.	Solar excess anomaly.	Air temperature anomaly.	Nocturnal depression anomaly.	Solar excess anomaly.
November, ...	+4·0	—1·6	—2·5	—0·6	+1·0	—0·7	—2·5	+0·7	+1·7
December, ...	+0·7	—1·7	—3·6	—0·5	+1·0	+1·4	—1·0	+0·8	+0·2

In every case, the air temperature anomaly has the opposite sign to that of the nocturnal depression, indicating that, when the loss of heat by nocturnal radiation is less than usual, the mean air temperature of the month (not of the night only) is above the average; and that when the nocturnal radiation is greater than usual, the mean air temperature is below the average; and this action is sufficient to outweigh the varying intensity of solar radiation.

It is only in the months of November and December, that the air temperature shows, distinctly, the predominant influence of nocturnal radiation, as affected by cloud. In October, solar radiation on the one hand, and evaporation on the other, seem to be more effectual in influencing the air temperature than the variations of nocturnal radiation; and thus, an excess of cloud is more frequently accompanied with a nega-

tive than a positive anomaly of air temperature. In January, the two kinds of action are more nearly balanced. This conclusion is illustrated in the following table, which exhibits the mean results of the six Punjab stations above enumerated in the five years 1875-79.

Months.		1875.	1876.	1877.	1878.	1879.
January, ..	Temperature anomaly.	—0·2	+0·7	+0·9	—0·8	+2·2
	Cloud proportion.	2·71	3·21	5·55	3·34	2·12
	Rain in inches.	0·09	0·68	2·54	0·62	0·10
	Rainy days.	0·7	1·3	4·3	1·3	0·2
October, ..	Temperature anomaly.	—2·8	—1·8	—0·3	+2·6	+0·6
	Cloud proportion.	0·63	2·08	2·71	0·47	0·42
	Rain in inches.	0·83	1·13	1·88	0·13	0·13
	Rainy days.	1·5	2·8	2·7	0·2	0·2

In any discussion of the causes which affect the temperature and modify the temperature anomaly of any given month or other short period, there is one important circumstance which must not be overlooked, although it is rarely referred to in the discussion of such questions. This is the temperature of the ground. It seems to be established by the observations of ground temperature, which have been made at Calcutta during the last two years, that the ground, to a considerable depth, serves as a reservoir of heat, the slow emission of which probably exercises an appreciable influence on the temperature of the lowest air stratum; and this will be more especially the case in a region such as the Punjab, where (in the cold season more particularly) the air has but little movement of translation. This effect becomes apparent, when two or three months, in succession, are characterised by abnormal dryness or its opposite, by the gradual exaggeration of the temperature anomaly, whether positive or negative, in the successive months. Of this phenomenon, examples have been given in the table on a previous page, more especially in the case of June, July, and August 1877, and March, April, and May 1879, in the North-Western Provinces; and many others may be noticed, in glancing through the tables of temperature anomalies in the annual meteorological reports. On the other hand, to the same modifying influence, may probably be traced in a large measure, the fact that homonymous months may be very similarly characterised by unusual dryness or dampness in two different years, and yet there may be a considerable difference in the temperature anomaly, if the period of a month or two immediately preceding has been of a different character in the two years compared. An instance of the kind has occurred during the present year (1880), which will be duly noticed in the annual report for that year.

To sum up the principal conclusions arrived at in the foregoing discussion. At all times of the year, the air temperature is dependent, 1st, on the quantity and intensity of the sunshine; 2nd, on the terrestrial radiation, which is predominantly active as a cooling action only at night; and 3rd, on the evaporation of rain. The influence of cloud, which checks both solar and terrestrial radiation, is such as, in conjunction with the rainfall, (which varies more or less *pari passu* with it), to lower the temperature from February to October, to raise it in November and December. On the mean of the whole year, therefore, cloud and rain exercise a preponderating cooling influence. The immediate effect of these agencies is, however, much modified by the condition of the ground, which acts as a reservoir of heat, and thus renders the temperature of any moderate period, to a certain extent, dependent on the condition of the period preceding it.

In general, and with but few and temporary exceptions, the pressure of the whole of India, was, throughout the year 1879, as persistently below the average, as it had been above it during the two years ending with August 1878; the depression, which set in in September 1878, having been almost continuous up to, at least, the end of 1879. As in the case of the preceding and opposite anomaly, this condition was evidently not due to the reduced density of the lower atmosphere, except partially in the months of April and May. For, the density of the lowest stratum, and therefore its static pressure, was above the average in March, and, in most cases, from June to the end of the year; on the mean of the whole year, the pressure of this stratum was in excess; as might have been expected from the fact, that its mean temperature was below the average; but this excess was more than neutralised by the deficiency of pressure of the higher strata, and the total pressure was in defect in all months, excepting July and partially in March, June, September, and November. Thus, then, we have, in 1879, conditions precisely the reverse of those obtaining in 1877 and the earlier part of 1878, when the temperature of the lower stratum being excessive, was accompanied by a density less than the average; but this anomaly was neutralised and outbalanced by the excessive pressure of the elevated strata.

Is this contrast of conditions in the lower and higher atmospheric strata, thus doubly illustrated in the barometric features of the last three or four years, a law of general incidence? and is it traceable to the play of physical processes which accompany these abnormal conditions? There are many circumstances which lead me to think this probable.

I must premise that the opposition of conditions, the coincidence of a decrease in the density of the higher with an increase in that of the lower strata of the atmosphere, and *vice versâ*, so far from being an extraordinary feature of our atmosphere, is one of regular annual occurrence in India. In Central India, May, in the North-Western Provinces either May or June, (according as the rains begin early or late), is the hottest month in the year. The first fall of rain brings about a rapid fall of temperature and with it a corresponding increase in the density of the lower air stratum; but notwithstanding this increase of density, there is no corresponding increase in the total pressure of the atmosphere. On the contrary, the minimum pressure does not occur until some weeks later; and, at the hill-stations, from 4,500 to 7,000 feet, above the plains, the pressure of the atmosphere continues falling till July. Hence, it must be concluded that the setting in of the rains is accompanied by a decrease in the static pressure of the higher strata, which compensates, or more than compensates, the increased density of the lower. The following data serve to illustrate this:—

	Hoshangabad and Pachmarhi.			Roorkee and Chakrata.		
	May.	June.	July.	May.	June.	July.
Temperature of lower station,	92·7°	88·1°	79·5°	87·7°	90·2°	84·6°
Pressure of lower station, ...	28·675″	28·584″	28·592″	28·754″	28·615″	28·617″
Barometric weight of intervening air stratum, ...	2·340″	2·332″	2·367″	5·545″	5·462″	5·499″
Pressure of upper station, ...	26·335″	26·252″	26·225″	23·209″	23·153″	23·118″

On the other hand, the months in which the temperature is lowest on the plains, and the lowest stratum of air, on the average, most dense, are December and January; but at the level of the Himalayan hill-stations Murree, Chakrata, Darjeeling, &c., the pressure in December is lower than, in November, and in January still lower; and at that of Leh it falls from October to February, in which month, according to our present data, occurs the absolute minimum pressure of the year. These facts seem to point to the conclusion that, at some greater elevation, (perhaps at that of the Karakoram plateau), the annual oscillation of pressure is probably approximately the reverse of that which takes place on the plains of India, the maximum occurring when, in the lower atmosphere, the summer monsoon is at its height; and the minimum in January or February.

In seeking the physical explanation of these changes, it may be postulated at the outset, that the variations in the density of the atmosphere with which we have to deal, whether those of the higher or lower strata, are mainly due to variations of mean temperature; to which, indeed, the influence of variations in the quantity of vapour constituent, (regarded as replacing dry air of the same tension), is of quite subordinate importance. I have shown elsewhere, that the reduction of barometric weight, which a column of air, 7,000 feet high, undergoes from January to July, over the plains of Bengal, is due to the rise of temperature in the proportion of $\frac{11}{12}$, to only $\frac{7}{12}$, consequent on the replacement of dry air by vapour; and the relative importance of temperature may be shown more in detail and with more direct reference to the present discussion, by the following comparison of the temperature and barometric anomalies, extracted from Tables XI and VIII in the Report on the Meteorology of 1879.

	Chakrata and Roorkee		Ranikhet and Bareilly.		Pachmarhi and Hoshangabad.	
	Barometric anomaly.	Mean temperature anomaly.	Barometric anomaly.	Mean temperature anomaly.	Barometric anomaly.	Mean temperature anomaly.
January	— 007	+2·0	—·010	+2·7	—·002	+0·3
February	—·019	+1·3	—·014	+1·5	+·011	+0·9
March	+·011	—0·4	+·007	—0·4	+·014	—1·7
April	—·035	+3·6	—·038	+3·5	—·021	+0·8
May	—·044	+4·3	—·048	+5·4	—·015	+0·7
June	+·055	—2·6	+·046	—1·6	+·014	—1·8
July	+·012	—1·5	+·044	—1·9	+·001	+0·4
August	+·031	—2·0	+·030	—1·6	+·014	—1·3
September	+·024	...	+·017	—0·1	+·021	—1·1
October	+·009	...	+·002	—0·4	+·009	—1·6
November	+·067	—2·5	+·037	—2·7	+·034	—1·9
December	+·028	—1·3	+·015	—2·4	+·024	—5·1

Considering the character of the data, that they can be regarded, at best, as affording rough approximations to the mean condition of the atmospheric stratum dealt with, as regards both density and temperature, and that variations of superincumbent pressure and humidity are entirely left out of account, the opposite march of temperature and density, exhibited by this table, is sufficiently striking, and affords a very satisfactory confirmation of the fundamental postulate. With respect to the higher atmospheric strata, direct evidence is of course wanting; but it may fairly be inferred that the variations of temperature therein, are at least as influential, relatively, on the density, as in the lower atmosphere here dealt with.

If these views be admitted, the frequent concurrence of a diminished density in the lower strata with an increased density of the higher, and *vice versâ*, resolves itself into this, that the temperature of the higher and lower strata tend to vary at opposite directions, the one being in excess when the other is in defect; and the discussion of the problem resolves itself into that of the processes by which the temperatures of the lower and higher strata are respectively influenced.

The conditions which principally affect variations of temperature on the land, (in India) have already been discussed. It has been shown that the most influential of these are the presence or absence of cloud and the evaporation of rainfall. That, excepting in one or two of the winter months, an increase of cloud is accompanied by a reduction of temperature, and, at all seasons, without exception, the evaporation of rain produces a similar effect. But the effect of cloud and the precipitation of rain, on the temperature of the higher atmospheric strata, must be of precisely the

opposite character. In the first place, the very condensation of the vapour which forms them, sets free a quantity of latent heat, which retards the fall of temperature, that would otherwise take place in every ascending current; and such currents exist in the large majority of rain clouds, if not in all; and, secondly, the solar radiation, which the cloud stratum shuts off from the earth, must be partly absorbed in the evaporation of the cloud surface.

Hence, there seems to be much probability, that the temperature anomalies of the higher strata of the atmosphere, as a general rule, are of the opposite character to those shown by our land observatories at low levels; but if so, the elevation at which this law holds good, must be considerably greater than that at which the hill observatories of the Himalaya afford the means of verifying it.

VII.—*Description of a rain-gauge with evapometer, for remote and secluded stations.* By H. F. Blanford, F. R. S., *Meteorological Reporter to the Government of India.*

(With Plate XV.)

[Received 25th March 1881. Read 6th April 1881.]

In the autumn of 1879, I received, through the Government of India, a description and sketch of a rain-gauge proposed by Mr. Hutchins, Assistant Conservator of Forests in Mysore, for the purpose of collecting the rainfall at remote and rarely visited stations, such as in certain forest tracts, and other places, where there are no permanent residents, and which can be visited only at longer or shorter intervals. There are, it is true, several forms of rain-gauge provided with mechanism for the purpose of registering the fall, but these are expensive at the outset, and if, as frequently happens, the mechanism becomes deranged, the gauge must as a rule be sent to a Presidency town or some large Government workshop for repair; involving further expense and an interruption of the record, at a time, perhaps, when it is most inconvenient.

Mr. Hutchins' idea was to provide a gauge of sufficient capacity to hold the rainfall of a month or even longer period, which might be measured on periodical visits to the station; and since, under such circumstances, there must always (except in prolonged wet weather) be an appreciable loss by evaporation, he proposed to use an evapometer with the gauge, which should show the evaporation in the intervals of the measurement; which quantity, being added to the rainfall collected and measured, would give the total fall in the interval.

The instrument proposed by Mr. Hutchins consisted of two cylindrical vessels of equal size, *viz.*, 8 inches diameter, one three times as deep as the other,* which were to be buried side by side in the ground. The deeper which was to receive the rain, was surmounted by a funnel of the usual character, also 8 inches in diameter; having a small hole at the bottom, through which the rain should run into the receiver. The other, which was to serve as an evapometer, was closed by a conical cover with a small hole at the apex; and over this was supported a second conical cover of the same diameter, leaving an interspace of about 1 inch, through which the vapour might diffuse and escape around the edges. Both were to be padlocked, to prevent any vitiation of the results, by unlicensed interference, on the part of any too curious enquirer.

Before having the instrument constructed, I slightly altered the design, by reducing the size of the outer or protecting conical cover of the evapometer, and surrounding both the receiving cylinders with a second outer cylinder, in order to protect the upper part of the receiver more effectually against direct heating by the sun. The instrument, thus modified, is represented in the accompanying figure; it was made at the Mathematical Instrument department and in March 1880 was set up at the Alipore observatory; (buried in the ground, in the immediate neighbourhood of the 5 inch Symons gauge, which serves for the daily measurement of the rainfall.

At the beginning, 4 inches of water, as measured in the measure-glass, for the 8-inch gauge, was placed in the evapometer, and an equal quantity in the receiver of the gauge, (in order to provide for evaporation in anticipation of rain). At the end of a month, the water in both cylinders was measured; and the difference taken as representing the rainfall of the period. Four inches of water was then replaced in each cylinder, and the instruments were closed and left untouched for another month.

Thus the rainfall collected in the new gauge was measured once a month only, while that in the smaller Symon's gauge was measured daily; and as this comparison was carried on throughout the rains and the subsequent fine and cold season, the new form of gauge has been fairly tested. The results are given in the following table; the rain of both gauges having been carefully measured, and the accuracy of the measuring-glasses verified by weighment of their contents. The small corrections, resulting from the verifications, have been applied to the figures in the table.

* In the drawing sent one was 20 inches the other about 7 inches in height.

Comparative table of the rainfall at Alipore observatory, as measured daily in a 5-inch gauge, and monthly in an 8-inch gauge with evapometer.

Month.	Actual Measurement, Monthly.			Corrected difference—rainfall.	Total of daily measurement.	Error of monthly measurement.
	Evapometer.	Gauge.	Difference.			
	Inches.	Inches.	Inches.	Inches.	Inches	Inches.
April	3·08	5·91	2·83	2·88	2·01	+0·87
May	3·37	8·90	5·53	5·63	4·88	+0·75
June	3·68	18·70	15·02	15·31	14·78	+0·53
July	3·58	17·03	13·45	13·71	13·46	+0·25
August	3·74	17·18	13·44	13·70	13·33	+0·37
September	3·63	16·95	13·32	13·57	13·17	+0·40
October	3·70	8·97	5·27	5·37	5·11	+0·26
November	3·62	3·96	0·34	0·35	0·02	+0·33
December	3·61	4·05	0·44	0·45	0·15	+0·30
January	3·64	3·90	0·26	0·26	...	+0·26
Total	...	...	...	71·23	66·91	+4·32

The quantity shown by the new gauge is therefore constantly in excess; and there can be little doubt that this is owing to the evaporation from the evapometer being greater them from the gauge. Nevertheless for a rough measurement of the rainfall, in the rainy season, the instrument may serve fairly enough; and I think that one or two slight alterations may very much improve its working.

It is not difficult to decrease the evaporation in the evapometer by increasing the size of the outer cone, and a few trials will show what dimensions give the best result.

VIII.—*On some Lepidopterous Insects belonging to the Rhopalocerous Genera* Euripus *and* Penthema *from India and Burmah.*—*By* J. Wood-Mason, *Deputy Superintendent, Indian Museum, Calcutta.*

[Received 5th February;—Read 6th April, 1881.]

(With Plates III & IV.)

1. Euripus consimilis. Pl. IV, Fig. 3.

Diadema (*Hestina*) *consimilis*, Westwood, Gen. Diurn. Lep., vol. ii, p. 281, note, ♀.

A fine specimen of the female of this striking species taken in the autumn of the past year in the Thoungyeen forests, British Burmah, by

Captain C. T. Bingham has been courteously lent to me by my friend Captain G. F. L. Marshall for figuring along with its South-Indian representative.

2. Euripus consimilis, var. meridionalis. Pl. IV, Fig. 2.

♀. Differs from the preceding in having the markings of the upper side in all the wings straw-coloured instead of pure and dazzling white; the basal two-thirds of the long streak in the interno-median space, as also the streak in the sutural area, of the anterior wings obsolete, and the submarginal short streaks at the apex of the same wings as prominent as those which succeed them; and all the venation of the posterior wings much more broadly dark-bordered, with the black patch referred to in the original description of *E. consimilis* consequently much less defined.

All the wings are bright carmine at their insertion on the under side just as in typical *E. consimilis*.

Hab. Trevandrum, Travancore, South India.

Specimens of the following species were received in the same collection with the preceding:—*Danais grammica*, Boisd. (= *D. ceylonica*, Felder); *Euploea core*, Cramer, *E.? montana*, Felder; *Mycalesis anaxias*, Hewitson, *M. junonia*, Butler; *Melanitis tristis?* Felder, *M. leda*, Linn.; *Parantirrhœa Marshalli*, gen. et sp. nov., W.-M.; *Zipoetes* saitis*, Hew.; *Elymnias caudata*, Butler; *Discophora lepida*, Moore; *Cirrhochroa lanka*, Moore; *Cynthia erota*, Fabr.; *Messaras erymanthis*, Drury, var. without spots on the apical black of the anterior wings; *Neptis varmona*, Moore; *Abisara prunosa*, Moore; *Lycaena ethion*, Doubld. and Hew., *L. decidea*, Hew.; *Scolitantides nyseus*, Guér.; *Myrina atymnus*, Cr.; *Pieris remba*, Moore; *Tachyris paulina*, Cr.; *Eronia valeria*, var. *pingasa*, two fine females; *Hebomoia glaucippe*, Linn.; *Papilio eurypylus*, Linn., *P. antiphates*, Cr., *P. aristolochiae*, Fabr., *P. jophon*, Gray, *P. dravidarum*, W.-M., a fine series of males, *P. polymnestor*, Cr., and *Ornithoptera pompeus*, var, *minos*, Cr.

3. Penthema lisarda. Pl. III, Fig. 1.

Numerous specimens of both sexes of this well-known species are in the Museum from the Sikkim Hills, the Naga Hills, and the southern slopes of the Khasi Hills (Sylhet).

The setose clothing at the base of the posterior wings between the median and submedian veins is scanty and cretaceous-white like the markings.

The specimen figured is a male.

* '*Zibœtes*' or '*Zipœtes*' (Ζιβοίτης vel Ζιποίτης), not '*Zipœtis*', nor '*Zipœtis*'.

4. Penthema darlisa. Pl. III, Fig. 2.

P. darlisa, Moore, Proc. Zool. Soc. Lond. 1878, p. 829, ♂ ♀.

Both sexes of this distinct species were described by Mr. Moore from specimens in my collection obtained in April at Meetan in Upper Tenasserim at an elevation of 3,000 feet.

Two specimens of the male out of many captured in March last by Captain Bingham in the Thoungyeen forests have been presented to the Museum by Captain Marshall.

This species also differs from *P. lisarda* in its broader wings, a character not mentioned by Moore in his description of the species.

The scanty setose clothing of the base of the posterior wings is fuscous.

5. Penthema Binghami, n. sp., Pl. IV, Fig. 1.

♂. Differs from *P. darlisa* in having fully the basal half (including the same extent of the abdomial area in the posterior wings) of all the wings devoid of markings, the submarginal and discal series of spots alone remaining in both pairs; these two series of spots are bluish-white in the anterior wings and of a beautiful straw-yellow in the posterior wings; they are, in fact, of the same colour, size, and shape as in *P. darlisa*; but *the inner of the latter two series is closer to the outer*, which is placed at the same distance from the external margin of the wings. The wings are all also somewhat narrower than in *P. darlisa*, thus approaching those of the typical species; and the posterior pair are furnished on the basal half, between the median and submedian veins and in the discoidal cell, with a thick and conspicuous furry clothing of rich dark fuscous setae exactly matching the dark ground-colour of the wings and the abdomen of the insect in shade, which setose clothing is so scantily developed as to be quite inconspicuous in both the previously described species. The whole body, too, but especially the abdomen, is much darker-coloured than in either of them. Shadowy traces of the lost spots are faintly discernible on the anterior wings.

Hab. The Thoungyeen forests, British Burmah, where a single specimen was obtained in March last by Captain Bingham, after whom, at Captain Marshall's suggestion, I have much pleasure in naming it.

Explanation of the Plates.

Plate III.

Fig. 1. *Penthema lisarda*, Doubleday, ♂.
Fig. 2. *Penthema darlisa*, Moore, ♂.

Plate IV.

Fig. 1. *Penthema Binghami*, n. sp., ♂.
Fig. 2. *Euripus consimilis*, var. *meridionalis*, ♀.
Fig. 3. *Euripus consimilis*, Westwood, ♀.

IX.—*On the Voles* (Arvicola) *of the Himalayas, Tibet, and Afghanistan.* —*By* W. T. Blanford, F. R. S., &c.

[Received 6th May 1881; Read 1st June 1881.]

(With Plates I and II.)

Within the last few years several species of *Arvicola* have been described from the Himalayas and from the country north of the range; and quite recently two additional forms have been procured from the same region, and two others have been found in the collection of the East-India Museum—one from the Himalayas, the other from Afghanistan. I propose in the present paper to give an account of all the Himalayan, Tibetan, and Afghan Voles hitherto described, so far as I am acquainted with them. I also propose to describe and figure the molar dentition of all available forms. I may add that I have had the advantage of examining the original specimens of all the species described.

There is much reason to doubt whether any kind of *Arvicola* has hitherto been described within the limits of the Oriental Region proper*, the forms occurring on the Himalayas being found at an elevation where there is either an intermingling of Oriental and Palæarctic types, or where the latter prevail—the rodents, undoubtedly obtained from the plains of India, that have been referred to the genus *Arvicola* being really true Murinæ, without the peculiar dental organization of the Voles. Such is especially the case with *Arvicola bengalensis* and *A. indica* of Gray and Hardwicke's 'Illustrations of Indian Zoology,' both of these forms having been shown to belong to the Murine genus or subgenus *Nesokia*†.

The earliest description of a Himalayan *Arvicola*, so far as I am aware, was that of *A. roylei*, by Dr. Gray‡, 1842. The same animal was

* In Blyth's 'Catalogue of the Mammalia in the Museum of the Asiatic Society,' Calcutta, a stuffed skin of *Arvicola roylei* is included, and said to have been obtained from Pind Dádun Khán, in the Punjab. This specimen was presented by Mr. Theobald in 1853, according to the catalogue; but it is remarkable that no reference is given, and that the species is not mentioned in either of the two lists of specimens from Pind Dádun Khán and other places presented to the Society's Museum by Mr. Theobald in 1853 (J. A. S. B. 1853, xxii. pp. 410, 580). The specimen could not be found lately, when a search was made for it at my request. I have no hesitation in considering that either the identification or the locality is open to grave question, and in rejecting the evidence as for the present in need of confirmation.

† Blyth. J. A. S. B. 1863, xxxii. p. 328; Anderson, J. A. S. B. 1878, xlvii. pt. 2, pp. 214, 221, 227.

‡ For references see synonymy of species.

mentioned at p. lxviii of the "Memoir on the Mammalogy of the Himalayas," by W. Ogilby, published as an appendix in Royle's 'Illustrations of the Botany &c. of the Himalayas,' and the dried skin was said to be undistinguishable from that of *A. arvalis*. In the same memoir, on the preceding page (lxvii), another short-tailed rodent is said to have been observed by Hodgson and Herbert, and supposed to be a Lemming. The animals noticed were doubtless *Arvicolæ*, no Lemming having ever been found as yet in the Himalayan area. The original specimen of *A. roylei* has been preserved in the British Museum, and was originally procured by Royle, it is said from Kashmir.

The next notice in order of date was by Mr. Hodgson, who, in 1849, recorded the occurrence of an Arvicoline animal in Sikkim. For this form, which he considered the type of a new genus, he proposed the name *Neodon sikimensis*. As will be shown presently, the genus cannot be maintained as distinct from *Arvicola*, although it forms a well-marked section, distinguished by its dentition. In 1863 Mr. Blyth proposed a third genus *Phaiomys*, for a species, which he named *Ph. leucurus*, brought by Mr. Theobald from the banks of the Tsomoriri, in Western Tibet. The reasons assigned for the establishment of the genus, namely, that the Tibetan form is more robust and has a well-developed thumb and nail to the fore foot, appear to have been suggested by comparison of an abnormally large individual with but one or two species of *Arvicola*, since many Voles are equally robust, and numerous species possess a well-marked thumb furnished with a nail*. The specific name also, having been preoccupied, has been changed to *A. blythi*.

The three species thus described were all enumerated in Blyth's 'Catalogue of the Mammalia in the Museum Asiatic Society,' published in 1863, and two of them were described in Jerdon's 'Mammals of India.' The third species, *Phaiomys leucurus*, was noticed only, not described, as the trans-Himalayan region was not comprised in the countries the animals of which were included by Jerdon in his fauna. No further addition was made to the number of Arvicoline animals from the Himalayas for some years, until, in 1872, A. Milne-Edwards described a new species, *A. melanogaster*, brought by Père David from the eastern portion of the Himalayan

* See 'Scientific Results of the Second Yarkand Mission,' Mammalia, pp. 39—43. There are three serious misprints on p. 39. The first, 15 lines from the bottom, consists of the omission of the words "of the thumb" after "ungual phalanx." The second is in the measurements: "Do. of fore foot and claws" should be "Length of fore foot" &c.; as it stands it appears to be the breadth. The third is the worst of all: I wished to point out that if the genus *Phaiomys* be retained, the correct spelling is *Phæomys*. The printer has made nonsense of this by putting *Phaiomys* in both instances.

tract. Another form was procured by Dr. Stoliczka on his last journey, when attached to Sir D. Forsyth's mission to Eastern Turkestan. This Vole was described by myself, in 1875, as *A. stoliczkanus*. In 1878 I received from my friend Mr. A. B. Wynne, of the Geological Survey of India, a skin and skull of an *Arvicola* obtained by him at Mari or Murree, in the hills north of the Punjab. On comparing this specimen with the description of *Arvicola roylei*, I found considerable similarity but there appeared to be a difference in the characters of the posterior upper molar teeth. This distinction alone, however, I thought insufficient without further comparison; and I therefore waited until I returned to England last year, when I compared the Murree animal (of which, in the meantime, Mr. Wynne had procured for me additional specimens) with the type of *A. roylei*, and ascertained that the two were distinct. At the same time Mr. Thomas found an example of another species from Kumaon in the specimens of the East-India Company's Museum, which had just been made over to the British Museum; and Dr. Scully brought several skins and spirit-specimens of yet another form from Gilgit. All these forms appeared to be undescribed. One more skin in the East-India Company's collection, procured by Griffith in Afghanistan, and hitherto supposed to be an imperfect specimen of *Mus mettada*, proved, on the skull being extracted, to be an *Arvicola*. There does not seem to be any definite character by which, judging from dried skins, this form can be distinguished from the Mongolian *A. mandarinus*; and although it is by no means improbable that fresh specimens may show the existence of specific distinction, it does not appear advisable to propose a new name for the Afghan specimen on the evidence of a single dried skin.

All of these Voles are fairly distinguishable by their dentition, and all when placed together, can be recognized by slight differences of coloration, and frequently by the relative proportions of the ears, feet, toes, or tail; but in descriptions it is very difficult to explain small distinctions of colour due to different shades of brown more or less mixed with grey, black, red, or yellow.

As is well known, the genus *Arvicola* is distributed throughout nearly the whole of the Palæarctic and Nearctic Regions, and comprises many species. The classification of these forms has proved a by no means easy problem, and various plans have been proposed; the best known and simplest of these appears to be that of Blasius*, some form of which has been adopted by most modern writers. This system depends chiefly on the

* München. Bull. Akad. 1853, col. 257; Münch. Gel. Anz. xxxvii. 1853, col. 105. Säugthiere Deutschlands, pp. 333—336 &c. The first sketch of the scheme was in Keyserling and Blasius 'Wirbelthiere Europa's (1840), p. 40.

characters of the molar teeth, and especially on the number of prisms, triangles, or spaces on the crowns, and the number of external and internal salient angles on the sides of each tooth. In estimating the number of prisms or spaces (Schmelzschlingen), those on different sides of the tooth are counted separately, unless they are exactly opposite to each other; whilst in estimating the salient angles, all that form a distinct fold on the outside of the tooth are enumerated, although, when the teeth are but little worn, such angles are not conspicuous on the crown. As in most other systems of biological definition, it is impossible to obtain absolute uniformity, since it is often a question whether the spaces on the crown of the tooth enclosed by angles on opposite sides correspond or alternate, and, consequently, whether they are to be counted as two or as one. An instance is afforded by the lower molar teeth of *A. sikimensis* (see Plate I. fig. A). In the first tooth it is difficult to say whether the number of spaces or prisms should be counted as 7, 8, or 9, the latter number, however, would best agree with the general practice; but in the hindmost lower molar we might by this plan count 5 prisms, whereas, in accordance with the usual plan, the number is but 3. To avoid this difficulty some writers enter into details on the construction of the separate teeth*, but this makes the description rather long.

In counting the external and internal angles also, it is difficult at times to say whether a mere convexity, that does not form a distinct angle, or a comparatively rudimentary fold, such as is frequently found in the anterior portion of the first lower molar, should be included or not; and there are sometimes individual variations within the limits of the same species. Good figures are the only safeguards against misunderstanding.

The European forms are thus divided by Blasius:—

I. *Molars furnished with roots in the adult animal.*

A. Hypudæus, Illig.

First lower molar with 7 spaces, 4 outer and 5 inner angles; second lower molar with 3 divided spaces and 3 internal and external angles; second upper molar with 4 spaces, 3 outer and 2 inner angles. The interparietal bone throughout the whole breadth of its hinder margin raised in a flat convexity, a pointed projection in the middle of the bone in front, and a long gradually diminishing point on each side.

The European forms are *A. glareolus* and *A. rutilus*.

II. *Molars rootless.*

B. Paludicola.

First lower molar with 7 spaces, 4 outer and 5 inner angles; second lower molar with 5 simple spaces and 3 internal and external angles; second

* For instance, Coues and Allen, 'Monograph of North-American Rodentia,' *Muridæ*, genus *Arvicola*.

upper molar with 4 spaces, 3 outer and 2 inner angles. Interparietal bone with the hinder edge raised in the middle, concave towards the sides, with a projecting point in the middle in front, obliquely truncated on the sides, and terminating in long points projecting outwards and backwards. Dorsal surface of body grey of various shades to brownish black.

This comprises *A. amphibius*, *A. nivalis*, *A. ratticeps*, and *A. brandti*.

C. Agricola.

First lower molar with 9 spaces, 5 outer and 6 inner angles; second upper molar with 5 spaces, and 3 angles both inside and outside; second lower molar with 5 spaces and 3 angles on each side. The interparietal elevated into a flat convexity along the whole width of the hinder margin, produced into an angle in front, and cut off almost at a right angle at the sides. The dorsal surface of the body dark blackish, brownish grey.

The only European form is *A. agrestis*.

D. Arvicola.

First lower molar with 9 spaces, 5 outer and 6 inner angles; second upper molar with 4 spaces, 3 outer and 2 inner angles; second lower molar with 5 simple spaces and 3 angles, both outside and inside. Interparietal convexly swollen throughout the whole breadth of the hinder margin, produced in front into a middle point, attenuate at the sides and sharply truncate, with a short oblique pointed projection directed outwards and backwards. Dorsal surface grey of various shades.

This, the typical form, is again divided into:—the Long-eared Voles, *Arvicola*—with 8 mammæ (4 on the breast, 4 on the groin), the planta with 6 distinctly separate roundish tubercles, the ear projecting beyond the fur, and the eye rather large; and the Short-eared Voles, *Microtus*—with only 4 mammæ, all on the groin, the planta with 4 tubercles, ears concealed by the fur, and eye very small. The first comprises the European *A. campestris* and *A. arvalis* and several Asiatic species, such as *A. socialis*, *A. saxatilis*, and *A. gregalis*; the second *A. subterraneus* and *A. savii*.

The American species have been similarly classified by Baird* and Coues†. The only European section said to be represented in America is the *Hypudæus* of Keyserling and Blasius‡, for which, as it is not the original *Hypudæus* of Illiger§, Coues has proposed the name *Evotomys*. It appears probable that this name must be adopted for the section of

* Mammals of North America, pp. 509–553 (1857).

† Monograph of North-American Rodentia, pp. 152 &c. (1877).

‡ Wirbelthiere Europa's, p. 34.

§ Prod. Syst. Mam. Av. p. 87.

Arvicolæ with rooted molars in the adult state. By both Baird and Coues *Evotomys* and *Hypudæus* are classed as a distinct genus. The true *Arvicolæ* of North America are divided into four subgenera. As none of these are Himalayan, it is unnecessary to specify them more fully. One of these sections (*Hemiotomys* of Baird, *Myonomes* of Coues), like the European *Agricola* and the Himalayan *Neodon*, has 3 salient angles on the inside of the second upper molar; but it has a 7-spaced first lower molar with but 4 outer and 5 inner angles, instead of a 9-spaced tooth with 5 outer and 6 inner angles.

We may now return to the Himalayan and Tibetan forms. None, so far as I know, have rooted molars. I have not been able to examine all the species; but as there are no roots to the molars of *A. sikimensis*, *A. wynnei*, *A. blythi*, *A. blanfordi*, or *A. stracheyi*, I think it improbable that the allied forms should exhibit so remarkable a character. All but two *A. sikimensis* and *A. melanogaster*, have the first lower molar, as in Blasius's section *Paludicola* (and as in *Hypudæus* or *Evotomys*), with 7 prismatic spaces, and normally with 4 outer and 5 inner angles, a fifth more or less rudimentary outer angle in front being present in some forms. The second lower and the second upper molar have also the same structure as the corresponding teeth in European forms of *Paludicola*—the circumstance that in some forms there are but 3 double spaces in the second lower molar instead of 5 simple prisms being, in fact, of no structural importance since the difference depends on whether the angles on opposite sides of the tooth correspond or alternate; and there is every possible gradation between one condition and the other. The Himalayan species, with 7-spaced anterior lower molars, however, are divided into two groups by the structure of the hinder upper molar. In *A. stoliczkanus*, *A. stracheyi*, *A. roylei*, *A. blanfordi*, and *A. wynnei* this tooth terminates in a narrow elongate lobe, produced backwards in the direction of the row of teeth, and posteriorly destitute of salient angles; whilst in *A. blythi* and in *A. mandarinus* (?) the last upper molar terminates, as in *A. amphibius* and its allies, in a crescent or transverse lobe, with a well-marked internal salient angle. The latter two species appear to belong to the European section *Paludicola*; for the former I venture to propose a new section, *Alticola*, of which *A. stoliczkanus* may be considered the type. In this form and in the nearly allied *A. stracheyi* the structure of the last tooth is so peculiar that they certainly deserve distinction. There are two small external angles anteriorly and two posteriorly, the two pairs being separated by a deep sinus, and there are but two interior angles, both, however, much stronger than those on the outer side of the tooth. These two typical forms of *Alticola*, moreover, are well distinguished from the others by the absence of any claw to the thumb. Of the other three forms *A. wynnei* is distin-

guished by having on the upper molar two well-marked external and two equally strong internal angles on the front part of the tooth, and a third rounded external angle on the posterior lobe; whilst in *A. roylei* and *A. blanfordi* there is a nearer approach to the structure of *A. stoliczkanus*, but there are three internal angles on the last upper molar.

A. sikimensis and *A. melanogaster* differ from the other Himalayan forms, firstly by having a longer first lower molar with, normally, 9 spaces, though there are fewer in *A. melanogaster*, owing to some of the angles on opposite sides corresponding; secondly, in both the first and second upper molars having an additional internal angle posteriorly. In the characters of the first lower and second upper molars, *A. sikimensis* agrees with the European *A. agrestis*, the type of the subgenus *Agricola* of Blasius, and the second upper molar is similar to that in the American subgenus *Myonomes* of Coues (type *A. riparius*), of which the first lower molar has but 7 prismatic spaces; but the first upper molar in *A. sikimensis* is different from that in any known European or American form, though, as will presently be noticed, there is a Western-Asiatic species with somewhat similar dentition. There can be but little doubt that the distinction was observed by Hodgson; it was noticed by Jerdon, and appears to have been the principal character upon which Hodgson's genus *Neodon* was founded. Another peculiarity of *A. sikimensis*, also mentioned by the same naturalists, is that the posterior lower molars are scarcely narrower than the preceding tooth. In most species of *Arvicola* there is a much greater diminution in the breadth of the lower molars posteriorly.

Although I fully admit the value of the distinction, I fail to see that the presence of this additional angle in the first upper molar of *A. sikimensis* proves that that species is generically distinct from *A. agrestis* (*Agricola*). The difference appears to me of the same value* as that between *A. agrestis*, for instance, and *A. arvalis*; that is to say, the distinction is merely sectional or subgeneric. I consequently consider *Neodon* a section or subgenus of *Arvicola*.

The species from Moupin, in Eastern Tibet, called *A. melanogaster* by A. Milne-Edwards, has a somewhat peculiar dentition owing to so many

* In the 'Scientific Results of the Second Yarkand Mission,' Mammalia, p. 41, footnote, I remarked that the additional prism on the last upper molar of *A. saxatilis* and *A. brandti* appeared to be quite as important as the presence of one ridge more, than in other species, on the first upper molar of *A. sikimensis*. After a more extensive study of the genus than I had the opportunity of making in Calcutta, I prefer to modify this view. The last upper molar in *Arvicola* appears to be more variable than the first, and differences in the latter tooth appear therefore more important for purposes of classification than similar characters in the former. At the same time, I see no reason to alter the view I then expressed that such differences are not of generic value.

of the angles on opposite sides of the molars corresponding and the spaces on the crowns of the teeth being consequently double or diamond-shaped instead of triangular, and their number necessarily smaller. The number of internal and external angles in the first and second upper molars is however, the same as in *A. sikimensis*, and the species may therefore, for the present, be assigned to the same section.

The Western-Asiatic form above referred to as resembling *Neodon* in its dentition is *A. guentheri*, Danford and Alston*, from Asia Minor. The posterior inner angles on the first and second upper molars, judging from the figure given, are less developed than in *A. sikimensis* (but still they exist), and all the molar teeth, both in the upper and lower jaws, are very similar to those in the Sikkim species. Externally *A. guentheri* is very different, as it has but a rudimentary thumb without any claw, a much shorter tail, different coloration, &c.

The following table will show how the species of Himalayan and Tibetan Voles hitherto described may be distinguished by the characters of their teeth:—

I. The anterior upper molar has 3 angles inside and 3 outside; the second 2 inside and 3 outside. The anterior lower molar has normally 7 spaces.

A. The posterior upper molar terminates behind in a narrow process, prolonged backwards in the line of the jaw.—ALTICOLA.

a. The posterior upper molar has two strong internal angles and four weak outer angles, the two anterior of the latter widely separated from the two posterior.

α. The posterior lobe of the last upper molar behind the second inner angle is much less than half the length of the tooth ..... 1. *A. stoliczkanus.*

β. The posterior lobe of the last upper molar behind the second inner angle is half the length of the tooth..... 2. *A. stracheyi.*

b. The posterior upper molar has 2 internal and 3 external angles ..... 3. *A wynnei.*

c. The posterior upper molar has 3 angles on each side.

α. In the anterior lower molar the first inner angle is behind (proximal to) the first outer ..... 4. *A. roylei.*

β. In the anterior lower molar the first inner angle is in front of (distal to) the first outer ..... 5. *A. blanfordi.*

B. The posterior upper molar does not terminate behind in a narrow process prolonged backward in the line of the jaw.—PALUDICOLA.

a. The posterior upper molar has 3 external angles, and the first lower molar 4 ..... 6. *A. blythi*

b. The posterior upper molar has 4 external angles, and the first lower molar 5 ..... 7. *A. mandarinus?*

* P. Z. S. 1880, p. 62, pl. v.

II. The anterior upper molar has 4 angles inside and 3 outside; the second 3 inside and 3 outside; the anterior lower molar has normally 9 spaces.—Neodon.

A. The posterior inner angle in the two anterior upper molars is weaker than the other inner angles of the same tooth; the last upper molar ends with an internal projecting spur; the first lower molar has 6 well-marked angles inside ..... 8. *A. sikimensis.*

B. The posterior inner angle in both the anterior upper molars is usually equal or nearly equal to the others; the last upper molar, as a rule, does not terminate with an internal spur; the first lower molar has 5 well-marked angles inside ..... 9. *A melanogaster.*

N.B. The differences in the molar teeth of the last two species are not constant, and the distinction of the species depends on external characters.

In the next table an attempt is made to discriminate the forms by external characters:—

I. Thumb rudimentary and clawless.

Colour light ferruginous brown ..... 1. *A. stoliczkanus.*

Colour light brown, with a grey tinge ..... 2. *A. stracheyi.*

II. Thumb with a small claw.

A. Ears short, not projecting beyond the fur.

Colour dark rich brown, lower parts light brown .... 3. *A. wynnei.*

Colour yellowish brown, with a rufous tinge; lower parts buff ..... 4. *A. roylei.*

Colour earthy brown; lower parts whitish ..... 6. *A. blythi.*

Colour light greyish rufescent brown (isabelline); lower parts white ..... 7. *A. mandarinus;*

B. Ears projecting beyond the fur.

a. Ears only projecting by about one third of their length.

Colour dark yellowish or rufous-brown; underparts slaty grey; hind foot $\frac{9}{10}$ inch, ear less than $\frac{3}{4}$ inch long 9. *A. melanogaster*

b. Ears projecting by fully half their length.

Colour dark yellowish brown; lower parts slaty grey; hind foot $\frac{3}{4}$ inch, ears fully $\frac{1}{2}$ inch long; tail one third the length of the head and body ..... 8. *A. sikimensis.*

Colour light greyish rufescent brown; ears nearly $\frac{3}{4}$ inch long; tail half the length of the head and body ..... 5. *A. blanfordi.*

Section I. Alticola.

The first lower molar with, normally, 7 spaces, 4 or 5 external and 5 internal angles; the first upper molar with 5 spaces, 3 inner and 3 outer angles; the second with 4 spaces, 3 outer and 2 inner angles; the third terminating in an elongate lobe, produced backwards in the line of the jaw.

1. Arvicola stoliczkanus.

Arvicola stoliczkanus, *W. Blanford, J. A. S. B* 1875, xliv. pt. 2. p. 107; *Scient. Res. Second Yarkand Miss., Mamm.* 1879, p. 42, pl. viii. fig. 1, pl. x *b*. fig. 2.

Colour bright ferruginous brown above*, white below, the two colours sharply divided; feet and tail white.

Fur soft, rather woolly, dark leaden grey at the base, the terminal fourth on the back rufous-white, tipped with darker rufous, numerous rather longer hairs with dark rufous-brown tips being intermixed.

Ears small, completely concealed by the fur, covered with short bright rufous hair towards the margin inside, and with longer and paler hair outside.

Feet small; claws long, compressed, much concealed by long white hairs; thumb quite rudimentary and clawless. Tarsus hairy below, and with a few hairs between the pads of the toes.

Tail short, apparently about a quarter the length of the head and body together, covered with stiff fulvescent white hair, which extend half an inch beyond the end.

	inches.
Length of head and body	4·0
„ tail without hairs	1·0
„ tarsus and hind foot with claws ..	0·7
„ skull	1·15

The description and measurements are from dried skins.

The following are the characters of the molar teeth:—

Upper molar	I,	5	spaces,	3	external	and	3	internal angles.
„ „	II,	4	„	3	„	„	2	„ „
„ „	III,	3	„	4	„	„	2	„ „
Lower molar	I,	7	„	5	„	„	5	„ „
„ „	II,	5	„	3	„	„	3	„ „
„ „	III,	3	„	3	„	„	3	„ „

The hinder upper molar has two strong salient angles on the anterior portion of the inner side; on the outer side there are anteriorly two weak angles rather close together, then a deep sinus or emargination opposite to the second inner angle, and behind this the tooth terminates in a narrow elongate process with two slight projecting angles on the external side only, none on the inside. This process behind the second inner angle is much less than half the length of the tooth.

The only two specimens of this species hitherto examined are from the high plateaus of Northern Ladák (Western Tibet).

* In the figure given in the 'Scientific Results of the Second Yarkand Mission the colour is too dull and brown: it should be more rufous.

1. Arvicola stoliczkanus.

Arvicola stoliczkanus, *W. Blanford, J. A. S. B* 1875, xliv. pt. 2, p. 107; *Scient. Res. Second Yarkand Miss., Mamm.* 1879, p. 42, pl. viii. fig. 1, pl. x *b*. fig. 2.

Colour bright ferruginous brown above*, white below, the two colours sharply divided; feet and tail white.

Fur soft, rather woolly, dark leaden grey at the base, the terminal fourth on the back rufous-white, tipped with darker rufous, numerous rather longer hairs with dark rufous-brown tips being intermixed.

Ears small, completely concealed by the fur, covered with short bright rufous hair towards the margin inside, and with longer and paler hair outside.

Feet small; claws long, compressed, much concealed by long white hairs; thumb quite rudimentary and clawless. Tarsus hairy below, and with a few hairs between the pads of the toes.

Tail short, apparently about a quarter the length of the head and body together, covered with stiff fulvescent white hair, which extend half an inch beyond the end.

	inches.
Length of head and body	4·0
„ tail without hairs	1·0
„ tarsus and hind foot with claws ..	0·7
„ skull	1·15

The description and measurements are from dried skins.

The following are the characters of the molar teeth:—

Upper molar	I,	5	spaces,	3	external	and	3	internal	angles.
„	„ II,	4	„	3	„	„	2	„	„
„	„ III,	3	„	4	„	„	2	„	„
Lower molar	I,	7	„	5	„	„	5	„	„
„	„ II,	5	„	3	„	„	3	„	„
„	„ III,	3	„	3	„	„	3	„	„

The hinder upper molar has two strong salient angles on the anterior portion of the inner side; on the outer side there are anteriorly two weak angles rather close together, then a deep sinus or emargination opposite to the second inner angle, and behind this the tooth terminates in a narrow elongate process with two slight projecting angles on the external side only, none on the inside. This process behind the second inner angle is much less than half the length of the tooth.

The only two specimens of this species hitherto examined are from the high plateaus of Northern Ladák (Western Tibet).

* In the figure given in the 'Scientific Results of the Second Yarkand Mission the colour is too dull and brown: it should be more rufous.

2. **Arvicola stracheyi.** (Teeth, Plate I. fig. C.)

Arvicola stracheyi, *Oldfield Thomas, Ann. & Mag. Nat. Hist.* Oct. 1880, ser. 5, vol. vi. p. 332.

Colour light brown, with a grey tinge above, white below; forehead rather dusky; feet and tail white.

Fur soft, long, slaty grey at the base; on the back there is a pale whitish band on the hairs, a little way from the skin (this may, perhaps, be an individual peculiarity or due to season, only one specimen being known) the first and third fourths of the length being slaty grey and the terminal fourth brownish yellow, some hairs with black tips being interspersed. On the lower parts the basal half of the hairs is grey, the terminal half white.

Ears small, not projecting beyond the fur and thickly covered inside and out with moderately long hair.

Feet of moderate size; claws pale, overhung with hairs; thumb quite rudimentary and clawless; fourth toe in the fore foot slightly longer than the second, and the third longer than the fourth by about the same difference. In the hind foot the second and fourth toes are nearly equal, third very little longer. Tarsus hairy below.

Tail short (vertebræ preserved), apparently not more than one fifth the length of the head and body, covered with white hairs, which extend half an inch beyond the end.

	inches.
Length of head and body	3·7
„ tail without hairs.	0·7
„ tarsus and hind foot without claws...	0·65

The description and measurements are from a single dried skin brought by Capt. (now Lieut.-Gen.) R. Strachey from Kumaon, and presented to the East-India Museum, where it was entered in the Catalogue as *Cricetus songarus*. When the zoological specimens of the East-India were incorporated in the British Museum, the skull was extracted by Mr. Thomas and the real nature of the animal recognized.

The following are the characters of the molar teeth:—

Upper molar	I,	5	spaces,	3	external	and	3	internal angles.
„	II,	4	„	3	„	„	2	„ „
„	III,	3	„	4	„	„	2	„ „
Lower molar	I,	7	„	5	„	„	5	„ „
„	II,	5	„	3	„	„	3*	„ „
„	III,	4	„	3	„	„	3	„ „

The hinder upper molar much resembles that of *A. stoliczkanus*, and like the latter, has two strong salient angles on the anterior portion of the

inner side followed by the straight inner edge of the long posterior lobe. On the outer side there are, anteriorly, two weak angles rather close together, then a deep sinus opposite to the second inner angle, and behind this the tooth terminates in a narrow elongate process with two slight angles on the outer side only; none inside. This process, behind the second inner angle, is half the length of the tooth.

In the first lower molar the anterior inner and outer angles are almost rudimentary on the crown, but they form distinct folds on the sides of the tooth*. The first three spaces in this tooth are confluent, the first two especially are scarcely separable. The same is the case with the first and second spaces in the second lower molar, and with the second and third spaces in the third; in the latter case the two are just sufficiently distinguishable to be counted apart.

3. **Arvicola wynnei.** (Teeth, Plate I, fig. B.)

Arvicola wynnei, *W. Blanford, J. A. S. B.* 1880, Vol. XLIX, Pt. II, p. 244.

Colour above dark rich brown, with a slight greyish tinge†; head rufescent; lower parts pale brown; tail the same colour as the back; feet covered with brown hairs above, soles pale.

Fur very soft; hairs very dark leaden grey, nearly black at the base, and for three fourths to four fifths of their length on the back, the tips being rufous-brown in general, some more or less grey; the terminal portion on the lower parts pale brown. No longer hairs on the back; a few scarcely exceeding the rest of the fur, on the rump. The length of the hair on the back in skins collected in the summer and autumn is half an inch or rather less.

Ears short and rounded, completely concealed by the fur, thinly clad with long hair on the external surface, and with short brown hair on the inside towards the border; a tuft of long hair on the anterior edge of the inner surface.

Whiskers brown, the lower greyish, the longest reaching the ear.

Feet moderate; fore feet rather large; claws long, compressed, white, not overhung with long hairs. Thumb of fore foot short, with a short compressed claw; the middle toe exceeds the fourth by about half the length of the terminal phalanx; the fourth is scarcely longer than the second, which extends by about the length of its last phalanx beyond the fifth. In the hind foot the third toe is very little longer than the second,

* They are not counted in the original description; but I think that similar folds should be noticed, and they appear to be included by Blasius.

† In one specimen preserved in spirits the greyish tinge is wanting, and the colour above dark chestnut.

which, again, is but little longer than the fourth. This exceeds the fifth by more than the length of its last phalanx, and the fifth is longer than the first by about half the same length. There are five pads or tubercles beneath the fore foot; the two hinder the largest, opposite to each other and to the base of the thumb; the three distal pads small, and arranged in a triangle at the base of the toes. On the sole of the hind foot there are also five tubercles—two in front, one on each side of the base of the middle toe, another pair at the base of the two outer toes, the outer nearer the distal extremity of the foot than the inner, and the fifth at the proximal extremity of the naked sole, and about as far behind that at the base of the fifth toe as the latter is from the pair at the base of the middle toe. Lower portion of tarsus hairy.

Tail between one third and one fourth the length of the head and body, almost cylindrical, diminishing but little in thickness towards the end, clothed with long hair at the base, and with short brown hair throughout the terminal three quarters of its length. The hairs only project one eighth to one fourth of an inch beyond the end of the tail.

The following are the dimensions of the specimens, both adult males, in spirit*:—

	in.	in.
Length of head and body from nose to vent	4·75	3·5
Tail from vent (hair at end not included)	1·35	1·2
Height of ear from orifice	0·25	0·26
Breadth of ditto	0·25	0·26
Length of fore foot without claws	0·4	0·4
„ hind foot and tarsus without claws	0·7	0·7
„ claw of middle toe	0·11	0·13

The incisors are deep orange. The following are the characters of the molars:—

Upper molar I, 5 spaces, 3 external and 3 internal angles.
„ „ II, 4 „ 3 „ „ 2 „ „
„ „ III, 4 „ 3 „ „ 2 „ „
Lower molar I, 7 „ 4 „ „ 5 „ „
„ „ II, 3 „ 3 „ „ 3 „ „
„ „ III, 3 „ 3 „ „ 3 „ „

The two anterior upper molars resemble those in all other Himalayan *Arvicolæ* except *A. sikimensis* and *H. melanogaster*, and in the majority of European and American forms. The hinder upper molar has two small salient angles on the outer side in front, much closer together and smaller than the two inner angles. Behind the second outer angle there is a sinus,

* Spirit-specimens always measure rather less in the length of the body and ears than freshly-killed animals.

a very little deeper and somewhat broader than that between the first and second. The posterior portion of the tooth is a nearly oval longitudinal lobe, forming rather more than one third the length, more prominent externally than internally, so as to form a blunt third external angle, but not sufficiently prominent on the inner side to form a third inner saliency. The spaces or prisms of a tooth like this are always somewhat indefinite; the first space is enclosed by the anterior outer and the corresponding inner angle; the second is not separated from the first, and is enclosed by the second outer angle, the third by the second inner angle, and the fourth corresponds to the posterior lobe.

In the first lower molar the first three spaces are confluent, and so are the fourth and fifth. The anterior outer and inner angles project less than those behind; the first inner angle especially, which is close to the extremity of the tooth, and much in advance of the first outer angle, is weak and rounded; these two anterior angles enclose the first space, which is oblong-ovate, with its longer diameter diagonally placed. The third inner and outer angles are so nearly opposite to each other that it is almost a question whether the two spaces they enclose should not be considered as one. In the second and third lower molars all the spaces are lozenge-shaped, the outer and inner angles being nearly or quite opposite to each other, and each space being bounded both by an exterior and an interior angle. The outer external angles of the third lower molar are rather less prominent than the inner. The third molar is considerably narrower than the second, and the second somewhat narrower than the first.

The interparietal bone is subtriangular. The hinder margin, neglecting small projections and emarginations, runs nearly straight, and consists of two slightly concave halves meeting in a trifling angle, projecting in the middle; the anterior margin is formed by two almost straight lines meeting in the middle of the skull at an angle a little more open than a right angle, without any point projecting anteriorly beyond the angle. The nasals in the only skull I have extracted are slightly injured behind, so I cannot determine the shape of the posterior extremity; the outer edge of each appears to be convex throughout, not emarginate posteriorly.

The following are the dimensions of a skull:—

	inches.
Length from occipital plane to end of nasals	1·14
„ of nasals	0·31
Breadth across widest parts of zygomatic arches	0·74
„ between orbits where narrowest	0·18
„ of nasal bones in front	0·14
„ of interparietal bone	0·23
Length of upper molars together	0·28

Distance from upper molars to incisors	0·38
Length of lower jaw from condyle to symphysis	0·75
„ of lower molars together	0·27

This species has been described from two specimens in spirit and two skins, procured at the hill-station of Mari (Murree) in the Punjab by Mr. A. B. Wynne, of the Geological Survey of India. All the specimens were captured, I believe, by a house-cat; so the animal is probably common in the gardens of the station. The native name is *Kanis* (Kunnees).

There is in the British Museum a specimen in spirit of an *Arvicola* of unknown locality, but probably Himalayan, and very possibly from Kashmir, having the same dentition as *A. wynnei*, but differently coloured with larger ears. This specimen was obtained by purchase, together with a specimen of *Nesokia bengalensis* (*N. indica*, Blyth and Jerdon) and some other mammals, all apparently Indian, but all supposed at the time to be from Africa. I shall not name a specimen of such dubious antecedents; there is not sufficient evidence that it is even Indian, or that it comes from the same country as the associated specimens; but as it is far from improbable that it may prove to be Himalayan, the following characters may enable the species to be identified when met with:—

Colour brown (about the same as a wild rabbit, not dark rufous brown like typical *A. wynnei*) above, whitish below. The tail much darker above than below. Feet brown above, similar in proportions and pads to those of *A. wynnei*. Ears rounded, projecting considerably beyond the fur. Teeth as in *A. wynnei*.

	inches.
Length of head and body from nose to vent	4
„ tail from vent (hair at end not included).....	1·3
Height of ear from orifice	0·42
Breadth of ditto	0·37
Length of forefoot without claws	0·35
„ hindfoot and tarsus „	0·7

It should be mentioned that the peculiar form of the last upper molar, characteristic of the Section *Alticola*, has hitherto only been found in Himalayan species of *Arvicola*.

4. Arvicola roylei. (Teeth, Plate I. fig. D.)

Arvicola roylei, *Gray, Ann. & Mag. Nat. Hist.* Vol. X, p. 265 (1842); *Schreber, Säugth. Suppl.* III, p. 587 (1843); *Giebel, Säugth.* p. 613 (1859); ? *Blyth, Cat. Mamm. Mus. As. Soc.* p. 125 (1863); *Jerdon, Mammals of India*, No. 202, p. 216 (1867).

Colour above yellowish brown,* rather rufous in the middle of the back, below paler and isabelline or fulvous; tail brown above, white below; feet apparently the same colour as the lower parts.

Fur dark slaty at the base and for about two thirds of the length, the terminal third being tawny at first, the tips partly brown, partly black on the upper parts; on the lower parts all the tips are tawny.

Ears small, hairy, concealed by the fur.

Feet small; claws pale, short, overhung by hairs; thumb in the fore foot very small, but with a distinct claw; middle finger but little longer than the fourth, which is considerably longer than the second. The characters of the toes in the hind feet, which are contracted in the dried skin, cannot be made out clearly.

Tail nearly cylindrical, apparently rather more than a third of the length of head and body together, and covered with short hair, which only extends a short distance beyond the end, and is rather darker and more rufescent above than below.

The measurements are taken from the dried skin (1); those given by Jerdon, from a specimen collected by himself, are added (2) as will be shewn presently, it is not certain that this specimen was of the same species.

	(1)	(2)
	in.	in.
Length of head and body.....	3	3·75
„ of tail-vertebræ	1·1	1·375
„ of tarsus and hind foot without claws.....	0·8	

The following are the characters of the molar teeth :—

Upper molar I, 5 spaces, 3 external and 3 internal angles.
„ „ II, 4 „ 3 „ „ 2 „ „
„ „ III, 3 „ 3 „ „ 3 „ „
Lower molar I, 7 „ 4 „ „ 5 „ „
„ „ II, 5 „ 3 „ „ 3 „ „
„ „ III, 3 „ 3 „ „ 3 „ „

In the first upper molar the anterior outer angle is a little in front of the corresponding inner angle. The last upper molar has three nearly

* Gray calls the colour rufous-grey. As he undoubtedly described the same skin as I have examined, I can only say that his ideas of coloration were different from mine, for it is difficult to believe that the colour has changed from rufous-grey to yellowish brown. A change from yellowish brown to rufous-grey would be far more likely to result had the specimen been exposed to light; to the best of my belief, however, the skin has not been exposed. Jerdon calls the colour ashy brown, with a tinge of rufous more or less apparent; but he described different specimens, and as he did not examine the teeth it is by no means certain that they belonged to the same species.

equidistant outer angles, but the hollow between the two posterior angles is much deeper than that between the two anterior, the three inner angles are also nearly equidistant; the hindmost portion of the tooth behind the third internal angle is a longitudinal lobe, forming about one third of the whole length, and without angles; the anterior space is continued between the first inner and first and second outer angles; the second space corresponds to the second inner angle; the third space is enclosed by the posterior angle on each side and the lobe.

In the first lower molar the anterior angle on each side is very small and blunt, and there is a rudimentary fifth external angle in front; the first and second spaces, the latter corresponding to the second inner angle, are not separate. In the second lower molar the first space is confluent with the second, and the third with the fourth. Similarly in the third lower molar the first and second spaces are not distinct, nor are the third and fourth.

The above description is from the single type, a dried skin in poor condition, obtained by Royle in Kashmir. Jerdon states that he found this species in Kunawar near Chini, and observed it on the Pir-Panjal pass, south of Kashmir; but he had no opportunity of comparing specimens; and as so many additional species have since been described it is possible the voles he saw may not have been *A. roylei*. The locality given by Blyth (Pind Dádun Khán, in the Panjab) is probably, as already noticed, due to a mistake.

5. Arvicola blanfordi. (Teeth, Plate I, fig. E.)

Arvicola blanfordi, *J. Scully, Ann. & Mag. Nat. Hist.* Nov. 1880, Ser. 5, Vol. VI, p. 399.

Colour above rather light greyish brown, with a very slight rufous tinge, below greyish white; feet white; tail brown above, sullied white below.

Fur soft, the hairs slaty grey at the base, and on the back for about three quarters of their length, the terminal fourth on the upper parts fawn-colour, numerous rather longer hairs with black tips being interspersed. On the lower parts the tips of the hairs are white.

Ears of moderate size, rounded, projecting considerably beyond the fur, covered with moderately short hair inside near the margin, and outside except on the anterior part of the outer surface, where the hair is longer.

Whiskers long, some of them extending beyond the tips of the ears, the greater portion white, a few dark brown.

Feet of moderate size; claws white, compressed, not long, overhung with long hairs; thumb of fore foot very small, almost rudimentary, but

furnished with a small claw; middle finger very little longer than the fourth, but there is much more difference between the latter and the second, about as much as there is between the second and fifth. Tubercles beneath the fore foot five in number, all of good size and near together, three in a triangle at the base of the middle toes, and two opposite to each other and to the base of the thumb. In the hind foot the second and fourth toes are very nearly the same length, and but very little shorter than the third; the fourth exceeds the fifth by rather more than the length of the terminal phalanx of the former, and the difference between the fifth and first is less, being about the length of the distal phalanx of the fifth toe. There are six pads or tubercles on the sole of the hind foot, the three inner much further apart than the three outer, the last outer being rather smaller than the rest, and the last inner pad, which is considerably behind all the others, being situated rather nearer to the most distal tubercle than to the heel. Lower portion of tarsus well covered with hair.

Tail between one third and one half the length of the head and body, cylindrical, scarcely diminishing in diameter towards the tip, well clad with hair, which projects about one fifth of an inch beyond the end of the vertebræ.

The following dimensions are (1) of a fresh adult male specimen taken by Dr. Scully, and (2) of an adult male in spirit:—

	(1) in.	(2) in.
Length of head and body from nose to vent	4·55	3·9
„ of tail from vent (hair at end not included)	2·05	1·9
Length of ear from orifice	0·7	0·58
Breadth of ear	0·68	0·54
Length of fore foot without claws	0·4	0·4
„ of hind foot from heel without claws	0·75	0·76

The molars have the following characters:—

Upper molar	I,	5	spaces,	3	external	and	3	internal angles.
„ „	II,	4	„	3	„	„	2	„ „
„ „	III,	4	„	3	„	„	3	„ „
Lower molar	I,	7	„	4	„	„	5	„ „
„ „	II,	5	„	3	„	„	3	„ „
„ „	III,	3	„	3	„	„	3	„ „

In the first upper molar the anterior outer angle is distinctly nearer the hinder part of the jaw than the anterior inner angle. The third upper molar has three nearly equidistant outer angles, the sinus intervening between the second and third angle being much deeper than that between the first and second. The inner angles in this tooth are much more promi-

nent than the outer. The longitudinal lobe forming the posterior portion of the tooth behind the third internal angle is of small length, scarcely one fourth of the tooth; there are two rudimentary external and one internal angle on the lobe that are not counted. The spaces are not very different from those in *A. roylei*, although one more is counted; the first is bounded by the first internal and first two external angles; the second corresponds to the second internal angle; the third, which is small, to the third external angle, whilst the fourth is included by the third internal angle and the posterior lobe.

On the first lower molar there is a rudimentary anterior external angle that has not been counted, the first internal angle is much smaller than the others, and the first external somewhat less prominent. The first and second spaces, the latter corresponding to the second inner angle, are not separated. In the third molar the second space is almost double, the two angles not being quite opposite, and it is a question whether this tooth should be considered as having 3 spaces or 4.

Interparietal with the hinder border almost straight; each of the lateral margins forms an ogee curve, concave anteriorly, convex behind, and meeting the posterior margin at an angle rather less than a right angle. The lateral angles are not produced; the anterior angle projects very slightly forward.

Dr. J. Scully has done me the honour of naming this Vole after me. It is found commonly on the mountains around Gilgit at an elevation of 9000 to 10,000 feet. It is closely allied in the structure of the teeth to *A. roylei*, but differs widely in external characters, the tail and ears being much longer and the coloration quite different.

This species, in which the posterior lobe of the last upper molar is less developed than in the other four forms of the section, shows a passage to *Paludicola*.

Section II. Paludicola.

The first lower molar with normally 7 spaces, 4 or 5 external and 5 internal angles; the first upper molar with 5 spaces, 3 inner and 3 outer angles; the second with 4 spaces, 5 outer and 2 inner angles; the third not terminating in an elongate lobe.

6. Arvicola blythi. (Teeth, Plate II, fig. B.)

Phaiomys leucurus, *Blyth, J. A. S. B.*, 1863, XXXII, p. 89; *Theobald, J. A. S. B.*, 1862, XXXI, p. 519; *Stoliczka, J. A. S. B.*, 1865, XXXIV, p. 110. *Nec* Arvicola leucurus, *Gerbe* (1852); *nec* idem, *Severtzoff* (1873).

Arvicola blythi, *W. Blanf. J. A. S. B.*, 1875, XLIV, pt. 2, p. 107; *id. Scientific Results Second Yarkand Mission, Mammalia*, p. 39, pl. VIII, fig. 2, & pl. X, *b*. fig. 1.

Colour above earthy brown (yellowish brown with a greyish tinge), below brownish white. Feet the same colour as the underparts; tail light brown.

Fur soft, the basal two thirds on the upper surface, and about one half on the lower, dark slaty; the tips on the upper surface of two kinds—the finer isabelline, the coarser dark brown, almost black; tips on the abdomen brownish white.

Ears small, round, not extending beyond the fur, thinly clad with light-brown hairs inside, more thickly and with longer hairs outside.

Whiskers dark brown above, white below, the longest nearly an inch in length.

Feet of moderate size; claws compressed, horn-coloured; thumb short, with a short compressed claw.

Tail cylindrical, about one fourth to one third the length of the head and body, covered with short hair.

The following dimensions are (1) from a fresh specimen taken by Dr. Stoliczka, (2) from another fresh specimen, a large female, by Mr. Theobald, (3) from an adult specimen in spirit:—

	(1)	(2)	(3)
	in.	in.	in.
Length of head and body	4	4·9	3·7
„ of tail, without hairs at end	1·35	1·25	1·1
„ of ear			0·33
Breadth of ear			0·37
Length of fore foot and claws			0·45
„ of hind foot and claws			0·82
„ of skull			1·03

The following are the characters of the molar teeth:—

Upper molar I, 5 spaces, 3 external and 3 internal angles.
„ „ II, 4 „ 3 „ „ 2 „ „
„ „ III, 5 „ 3 „ „ 3 „ „
Lower molar I, 7 „ 4 „ „ 5 „ „
„ „ II, 5 „ 3 „ „ 3 „ „
„ „ III, 4 „ 2 „ „ 3 „ „

In the third upper molar all the internal angles are much more prominent than the outer, and the first two internal angles are more developed than the last. The first space is included by the first internal and first external angle, the second space by the second external angle, the third by

the second internal, the fourth by the third external, and the fifth by the third internal angle; the last two are not separate, but form together an inequilateral arrowhead,* the internal angle being nearer to the posterior extremity of the tooth, but directed forwards, and with a deeper notch in front of it than the other angles.

In the first lower molar the first outer angle is much rounder and less prominent than the others. The third lower molar is peculiar, as the usual anterior outer angle is completely wanting,† and the first outer angle (corresponding to the second in other *Arvicolæ*) is very small and not so prominent as the second, which, again, is inferior in size to each of the three inner angles. The first space corresponds to the first inner angle, the second space to the second inner and first outer, the third space to the second outer angle, and the fourth space to the third inner angle. The last two spaces are confluent in some specimens.

The interparietal has the hinder edge nearly straight, and the two lateral edges forming an ogee curve, the concave portion near the anterior angle, the convex external; the anterior angle slightly prominent, the lateral angles not so, each of the latter being a little less than a right angle.

This species has been obtained in two parts of Western Tibet—on the banks of the Tsomoriri, a large lake north of Spiti, and in the country between Leh and the Pankong lake in Ladák. Both places are at a considerable elevation, over 13,000 feet above the sea.

7. Arvicola mandarinus?, var. (Teeth, Plate II, fig. C.)

? Arvicola mandarinus, *A. Milne-Edwards, Recherches Mammifères*, p. 120, pl. XII, fig. 4, pl. XIII, fig. 4.

Golunda meltada, *Gray* ("var? or distinct species from Griffith's collection in Afghanistan"), *Horsf. Cat. Mamm. Mus. E. I. Co.*, p. 144.

The following description is that of the Afghan skin in the British Museum:—

Colour rufescent fulvous (light greyish rufescent brown) above, white beneath; tail the same as the back; feet whitish.

Fur soft, basal two thirds leaden black; tips isabelline (pale fulvous), a few slightly longer black tips interspersed throughout the dorsal surface.

Ears short, concealed by the fur, hairy inside and out.

Feet of moderate size; thumb of fore foot very short, but furnished

* In the description of the Mammalia of the Second Yarkand Mission I described this tooth as composed of four lobes, the two posterior spaces being counted together

† A somewhat similar character is shown in Blasius's figure of the corresponding tooth in *A. agrestis* (Säugh. Deutschl. p. 370) and in that of the *petrophilus*-form of *A. nivalis* (ib. p. 360), but not to the same extent as in *A. blythi*.

with a claw; claws of moderate length, pale in colour, overhung by the hairs of the toes. In the fore foot the difference between the fourth and second toes is about double that between the third and fourth, and equal to that between the second and third. In the hind foot the third toe is distinctly the longest, and there is but little difference between the second and fourth; tarsus hairy beneath.

Tail about a quarter the length of the head and body (judging from the dried skin), covered with short hairs extending about $\frac{1}{8}$ inch beyond the end.

	inches.
Length of skin from nose to vent	4
„ tail without hairs at end (the vertebræ preserved)...	1
„ hind foot, without claws.....	0·67

The skull extracted from the skin is imperfect, and the hinder portion (including the interparietal) is wanting. The nasals are rounded at their posterior extremity; they do not extend quite so far back as the premaxillaries, and their outer edges are slightly concave. The following are the characters of the molar teeth:—

Upper molar	I,	5	spaces,	3	external	and	3	internal angles.
„ „	II,	4	„	3	„	„	2	„ „
„ „	III,	5	„	4	„	„	3	„ „
Lower molar	I,	7	„	5	„	„	5	„ „
„ „	II,	5	„	3	„	„	3	„ „
„ „	III,	4	„	2	„	„	3	„ „

On the third upper molar there is a rudimentary fourth inner angle; the third and fourth outer angles are less marked than the others; the spaces might be reckoned either 4 or 6; the three first are well separated, but not those behind. In the first lower molar the two anterior external angles are blunt and ill-developed; they, with the first internal angle, enclose one space. In the third lower molar, as in the corresponding tooth of *A. blythi*, the usual anterior external angle is entirely wanting; the second and third spaces are imperfectly separated.

The molars thus closely resemble those of *A. blythi*, but there is an additional outer angle on the third upper molar and another on the first lower molar, whilst the first outer angle on the third lower molar is better developed and includes a space to itself. These differences are not of specific value by themselves, but the external differences are more important.

I have examined the types, two in number, of *A. mandarinus*, in the Paris Museum (Jardin des Plantes). They are rather browner than the Afghan specimen, but otherwise coincide very fairly; they have a small thumb with a claw. The colour is light rufous-brown, and the fur is long

and soft, dark slaty at the base, with isabelline (pale fulvous) tips. The molars have the following characters :—

Upper molar I,	5	spaces,	3	external	and	3	internal	angles.
„ „ II,	4	„	3	„	„	2	„	„
„ „ III,	4	„	4	„	„	3	„	„
Lower molar I,	7	„	4	„	„	5	„	„
„ „ II,	5	„	3	„	„	3	„	„
„ „ III,	3	„	2	„	„	3	„	„

The two hinder external angles of the third upper molar are ill-developed, and very possibly the last disappears in some cases ; the last space is formed by the two last outer and the last inner angle.

It will be seen that the number of the spaces in the third upper and lower molars is not precisely the same, although the number of angles coincides. But the precise number of spaces in these two teeth is not of much importance, and may even vary with age.

The type was collected by W. Griffith in Afghanistan, and until the skull was examined was not known to be an *Arvicola*. The exact locality is of course doubtful.

Section III. Neodon.

The first upper molar has 3 external and 4 internal angles ; the second 3, both inside and out. The first lower molar has 5 or 6 internal and 5 external angles.

8. Arvicola sikimensis. (Teeth, Plate I, fig. A.)

"Neodon sikimensis, *Hodgson*," *Horsfield, Ann. & Mag. Nat. Hist.* Ser. 2, Vol. III, p. 203 (1849) ; *id. Cat. Mamm. Mus. E. I. Co.* pp. 145, 146 (1851) ; *id. P. Z. S.* 1856, p. 401 ; *Gray, Cat. Spec. Mamm. &c. Nepal and Tibet, Brit. Mus.* 2nd edit. (1863), No. 117, p. 11 ; *Blyth, Cat. Mamm. As. Soc.* (1863), No. 311, p. 125 ; *Jerdon, Mamm. Ind.* (1867), No. 203, p. 217 ; *W. Blanf. Scientific Res. Second Yarkand Mission, Mammalia*, pp. 41, note, 42 (1879).

Arvicola thricolis (thricotis), *Hodgson, Cat. Spec. Mamm. &c. Nepal and Tibet, Brit. Mus.* 2nd edit. No. 116, p. 10 (not described).

Arvicola nigrescens, *Hodgson, tom. cit.* p. 11, (undescribed).

Bicunedens perfuscus, *Hodgson, tom. cit.* p. 11, (undescribed).

Phalchua *of Nepalese ;* Cheek yu, *Kiranti ;* Sing phuchi, *Tibetan* (*teste Hodgson*).

Colour above yellowish brown, almost golden brown, a dark brown minutely interspersed with yellow* ; below slaty-grey, slightly washed with fulvous. Tail the same colour as the back ; feet brown above.

* This is the colour in two specimens before me—one a dry skin, the other preserved in spirit. Horsfield, however, whose description was copied by Jerdon, de-

Fur soft, leaden grey at the base; the terminal fourth on the back light brown, almost tawny, with numerous rather longer black-tipped hairs intermixed. On the underparts the extreme tips only of the hair are whitish; but here also longer and coarser hairs with dirty-white ends, are intermixed.

Ears not covered by the fur, but projecting for about half their length, rounded, very thinly clad inside and out with short dark-brown hair. A tuft of long hair on the base, just below the orifice, and long hair on the anterior part of the outer surface. The anterior portion of the inner and posterior portion of the outer surface almost naked.

Whiskers of moderate length, extending to the ears, but not beyond them; some black, others grey.

Feet of moderate size; claws horn-colour, not white, short, compressed, overhung by hairs, which often exceed the claws themselves in length. Thumb very short, but furnished with a small claw. The middle toe in the fore foot only just longer than the fourth, which exceeds the second by nearly the length of the terminal phalanx; the fifth only comes short of the second by about half the same length. Tubercles on the sole of the fore foot 5 in number, the three anterior arranged in a triangle at the base of the four longer toes, the posterior pair opposite each other in a transverse line at the base of the thumb, that nearest the thumb being especially large. In the hind foot the three middle toes differ but little in length, the third just exceeding the fourth, which is a little longer than the second; the latter, by the length of its terminal phalanx, exceeds the fifth, and there is a still greater difference between the fifth and the first. The pads or tubercles are 6 in number, one, however, being very small and very possibly wanting* in some individuals; the two anterior are close together, the inner of the two being nearer the heel or proximal to the other, the third a little further back at the base of the fifth toe, the fourth at the base of the first, the posterior pair as far behind the second pair as the fourth pad is behind the second; the outer of the last pair is thus considerably in advance of the inner, and is small and rudimentary; the last of all is situated about halfway between the base of the middle toe and the heel. The tarsus is almost naked below.

Tail fully one third the length of the head and body, or rather more, diminishing gradually (not rapidly) in thickness behind, thinly clad with short brown hair, which projects but little beyond the end.

scribed the colour above as "deep brownish black, with a slight rusty shade, minutely and copiously grizzled with hairs of a deep ferruginous tint." This may indicate that some individuals are much more rufous than those I have examined.

* It was wanting in the specimens examined by Hodgson.

The following measurements are (1) those given by Hodgson,* apparently from a fresh specimen, (2) from an adult female specimen in spirits:—

	(1) in.	(2) in.
Length of head and body from nose to vent	4·75	4
Tail from vent (hair at end not included)	1·75	1·6
Height of ear from orifice.....		0·5
Breadth of ear		0·35
Length of fore foot (palma), without claws	0·44	0·35
„ of hind foot and tarsus, without claws	0·75	0·72

There are 6 teats according to Hodgson, but 8 in his MS. notes. In the specimen before me I find two pairs on the breast, both postaxillar; the inguinal mammæ appear undeveloped, and cannot be distinctly traced. The true number must be 8 at least.

Incisors deep orange. The following are the characters of the molar teeth:—

Upper molar	I,	5	spaces,	3	external	and	4	internal angles.
„	„ II,	5	„	3	„	„	3	„ „
„	„ III,	6	„	3	„	„	4	„ „
Lower molar	I,	9	„	5	„	„	6	„ „
„	„ II,	5	„	3	„	„	3	„ „
„	„ III,	3	„	3	„	„	3	„ „

The hindmost inner angle of the first upper molar is much smaller than the others, and does not enclose a distinguishable space. The hindmost inner angles of the second and third upper molars are also smaller than the other angles of those teeth, and the enclosed spaces are not distinctly separate from those preceding. In the first lower molar the second space is imperfectly separated from the third, and the third from the fourth.

This species has hitherto only been found in Sikkim, at elevations of from 7000 to 10,000 feet. It inhabits forests, and, according to Hodgson, breeds in fallen trees.

Amongst the original drawings of Nepalese and Sikkim Mammalia presented to the Zoological Society of London by Mr. Hodgson, there are figures of *Neodon sikimensis* and *Arvicola thricotis*, the name *thricolis* of the British Museum catalogue being manifestly a misprint. These sheets, like those bearing other drawings in the same collection, are covered with MS. notes on habits and structure, visceral anatomy, &c., showing what a very large number of important observations Mr. Hodgson had accumulated. It may be added that when these drawings were made, the anatomy of allied European forms was very imperfectly known, but that, since fuller

* Horsfield, from Hodgson's MS., P. Z. S. 1856, p. 401.

descriptions have been published, a large proportion of the anatomical details figured and explained in Mr. Hodgson's notes prove to be common to whole genera or even families. Such is the case in the present instance. There appears nothing in the anatomy of *A. sikimensis* to distinguish that species from European Voles.*

The intestines in two specimens, both females, were 26 and 28 inches long, the cæcum $3\frac{3}{4}$ and 4 inches, and $\frac{3}{8}$ wide, in one case 10 inches, in the other 13 from the anal end of the intestine. In a male the intestines measured 25 inches; the cæcum, 11 inches from the anus, was $6\frac{1}{2}$ inches long and rather less than half an inch broad. "Liver 3-lobed, each lobe divided, and a lobulus. Gall-bladder deeply imbedded in largest and central lobe, and having a large clear duct. Spleen 1 inch, tongue-shaped, and deep red." In the stomach the two orifices are said to be about a quarter of an inch apart.

Several measurements, evidently from fresh specimens, are given. They are useful as showing to some extent the amount of variation.

	1, ♂	2, ♀	3, juv.	4, ♂	5, ♀.
	in.	in.	in.	in.	in.
Length from nose to anus	$4\frac{5}{8}$	$4\frac{1}{4}$	$3\frac{2}{3}$	$4\frac{1}{8}$	4
„ of head to nape	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{3}{16}$	$1\frac{1}{8}$
„ from snout to fore angle of eye.	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	
„ thence to base of ear	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{1}{2}$	$\frac{10}{16}$	
„ of ear entire	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Breadth of free portion (measured from the skull)	$\frac{5}{16}$	...	$\frac{5}{16}$	$\frac{3}{8}$	
Length of tail	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{7}{16}$	$1\frac{7}{8}$
„ palma and nails	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$
„ planta and nails (from *os calcis*).	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{13}{16}$
Weight	$1\frac{1}{4}$ oz.	$1\frac{1}{4}$ oz.	...	$1\frac{1}{4}$ oz.	1 oz.

No. 5 is the type of *Arvicola thricotis*, which is separately figured. It will be seen that there is nothing in the dimensions to show any difference from *A. sikimensis;* the coloration is identical. But of several skins and specimens in spirit presented by Mr. Hodgson, not one is marked as *A. thricotis;* and as the publication of the name does not appear to have been authorized by that gentleman, it is probable that he had recognized the identity of the animal thus named with *A. sikimensis*. In Gray's second edition of the British Museum catalogue of Mr. Hodgson's specimens all that is stated of the species (which has, of course, never been described in print) is:—"*Hab.* Darjiling, in woods near houses. India Office, Nov. 1852 (in spirits). Compare with *Neodon sikimensis?*" From this it may

* For an account of the anatomy of *A. amphibius* and *A. agrestis* see H. Beger, Zeitschrift ges. Naturwiss. XXX, 1867, p. 115; and Retzius, Muller's Archiv. 1841, p. 493.

fairly be inferred that the type was one of the spirit-specimens recently received at the British Museum from the East-India Museum. All such specimens are unquestionably *A. sikimensis*.

All Mr. Hodgson's specimens appear to have been obtained in Darjiling itself or the immediate vicinity of the station. In one case he obtained a male, female, and two young in a nest, saucer-shaped, made of soft grass, without any lining, 6 inches in diameter. The nest was in a decayed fallen tree in the forest. The young were "2⅛ inches long, hairy above, nude below, and blind; the ears also closed."

A story current amongst the people is noticed, to the effect that this animal, which the Hindi-speaking Nepalese call *Phal-chua*, or Fruit-Rat, appears at long intervals, and is produced out of the fruit of a tree, a large species of wild olive, said, on Dr. Thomson's authority, to be common in the deep forests of the central and northern region at 7000 to 15,000 feet (neither the botanical nor Nepalese name of the tree is given in the MS. notes). It is probable, from the existence of this story, that these Voles, like some other species of the genus, appear in much larger numbers at times.

9. Arvicola melanogaster. (Teeth, Plate II, fig. A.)

Arvicola melanogaster, A. Milne-Edwards, *Nouv. Arch. du Museum*, 1871, Vol. VII, p. 93; *Recherches pour servir à l'histoire naturelle des Mammifères*, Vol. I, p. 284, pls. XLIV, XLVI *a*.

Colour above varying from dark brown with a greyish tinge to blackish brown, below ashy grey. Tail the same colour as the back above, rather paler and greyer beneath. Feet brown above. In some specimens the head is lighter and more rufous above than the back; but in general there is no difference. Of a variety from Fokien several specimens are bright rufous-brown above. The usual colour, however, is precisely the same as in *A. sikimensis*.

Fur soft, dark leaden grey at the base, tips brown. In the darker specimens (one marked as killed in March) there are much coarser hairs intermixed. In the brown specimens this is not usually the case to the same extent, but there are a few longer black-tipped hairs on the back and rump.

Ears projecting slightly beyond the fur by about one third of their length, not nearly so much as in *A. sikimensis*, thinly clad with short hair inside and out, and with a tuft of long hair on the anterior inner margin near the base.

Whiskers dark brown, a few of the lower grey, the longest extending to the ears, but not beyond.

Feet small; claws white, compressed, moderate in length, only partly

overhung by hairs, which do not extend to the end. In the fore foot the thumb is quite rudimentary, but it has a small claw. Third finger very little longer than the fourth, which exceeds the second; pads five, three in a triangle at the base of the middle toes, two opposite to each other and to the base of the thumb. In the hind foot the middle toe is the longest, as usual, the second and fourth very little shorter and subequal; there is a great difference between the second and fifth toe, less between the fifth and first. Five pads on the sole, besides a rudimentary sixth; of the two anterior pairs the outer is a little more distal than the inner, and the rudimentary sixth pad is equally in advance of the fifth, which is a little nearer to the origin of the middle toe than to the heel.

Tail rather more than one third the length of the head and body, slightly attenuate, covered with short hairs that project very little beyond the end.

The following dimensions are taken from three specimens in spirit in the Museum at the Jardin des Plantes, Paris; (1) is a male and (2) a female from Moupin, (3) a female from Fokien :—

	(1)	(2)	(3)
	in.	in.	in.
Length of head and body from nose to vent...	3·7	3·55	3·7
„ tail from vent (hairs at end not included)	1·4	1·35	1·6
Height of ear from orifice.....	0·37	0·38	0·35
Breadth of ear	0·35	0·36	0·35
Length of fore foot (palma) without claws ..	0·35	0·34	0·35
„ hind foot from heel without claws ...	0·6	0·6	0·65

The incisors are deep orange. The following are the characters of the molar teeth :—

Upper molar I, 6 spaces, 3 external and 4 internal angles.
„ „ II, 5 „ 3 „ 3 „ „
„ „ III, 4 „ 3 or 4 „ 3 or 4 „ „
Lower molar I, 6 to 8 5 „ 5 or 6 „ „
„ „ II, 3 „ 3 „ 3 „ „
„ „ III, 3 „ 3 „ 3 „ „

As was remarked by Milne-Edwards in his original description of this form, the spaces on the two sides of many of the teeth are so nearly opposite that they must often be reckoned as one; and as there is some variation in the degree of alternation or coincidence, the number of spaces is not characteristic. This is especially the case in the anterior lower molar. In the first upper molar spaces 5 and 6 coalesce. The last interior angle is frequently equal to the others, but is more commonly smaller. In the second upper molar the second and third spaces are imperfectly separated,

and so are the fourth and fifth; sometimes the tooth might be considered as having only three spaces. The last inner angle varies in size, but is usually equal or nearly equal to the next in front. In the last tooth the second and third spaces are not distinct; the posterior portion of the tooth varies, generally (as in the example figured herewith) there is a strong third angle inside, and another equally strong (the third) outside, and behind these is a U-shaped lobe with a weak external angle. Sometimes, however, the latter angle is wanting, whilst occasionally, on the other hand, a fourth internal angle is also well developed, as in *A. sikimensis*; and in one specimen this is stronger than the corresponding inner angle.

The anterior lower tooth also varies considerably. The angles on opposite sides are sometimes so perfectly parallel in position that there are only six spaces, the first and second being always imperfectly separated. The anterior inner angle too is very variable, being sometimes as strong as in *A. sikimensis*, sometimes altogether wanting.

The following are the dimensions of a skull:—

		inch.
Length from occipital plane to end of nasals	...	0·9
Breadth across hinder part of zygomatic arches	...	0·56
„ between orbits	...	0·19
Length of nasal suture	...	0·24
Breadth of interparietal	...	0·33
Length of upper molars	...	0·22
Distance between upper molars and incisors	...	0·25
Length of lower jaw from angle to symphysis	...	0·55
„ „ molars	...	0·24

The interparietal is generally more or less pentagonal, the lateral extremities being usually truncated, though occasionally angulate or subangulate. The posterior edge is usually nearly straight, sometimes convex, the two anterior edges very little concave, and the anterior angle very slightly projecting. The nasals diminish regularly in breadth behind.

Besides the original examples from Moupin and Western Sechuen, specimens have been sent to the Paris Museum from the western part of the province of Fokien, the South-western China.

This species is undoubtedly very close to *A. sikimensis*, from which it is only distinguished by its shorter ears and feet, the characters of the teeth not being sufficiently constant to serve as a satisfactory distinction. It is far from improbable that intermediate forms may exist in the Bhutan and the other Eastern Himalayan tracts intervening between Sikkim and Moupin.

The following Indian and Himalayan rats and mice have been incorrectly referred to the genus *Arvicola* :—

Arvicola indica, Gray and Hardwicke, Illustrations of Indian Zoology, I, pl. 11 ; = *Mus* (*Nesokia*) *hardwickii*.

Arvicola bengalensis, Gray and Hardwicke, Illustrations of Indian Zoology, II, pl. 21 ; = *Mus* (*Nesokia*) *bengalensis*, [= *Nesokia indica*, Blyth and Jerdon ; *Mus* (*Nesokia*) *blythianus*, Anderson.]

"*Arvicola ? Neotoma*, two sp n., *pyctorhis* and *myothrix*, nob.," Hodgson, J. A. S. B., 1841, X, p. 915.

"*Arvicola ? myothrix*, Hodgson," Horsfield, P. Z. S., 1856, p. 401.

These are the species very imperfectly described by Hodgson (Ann. & Mag. Nat. Hist. 1845, XV, p. 267) as *Mus ? pyctorhis* and *Mus ? myothrix*. The former proves, on an examination of the type in the British Museum by Mr. Thomas, to have been founded on an aberrant individual of the common house and tree-rat of India (*Mus rufescens* auctt.), and belongs to the form called *Mus æquicaudalis* by Hodgson. The type of *Mus myothrix* is a skin without any skull ; but I have no hesitation in identifying it with *Golunda ellioti*, to which an affinity was suggested by Jerdon ('Mammals of India,' p. 214).

"*Arvicola ? hydrophilus*, Hodgson," Gray, List of the Specimens of Mammalia in the British Museum, 1843, p. 119.

This is *Mus ? hydrophilus*, Hodgson, Ann. & Mag. Nat. Hist. 1845, XV, p. 267. No original type can be found, and it is quite uncertain what the species is. Mr. Thomas has endeavoured to identify it, but in vain. The figure in Hodgson's drawings shows a large mouse or small rat with a pure white belly, and might well be taken from a young individual of the common white-bellied Himalayan rat, *Mus nitidus* (= *Mus rufescens*, var.), or of *Mus jerdoni* (*Leggada jerdoni*, Blyth : this species is not a true *Leggada*).

Note.—The teeth figured in the accompanying plates are those of the right upper and right lower jaw, the anterior extremity uppermost, and the upper jaw teeth above the lower. It results from this arrangement that in the upper figures (upper teeth) the outer or external angles are to the left, the inner to the right ; whilst in the lower figures (lower jaw) the reverse is the case, the outer side of the jaw being to the right, the inner to the left. All the figures are enlarged 8 diameters.

X.—*On* Myospalax fuscicapillus, *Blyth*.—*By* W. T. Blanford, F. R. S., &c.

[Received May 8th;—Read June 1st, 1881.]

(With Plate II, in part.)

Forty years ago, some specimens of a rodent in the Society's collection were named by Mr. Blyth *Georychus fuscocapillus*. It was not known at the time whence they were procured, but Mr. Blyth supposed that they came from the Himalayas. The first mention of the name was in 1841,* in a list of specimens of skulls, and in the following year, a very brief and imperfect description of the animal was given.

No fuller account of the species was ever published. The true locality, Quetta, appears to have been ascertained by the late Captain Hutton, the animal was noticed and a short description of its habits given in his "Rough notes on the Zoology of Candahar" (J. A. S. B., XV, p. 141.) It was in this paper that the new generic name *Myospalax* appears to have been proposed for the first time: in a footnote, Mr. Blyth states that "this type differs from *Myodes* or the Lemming genus in the much greater size and strength of the feet, in the elongation and protrusion of its upper incisive tusks, &c., and he adds that he will describe the form more particularly, together with some other new rodents. That such was his intention is apparent also from a letter to the Honorary Secretary published in the preceding volume of the Society's Journal,† in which Mr. Blyth requests that a figure of the animal and its skull might be prepared for publication. The request was granted, but apparently the plate was never drawn, it was certainly, so far as I am aware, never published. In Mr. Blyth's Catalogue of the Mammalia, the specimens in the Society's collection are recorded with references to all the accounts above noticed.‡ So far as I am aware the animal has never been mentioned in European works,§ probably because the first brief notice escaped record in Wiegmann's Archiv.

Recently, when occupied in determining the *Arvicolæ* of the Himalayas, my attention was called to a specimen, brought by Mr. Griffith from Afghanistan, that had long been in the old East India Company's Museum

* For references see synonymy.

† J. A. S. B., XIV, Proc. Oct. 1845, p. ciii.

‡ There is also a brief allusion to this species by Mr. Blyth in 1863, J. A. S. B., XXXII, p. 89.

§ The same name *Myospalax* was subsequently used by Brandt, (Mem. Acad. St. Petersburg 1855, IX, and by Carus and Gerstaecker, (Handbuch der Zoologie, 1875, p. 108,) for the genus *Siphneus*, the type of which was named *Mus myospalax* by Laxmann in 1773. See A. Milne-Edwards, Rech. Mamm. pp. 71, &c.

and had finally been transferred to the British Museum. This proved to be a true *Arvicola* (see previous paper) but in external characters it had some resemblance to *Myospalax fuscicapillus*, of which I had a distinct recollection. On my application, Dr. Anderson, Superintendent of the Indian Museum, was good enough to obtain the permission of the Trustees to send one of the specimens of Blyth's species and a skull to London for me to examine. After comparing this with, Mr. Thomas's assistance, I am unable to find that the animal has ever been described elsewhere, and the most nearly allied known form appears to be the Russian *Ellobius talpinus*. I cannot find any good generic character to distinguish *Myospalax* from *Ellobius*, although the difference between the two is considerable, and may induce some naturalists to separate them generically. For the present, I think the Quetta species may be called *Ellobius fuscicapillus* the following is a description of the skin and skull, which, with the teeth, is figured on Pl. II.

ELLOBIUS FUSCICAPILLUS.

Georychus fuscocapillus, Blyth, J. A. S. B., 1841, X, p. 928; 1842, XI, p. 887.

Myospalax fuscocapillus, Blyth, J. A. S. B., 1846, XV, p. 141; Cat Mam. Mus. As. Soc. p. 126.

Colour on the upper parts buff, (very pale fulvous or light brownish yellow;) except on the upper surface of the head, which is hair brown. Lower parts rather paler, tail nearly the same colour as the back, feet pale.

Fur soft, light ashy grey at the base, and for rather more than half the length, terminal portion on the back dirty light brownish yellow, no longer hairs on the back, a few towards the rump, and around the base of the tail; these have not dark tips. On the head the hairs are brown throughout, in the middle of the belly yellowish white. The hair on the specimen examined is short, being only $\frac{3}{10}$ inch long, in the middle of the back.

Ear-conch rudimentary.

Whiskers buff, the uppermost brown, none in the skin examined extends back beyond the ears.

Feet of moderate size, rather broad, toes long, claws blunt, short, formed for digging, horn-coloured, overhung by long hairs. In the forefoot the second is but little shorter than the third but considerably longer than the fourth, exceeding it by about the same amount as that by which the fourth itself extends beyond the fifth; thumb very short, but with a claw nearly equal to that of the other toes. Pads beneath each fore foot 5 in number, the two anterior at the base of the three middle toes, of these the

outer appears to be double, (it is difficult to be certain of the characters in a dried specimen;) the third is inside the base of the 5th toe, the two posterior tubercles are considerably larger than the rest and the inner is rather more distal than the outer. On the hind foot the second toe is nearly as long as the third and considerably longer than the fourth, exceeding it by nearly the same amount as the fourth itself extends beyond the first, which again is but little longer than the fifth. There are 6 distinct pads or tubercles beneath the hind foot, arranged in 3 pairs as usual, the inner pad of the second pair, at the base of the first toe, appears to be double, those forming the proximal pair are nearly opposite to each other and are rather nearer to the anterior pair than to the heel. The whole planta to the heel is naked, though there are long hairs on the sides of the feet.

Tail very short, thinly clad with long light yellowish brown hair, that extends $\frac{1}{10}$ inch beyond the end.

The following are the dimensions *of the dried skin*.

	inches.
Length nose to rump	5.
„ tail, without hair at end	0·35
„ forefoot without claws	0·67
„ middle toe ditto	0·28
„ hindfoot from heel ditto	0·85
„ middle toe ditto	0·25

The *skull* is that of an aged individual the occipital crest is very strongly developed and the sutures too fully anchylosed for the shape of the interparietal to be distinguished. The cranium is not quite perfect, the parts around the *foramen magnum*, including the auditory bullæ, having been cut away. Compared with the skulls of *Arvicola*, the most striking differences are the greater thickness of all the bones, the much greater development of the occipital crest, of the zygomatic arch, and of the bones of the anterior or facial portion generally, as compared to the brain case. The measurements are:—

	inch.	met.
Length from middle of occipital plane to end of nasals	1·34	·0345
„ from paroccipital process to front of incisors	1·62	·041
„ of suture between nasals	0·47	·012
Breadth across hinder part of zygomatic arches	1·1	·028
„ across brain pan behind zygomatic process of squamosal	0·6	·015
„ across frontals where narrowest between orbits	0·23	·006
Length of row of upper molars (crowns only)	0·32	·008
Distance from anterior end of upper molar to base of incisors	0·55	·014
Length of anterior palatine foramina	0·14	·0035

Length from base of incisors to posterior termination of palate	0·9	·023
Breadth of bony palate between front lobes of anterior molars	0·13	·0035
Length of lower jaw from angle to symphysis	1·12	·028
Height of ditto to end of coronoid process	0·6	·015
Length of row of lower molars	0·32	·008

The occipital plane slopes backwards. The upper surface of the skull is rounded and slopes away more rapidly at the sides than in *Ellobius talpinus* or in *Arvicola*, the sagittal crest is strong posteriorly, but sinks down in front. The nasals are nearly of the shape of a wine bottle with concave sides, the posterior termination is not pointed but truncated by the irregular zigzag suture, the outer margins are straight and nearly parallel for a short distance from the posterior end, then convex, and again in front slightly concave. The premaxillæ extend further back than usual on the upper surface of the skull, and terminate posteriorly in points some distance behind both the end of the nasals and the origin of the zygomatic process of the maxilla. The zygomatic arch is very high in the middle and presents the peculiarity of the maxillar and squamosal processes meeting along the lower edge and forming a suture; the malar, a high but short bone, does not extend to the lower margin, nearly two-thirds of the length of which is composed of the maxillar process. The infraorbital foramen is large, triangular when received from the front, not produced in the form of a narrow slit below, and about one and a half times as high as broad.

The anterior palatine foramina are very small and narrow, the posterior palatine foramina are numerous, relatively large, and situated in two deep grooves, occupying the greater part of the palate posteriorly. The opening of posterior nares is very narrow, much narrower than each of the broad pterygoid fossæ.

Teeth. The incisors are long and project forward considerably in both jaws, those in the upper jaw are of moderate breadth and flat in front; lower incisors narrower, and rounded in front. They are nearly white in both jaws.

The row of upper molars is very slightly curved; all the teeth are of nearly equal breadth. The first upper molar has 3 external and 3 internal angles, the internal (those to the right in the figure) being rather anterior to the external. The slope from the hinder angle on each side to the posterior extremity of the tooth is concave, especially on the external side. The second tooth has 3 subequal angles outside and terminates posteriorly in a rudimentary angle in contact with the hinder molars; on the inside there are 3 angles first a small angle, then a larger one, there being no distinct re-entering angle between the two, the re-entering angles between the second and third inner angles, and between the last and the first of the hinder tooth are square, not pointed. The third tooth has 3 outer and 2

inner angles, the outer are nearly equi distant, but there is no re-entering angle between the first and second, though there is between the second and third, the posterior termination of the tooth is a very slightly projecting rounded lobe, and it may be noted that each of the upper molars terminates in a somewhat similar lobe, as in *Arvicola*.

In the first lower molar there are 4 outer and 5 inner angles, the first on each side rounded and less prominent than the others, the two hinder pairs on opposite sides of the tooth nearly opposite to each other; the anterior extremity is a rounded lobe, nearly as broad as long, with a very blunt rounded angle inside, in advance of a still blunter one outside. The second and third lower molars have each 3 angles on each side, all nearly opposite to each other, the outer (those to the right in the figure) being in each case a little in advance of the inner. In the second molar the angles inside and outside are nearly equal to each other, in the posterior molar the inner angles are stronger than the outer, and the first outer angle is less prominent than the other two.

The lower jaw is strong, the coronoid process well developed, the tubercular projection corresponding to the posterior extremity of the lower incisor situated just outside and a little below the condyle, so as to make the latter appear almost double.

Compared with *Ellobius talpinus*, the differences presented by the form here described are numerous, but the external distinctions are less striking than those shewn by the skull. *E. fuscicapillus* is larger, yellower, and rather paler-coloured, and the tail appears a little longer. The base of the fur is much paler, that of *E. talpinus* being almost black, that of *E. fuscicapillus* light grey. There are some slight differences too in the feet, *e. g.*, the second toe of the fore foot in *E. talpinus* appears to be much shorter in proportion to the middle toe than in *E. fuscicapillus*. The feet too appear larger in the latter but it must be remembered that the comparison is made between dried skins.

The hinder upper molar in *E. talpinus* is proportionately much shorter, the two anterior outer angles are close together, and the posterior lobe behind the hindmost outer angle is wanting. The second inner angle too is ill developed or obsolete. In the first tooth of the lower jaw there are only 3 distinct external and 4 internal angles, instead of 4 and 5, and the anterior lobe is very slightly developed.

The skulls of *E. talpinus* in the British Museum (two in number) differ greatly in form from that of *E. fuscicapillus* and are much more Arvicoline, the facial bones being far less developed in proportion to the brain case, and the occipital crest very small. The zygomatic arch is less high but similar in form and in the arrangement of the bones, the maxillar process, however, is not quite in contact with that of the squamosal

although the two approach each other very closely. The nasals have not the peculiar form that they have in *E. fuscicapillus*, but are simply arcuate or convex externally, and the præmaxillæ terminate posteriorly opposite the end of the nasals and the origin of the zygomatic arch. The anterior palatine foramina, though small are not quite so minute as in the Quetta species, and the posterior portion of the palate is less deeply grooved. The posterior nares and pterygoid fossæ are similarly shaped. In the lower jaw the coronoid process is shorter, and the angle is differently shaped, but the peculiar condyle is precisely similar, the tubercle at the root of the incisor being just outside and below in both species.

It is evident that if, as I believe, *E. fuscicapillus* belongs to the genus *Ellobius*, the short description of that genus by Alston in his classification of the order *Glires** will need some modification, since the skull in the species now described is not very like that of *Arvicola* and the facial portion is more developed instead of less.

* P. Z. S., 1876, p. 85.

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XI.—*New or little-known* Mollusca *of the Indo-Malayan Fauna.*

By GEOFFREY NEVILL, C. M. Z. S.

[Received 30th June;—Read 6th July, 1881.]

(With Plates V, VI, & VII.)

Mr. A. R. Wallace in his very interesting new work—'Island Life'—devotes a chapter to the Madagascar Group, and he comes to the conclusion that the presence there of the numerous and important Indo-Malayan forms cannot be accounted for by a former continental land connection, for which the term "Lemuria" has been suggested by an eminent zoologist. If I understand rightly, the distinguished author accounts for the presence of these forms by their introduction from Europe, and from consequently Asia, before the separation of Africa by the sea in early Tertiary times; in another passage, he suggests the probable submergence of many large islands, whose former position is indicated at the present time by the banks and reefs of the Cargados, Chagos, Maldives, &c., to account for the "transmission of organisms from the Indian Peninsula."

As Mr. Wallace twice alludes to my papers on the Mollusca of the Seychelle Islands (pp. 405 and 415), which I wrote so long ago as 1868-9, I now wish to add a few remarks. Speaking solely from the conchological point of view, I would submit that there is certainly no necessity for presuming the existence of a continent, "Lemuria;" on the contrary, an archipelago, thickly studded with large islands, such as appears to be unmistakeably indicated in

this region, presents several points of greater probability judging from the character of the existing landshells, and I would question the former immediate land connection with the Indian Peninsula. I think I can point out several remarkable features, which tend to show that this archipelago probably received its Mollusca rather by a close connection with the Nicobars, Sumatra, Java, &c., and thus of course with the Malayan Peninsula. It is scarcely necessary for me to mention that the Mollusca of the Madagascar and Mascarene province give no support to the theory of an ancient emigration from Europe, so few fossil landshells of pretertiary times being known; the entire absence of the genus *Helicina* from the tertiary deposits of Europe as also from India proper and Ceylon at the present time, I consider very significant, as the genus from its well-marked characters, its robust substance, and local abundance could hardly have escaped attention. I showed in 1869 that the Seychelles possess a species (*H. theobaldiana*, Nevill) only just separable from others found in the Nicobars and adjoining Islands; M. Morelet again has lately described a most remarkable extinct subfossil form from Mauritius as *Helicina undulata*: this species is closely allied to the *Trochatella mouhoti* of Pfeiffer from Cambodia, which, Dr. Dohrn has justly shown, cannot be classed with the West Indian species of *Trochatella*, but must be referred to *Helicina*; for these two species I suggest the new subgeneric division *Pseudotrochatella*; the group has its nearest known allies in some Philippine forms. It will be important to endeavour to find out whether there are any fossil or subfossil forms of *Helicina* to be found in Madagascar itself. The remarkable "Malagash" section of *Megalomastoma*, called *Hainesia* by Pfeiffer (= *Mascaria*, Angas), seems to me much more closely allied to the Malayan and Philippine section *Coptocheilus* of Gould than with the extinct European Tertiary forms.

Omphalotropis is undoubtedly a most significant feature of the shell-fauna of the Mascarene Islands, the genus not being known from Madagascar, the Comoro, or Seychelle Islands; it has also never been established as found fossil in Europe, or living in India or Ceylon; there is, however, one tertiary fossil to which I would call the attention of conchologists—the *Cardiostoma trochulus* of Sandberger ('Vorwelt,' pl. XII, fig. 8), which I consider perhaps referable to *Omphalotropis?* Besides the Mascarene Group, the genus is found in great abundance and variety in the Polynesian Archipelago and can, according to my theory, be fairly traced from the one region to the other. Excluding the allied New-Zealand genus *Realea*, several species have been described from New Caledonia, one from the Solomon Islands, two from Ceram, one from Shanghai, one (*O. strictus* of Gould from the Loo Choo Islands) has been lately rediscovered by Surgeon-Major R. Hungerford at Hongkong living on stone

walls at 300 feet above the sea, two from Borneo, one from Amboyna, one from the New Hebrides, one from the Pelew Islands, three from the Nicobars, and two (possibly more) from the Andamans. I can scarcely believe the genus does not occur in Sumatra or Java, though it has not yet been recorded from either, or indeed from the Malayan Peninsula.

Another remarkable "Indian" type is the *Cyathopoma blanfordi*, H. Adams, which was first discovered by myself at a considerable elevation on Mahé one of the Seychelles. This is undoubtedly an exception to my theory that the "Indian" forms of the Madagascar province show a closer connection with Sumatra, &c. than with India proper: species of *Cyathopoma* (*sensu lato*) being numerous in South India and Ceylon, and also existing on the Bombay and Golconda Hills, as well as at Darjiling, in Assam, and a single species, (fide cl. Theobald) in the Shan States; the genus hitherto not being known from any other region. But elsewhere in this paper I have endeavoured to prove that the genus *Diadema* of Pease from the Pacific Archipelago is not really separable, and I can also confirm the validity of Benson's species *Cyathopoma tignarium* from the Andamans, which Mr. W. T. Blanford has lately called in question, as I have received several living specimens from my energetic correspondent Mr. F. A. de Roepstorff, who has also sent me a single specimen of the true *Omphalotropis distermina*, Benson, as justly discriminated from its much commoner ally by Mr. Blanford, who has named the latter *O. andersoni*. The occurrence of *Cyathopoma procerum*, Blanford, at Beypore, close to the sea, is also worthy of note, in regard to the geographical distribution of the genus.

As well as I can judge, there is no fossil represented in Sandberger's 'Vorwelt,' which presents any resemblance to *Cyathopoma*. The genus is of such small size that it may have been easily overlooked hitherto in the Malayan province;—Blanford's genus *Cyclotopsis*, I consider as on an altogether different footing; I regard it as a strictly African genus, of which two species have made their way to India, two others to the Comoro Islands, and one (*C. conoideum*, Pfeiffer) to Mauritius; Sowerby's habitat "Seychelles" for this last is undoubtedly erroneous and should be altogether ignored. The two large Seychelle species of *Stylodon* (*Helix*) have their nearest ally in *H. cepoides*, Lea, of the Philippines, and are all three evidently allied to the species of *Phania*, Albers (*pars* = *Eucochlias*, Theobald), of which forms are known from Formosa (*H. swinhoei*), Tavoy (*H. saturnia*), Solomon Island, Cambodia, Moluccas, Khasi Hills, &c.

Mr. Wallace in Vol. II, p. 538, of his 'Geographical Distribution of Animals,' 1876, Prof. Sandberger in his 'Land &c. Conchylien der Vorwelt,'

and Prof. A. Nicholson in his 'Manual of Palæontology,' 1879, have all omitted to take cognizance of the four highly interesting and important species of fossil *Helix* described by Dr. Stoliczka in his Cretaceous Fauna of South India, Vol. II, 1867, three as species of *Anchistoma*, Klein (more correctly *Gonostoma*, Helder) and one as a species of *Macrocyclis*, Beck.

All of the above works therefore must be amended, to the effect that indubitable species of true *Helix* are known from the Upper Cretaceous. I have carefully examined all the specimens of these Cretaceous *Helicidae*, so excellently figured by Dr. Stoliczka, and am of opinion he was quite right in referring three of the species to the subgenus *Gonostoma* (= *Anchistoma*), and I think it will interest Mons. Bourguignat and other conchologists to find the ancestors of this, both in tertiary and recent times, essentially European group, in so ancient a geological formation as that of the Cretaceous rocks of South India. I consider Dr. Stoliczka to have been less happy in his remarks as to the affinity of these forms with our present Indian subgenera *Plectopylis* and *Corilla*, which seem to me entirely different groups. The fourth of these Cretaceous forms, the *Macrocyclis carnatica* of Stoliczka, is certainly not a species of true *Macrocyclis*, the type species of which is the South American *H. laxata*, Fér., now said by Mons. Fischer to form a section of typical *Helix*. Dr. Stoliczka's species evidently belongs to what is now known as *Patula*, Helder, but to which of the sections, it is impossible to say until better specimens are forthcoming.

In addition to the above recorded instances of landshells of proved greater antiquity than the Tertiary Period, I am indebted to Dr. Feistmantel for pointing out that three well preserved species have been described from the Coal Measures of Nova Scotia by Dr. Dawson, *Dawsonella meeki*, *Zonites* (*Conulus*) *priscus*, and *Pupa* (*Dendropupa*) *vetusta* (from "the hollow trunk of an erect Sigillaria"), copies of the figures of the two latter being given in Nicholson's Manual; these are doubtless the forms of *Helicidae* alluded to by Wallace in his above quoted work from the Carboniferous? Dr. Stoliczka, *l. c.*, page 6, also writes "Except the *Boysia Reussii*, which was in 1859 described by myself from a Cretaceous freshwater deposit in the North-Eastern Alps, I am not aware that any species of true *Helicidae* have been noticed from deposits lower than the Eocene strata." Pfeiffer does not record this so-called *Boysia*, nor indeed any of the above-mentioned Cretaceous Helices; it is, however, a very well characterized form, I should consider from the figure, possibly correctly referred to *Boysia*; it was found in tolerable abundance and is well figured in the Sitz. K. Ak. Wien, XXXVIII, 1859. This *Boysia reussii* has been latterly referred by Professor Sandberger to the genus *Strophostoma*,

Deshayes, and is consequently mentioned as the most ancient species as yet discovered of the *Cyclostomacea*, in his magnificent work, insufficiently studied by Conchologists, on the Land und Süsswasser Conchylien der Vorwelt, 1870-5.

HELICARION [AUSTENIA] MAGNIFICUS, G.-Austen and Nevill, Pl. V, Fig. 23.

Nevill, J. A. S. B., 1877, Momein [Yunnan], p. 24, diam. 46, axis 11½ mil., as *Helicarion magnificus*, "coll. J. Anderson"; Nevill, Handlist I, 1878, p. 16, as *Helicarion* [*Austenia*] *magnificus*; Godwin-Austen, P. Zool. S. 1880, as *Girasia magnifica*.

I am quite unable to agree with Colonel Godwin-Austen, in referring this species to *Girasia*; if I were persuaded that it was the case, I should not hesitate in uniting *Girasia* and *Austenia*. However, I consider both well characterized, if not as distinct genera, at least as well marked sections of *Helicarion*, not only as regards their shells but also on account of the differences in the animals themselves. *Austenia* has a less "helicoid" and more "slug-like" shell than true *Helicarion*, but is still always distinctly convoluted and of firm though fragile texture. Pfeiffer and the old school would have called them *Vitrina*. *Girasia* has merely a membranaceous shell scarcely if at all convoluted, more or less rudimentary; old authors considered them as "slugs" and not as *Helicidae* at all.

HELICARION [AUSTENIA] RESPLENDENS, Nevill, Pl. V, Fig. 24.

J. A. S. B., 1877, Sawady and Bhamó, coll. J. Anderson, M. D.

GIBBUS LYONETIANUS, Pallas.

Spicil. Zool. 1780, as *Helix lyonetiana*.

Besides the typical specimens which I have already recorded in my 'Handlist of Mollusca in the Indian Museum,' the following forms seem worthy of record:—

var. ANTONI, Pfeiffer.

Zeits. Mal. 1847, as *Gibbus antoni*, from Mauritius [not *Pupa antoni*, Küster, 1844, from Berbice]; = *Pupa grateloupiana*, Pfr. 1868, from Mauritius.

There are two specimens in the Museum, collected by myself in the "Bois Sec," Savanne District, Mauritius. The above local name in my 'Handlist' was unfortunately changed, during my absence on furlough in Europe, to "Dry Forest," a name of no meaning!

var. SINISTRORSA, nov.

In 1878 I noticed a reversed specimen in the museum at Lyons; shortly afterwards I was fortunately successful in purchasing a second specimen for the Indian Museum, out of the collection of the late Lombe Taylor.

GIBBUS DUPONTIANUS, G. Nevill, Pl. VI. Fig. 1.

J. A. S. Beng., 1870, p. 411, and *l. c.*, 1871, p. 7, also Handlist p. 9, [sine descr.]; P. Zool. S. 1868, p 260, animal described as that of "*G. versipolis*" ; = *P. versipolis*, Pfr. var. [not of Férussac].

T. aperte rimata, subcylindrica, sat solidiuscula, flavido-cornea, oblique confertim fortiter sulcata, costis latis, flexuosis; spira cylindrica, in conum perobtusum terminata; anfr. 7, *convexiusculi, ultimus precedentibus vix major; apertura subverticalis, ovalis, sine dente parietali; perist. late expansum, pallide luteum, marginibus callo lævi junctis.*

Long. 14½, diam. 6¾ mil. Savanne District, Mauritius.

The number of whorls, different sculpture, absence of parietal tooth, light yellow colouration, &c., easily distinguish this species from its nearest ally *G. bacillus*, Pfr.; the animal is also different, as can be seen by reference to the Proc. Zool. Soc. 1868, p. 259 and 260 (*G. bacillus* and *G. versipolis*); it is perhaps Pfeiffer's Mauritian variety of *P. versipolis*, but is certainly not Férussac's species from Bourbon (= *P. funicula*, Val.), as already pointed out by M. Morelet and myself.

ENNEA (HUTTONELLA) MOERCHIANA, Roepstorff, MS.

Deeply, openly umbilicate, the umbilicus partly covered by the deflected last whorl; cylindrically ovate in shape, almost exactly like a gigantic *E. stenopylis;* arcuately ribbed, ribs thick and rather distant; white, solid, with obtusely conoidal apex and distinct suture; whorls 6½, convexly tumid, narrow, the 4th and 5th of equal breadth, the last not so broad and very little higher, rounded at base and brought round in front, so as to bring the aperture almost into the centre, or axis, of the shell, much as in *E. stenopylis*, thus partially covering the umbilicus; aperture vertical, contracted, quadrate, peristome anteriorly strongly sinuate, then very broadly reflected, quite straight, not oblique as in its ally, the columellar and basal margins more broadly reflected and boldly, evenly rounded instead of the former being nearly perpendicular as in *E. stenopylis*, margins joined with a callosity, nearly straight, in the centre provided with a well developed prominent, perpendicular tooth (or fold), another strong, but less prominent fold within the outer lip, at base of the above mentioned "sinus," that is where the peristome becomes markedly reflected, behind which there are some ten ribs so closely crowded together as to give almost the appearance of one very broad "varex," these ribs partially block up the umbilicus.

Long. (vix) 5, diam. max. 2¾ mil.

I have much pleasure in adopting, for this remarkable form, Mr. de Roepstorff's MS. name in honour of his late friend Dr. Moerch of Copen-

hagen, who contributed several excellent papers towards our knowledge of the Mollusca of the Nicobars.

Type, Indian Museum; centre of Great Nicobar, coll. F. A. de Roepstorff, Esq.

Genus NANINA, Gray.

P. Zool. S. 1834, types *H. nemorensis*, Müll. [*Xesta*], *H. javanensis*, Fér. [*Xesta*], *H. exilis*, Müll. [*Hemiplecta*], *H. citrina*, Lin. [*Xesta*], *H. monozonalis*, Lin. [*Xesta*], *H. clairevillia*, Fér. [*Hemiplecta*], *H. citrinoides*, Desh. [*Macrochlamys*], *H. juliana*, Gray [*Xesta*] and *N. striata*, Gray [*Hemiplecta*]; type restricted, Gray, P. Zool. S. 1847, p. 169, *Helix citrina*, Lin.; = *Xesta*, Albers, 1850, *type H. citrina*, Lin.; = "*Phereporae*," Desmoulins, Bull. Soc. Lin. Bord. III, 1829 [name inadmissible]; *pars?* = *Stenopus*, Guilding, Zool. Journ. III, 1828, type *S. lividus*, Guild. = *Guppya*, Mörch, J. de C. 1867, [as *Stenopus* had been previously used for a genus of Crustacea].

The type of Gray's *Nanina* is therefore *H. citrina* and not *H. vitrinoides* [*Macrochlamys indica*, Bs.], as supposed by some authors.

Benson himself distinctly admits the validity of Gray's *Nanina*, over his MS. name of *Tanychlamys* or *Macrochlamys* (*see* Proc. Zool. Soc. 1834, p. 89, J. A. S. B., 1836, and later on in the Annals and Mag.); had my Indian conchological friends referred to these papers, or to the J. A. S. B., 1832, p. 13, for the original and casual mention, in a footnote, of Benson's MS. name *Macrochlamys*, I am sure they would never have attempted to introduce so retrogade and useless a change, utterly unwarrantable in every way. Here is Benson's mention of the name in full,—"Those (*Pterocyclus* sp.) which I found, were, with several specimens of a *Cyclostoma*, a reversed *Carocolla* and *Macrochlamys*;"—then follows a foot-note,—"A new genus of the *Helicidae* separated by me from *Helix*, in consequence of the wide departure of the animal from the type of that genus." With this and a mere repetition of the name on page 76, ends the so-called description of *Macrochlamys* in 1832, although never claimed as such by Benson himself.

Many authors (Benson included) speak of his genus *Tanychlamys* as having been described in the Proc. Zool. Soc. 1834, but as far as I can trace this is not strictly the case. Benson appears to have sent a paper to the society containing an excellent description of the section, with the name *Tanychlamys* attached; the editor, however, changed it to *Nanina*, stating that it had been found to be the same as Gray's genus described a few pages previously; in the description the editor casually mentions that the form described was the *Tanychlamys* of Benson, MS. It is very doubtful if *Stenopus* is a section of *Nanina* at all; in any case the former can have no claim, as the name had previously been used for a genus of *Crustacea*, as has been pointed out by Mörch.

The fact of the name *Nanina* having been employed by Risso in 1826 is I consider of no importance, as it has long ago been pointed out that he

used the name for the immature state of his own genus *Cyclops*; his name *Nanina* was therefore null and void and should not bar Gray's genus.

As Colonel Godwin-Austen has lucidly explained, though he draws a wrong conclusion, *Nanina*, Gray, is not the same as *Ariophanta*, Desmoulins, but equals the latter's group "*Phereporae*"; it would never do to adopt the specially separated section or subgenus of *Ariophanta* for the whole group, any more than to replace Draparnaud's *Pupa* (1801) by the sectional name *Vertigo* of Müller (1788), which was specially introduced for the forms with two tentacles only. By the method now universally adopted by all the leading conchologists, all parties seem to me fairly treated. Gray has his genus *Nanina* employed in a wide and comprehensive sense, as he intended. Desmoulins and Benson have their names employed for their respective strictly limited sections as they both originally intended. Benson did not include *Ariophanta* in his *Macrochlamys*, as he calls it *Carocolla*, nor did Desmoulins do so in the reversed case.

NANINA [MACROCHLAMYS] PSEUDOVITRINOIDES, n. sp.

J. A. S. B., 1832, pp. 13 and 76, as *Macrochlamys indica*, sine descr. (not *H. indica*, Pfr.); *H. vitrinoides*, Gray, P. Zool. S. 1849, pl. 2, f. 1-3, *cum anim.* [not *H. vitrinoides*, Desh.]; = *H. petrosa*, Bs., *pars*, [not of Hutton].

This is the common "snail" throughout the plains of the Gangetic Delta, quite distinct, both as regards shell and animal, from its close ally *N. petrosa*, Hutton, the type of which was from Mirzapore and which takes the place of the former in the higher regions of Lower Bengal; the two species were confused together by Mr. Benson under the name of *N. indica*, which he afterwards united to Hutton's *N. petrosa*; he could have seen but few specimens of our Calcutta form and those probably not living ones; Mr. Hanley does not represent our species in his invaluable Con. Indica, but gives a very fair figure of *N. petrosa*. The two varieties of *N. petrosa* recorded in my Handlist must be altogether eliminated; I am indebted to my friends Colonel Mainwaring and Mr. J. Caldwell for other specimens from Lucknow and Monghyr of *N. petrosa*, and to Mr. J. Wood-Mason for a fine series of *N. pseudovitrinoides* from Silhet.

I think Pfeiffer's Pl. 110, figs. 10-12 of the Conch. Cab. II, [not figs. 13-15] represents *N. pseudovitrinoides*.

NANINA [MACROCHLAMYS?] SIKRIGALIENSIS, G. Nevill.

I described this species, from Sikrigali in Behar, in my Handlist page 28; unfortunately the name was misprinted *N. sikrigallensis!* I may also take this opportunity of recording that species No. 73, page 28, *l. c.*, should be *N. cordemoyi*, not '*condemoyi*' as printed. The species being called after Mons. Jacob de Cordemoy, a distinguished Mascarene botanist.

Subgenus Acusta, Albers.

In my Hand-list, p. 45, I have erroneously classed this group as a subgenus of *Nanina*. It is, however, a subgenus of *Helix*, not of *Nanina*; I overlooked a note to that effect by Prof. von Martens, Moll. Ost-Asien, describing the jaw, &c.

Trochomorpha percompressa, Blanford, Pl. V, Fig. 22.

Proc. Zool. Soc. 1869, p. 448, Bhamó, "coll. J. Anderson."

I know of no other specimen but the type, of which I now give a figure.

Helix (Aegista) perplanata, G. Nevill, Pl. V, Fig. 21.

J. A. S. B., 1877, p. 19, Mimboo, Upper Burma, diam. 17½, axis 4½ mil.

I now give a figure of the type of this species, which is closely allied to the Indian *H. tapeina* on the one hand and to the Chinese *H. trichotropis* on the other. It was discovered by Dr. Anderson at Mimboo, near the Yunnan frontier. In my Handlist, I have classed this group under the subgenus *Plectotropis*, Martens (1860, type *H. elegantissima*, Pfr.), but I now consider that it is not separable from the previously described *Aegista*, Albers (1850, type *H. oculus*, Pfr.); Prof. Martens has lately given an important tabular arrangement of *Aegista* (restr.) in his 'Conch. Mittheilungen', Bd. I, Heft. 5-6, with figures and descriptions; I fancy, however, the professor has overlooked an important locality I have recorded for *H. trichotropis, viz.*, Upper Burma; perhaps, too, the localities recorded for *H. setocincta* "Sando and Ava" are printer's errors for those given by A. Adams as "Sado and Awa-Sima"; at any rate, I do not suppose Ava in Upper Burma or Sanda in Yunnan are intended.

Subgenus Acavus, Montfort.

The specimens of some of this group in the Indian Museum are incorrectly registered in my Hand-list, page 8; the entries should be corrected as follows:—

Helix (Acavus) hæmastoma, Linnæus.

Syst. Nat. X, 1758; Reeve, Con. Ic. fig. 366 and Conch. Indica, pl. 127, fig. 2.

30 Ceylon; coll. H. F. Blanford and G. Nevill, Esqrs.

var. melanotragus, Born.

Index and Test. Mus. Vindob. 1780, as *H. melanotragus*; Reeve, *l. c.*, fig. 366 C. and Conch. Indica, pl. 127, fig. 3.

10 Ceylon; coll. H. F. Blanford and G. Nevill, Esqrs.

HELIX (ACAVUS) SUPERBA, Pfeiffer.

Zeits. Mal. 1850, Ceylon; Reeve, *l. c.*, fig. 368.

2 Ceylon; coll. H. Nevill, Esq.

VAR. ROSEOLABIATA, NOV.

Hanley and Theob., Con. Indica, pl. 127, fig. 4, as H. superba.

6 Ceylon; coll. H. Nevill, Esq.

A variety very different from Pfeiffer's type, a fact apparently not noticed by Mr. Hanley.

HELIX (ACAVUS) PHŒNIX, Pfeiffer.

Malak. Blät. 1854, for Conchyl. Cab., fig. 1134 and Ed. nov. t. 3, fig. 9-10; also Reeve, fig. 376, (as *H. melanotragus*, var.) and Conch. Indica, pl. 127, fig. 6.

10 Ceylon; ex c. H. F. Blanford and G. Nevill, Esqrs.

HELIX (ACAVUS) GREVILLEI, Pfeiffer.

Proc. Zool. Soc. Lond. 1856, Ceylon and Novit. Conch., t. 30, fig. 6-7.

3 Ceylon; coll. H. Nevill, Esq.

Subgenus CORASIA, Albers.

According to Prof. C. Semper (Reise Philippinen, 1874), should be a section of *Cochlostyla*, not of *Helix*, as given in my Hand-list, p. 114. The same is recorded, *l. c.*, of the subgenera *Axina*, Albers, and *Callicochlias*, Hartm. (emend.).

The type species of *Axina* was not, however, examined; so I still consider this last as doubtful.

AMPHIDROMUS MASONI, Godwin-Austen.

Journ. As. Soc. Beng., 1876, Dihiri Farbat at 2000 ft.

This is my species No. 19, p. 127, of Hand-list, where I have erroneously recorded the species as *A. daflaensis*.

Subgenus BEDDOMEA, G. Nevill.

Hand-list, 1878, p. 127, type *Bul. ceylanicus*, Pfr.

The animal of the type species of this very distinct and well-marked group was described by E. L. Layard (Ann. Mag. 1853), as "of a brilliant green colour, visible through the shell; it feeds on the Coffee Plant." The group is recorded in Pfeiffer's Nomenclator (ed. Clessin), 1879, as part of the section *Phengus* of the genus *Cochlostyla!*

BULIMINUS (CERASTUS) JICKELIANUS, G. Nevill, Pl. VI, Fig. 2.

Hand-list, 1878, p. 133, Wadela Plateau, Abyssinia.

Shell imperforate, or scarcely superficially rimate, elongately oblong, moderately solid, longitudinally subobsoletely and obliquely striate, the striæ distinct near the suture and also near the peristome; spire conically elongate, rather acutely pointed; whorls 6½ or 7, the first 4½ scarcely convex, increasing regularly and slowly, the last two distinctly convex, increasing rapidly, the last one unusually attenuately produced; aperture somewhat everted, compressed, considerably higher than broad, columella broadly reflected, somewhat oblique.

Long. 34, diam. 15; apert. alt. 15, lat. 10 mil.

HAB. Wadela Plateau, Abyssinia; coll. W. T. Blanford, Esq.

Type, Indian Museum, Calcutta.

The dimensions of *B. olivieri*, Pfr., as originally described are—

Long. 27, diam. 14; apert. alt. 14½, lat. 8 mil.

From this latter species, *B. jickelianus* can be distinguished by the more pointed spire, less convex whorls, the last one especially being much less globose; by the more or less obsolete sculpture, more oblique columella, more everted aperture, closed umbilicus, &c.

Genus STENOGYRA, Shuttleworth.

Bern. Mitth. 1851; type, restr. H. and A. Adams, 1855, *Helix calcarea*, Born.

Subgenus GLESSULA, Martens.

Albers Heliceen, II, 1860, type *Achatina gemma*, Benson.

A genus of the family *Cionellida* in Pfeiffer's Nomenclator (ed. Clessin), a classification which I consider altogether unjustifiable. I am afraid the group will prove not separable from *Subulina*, Beck, the type of which is the West Indian *Helix octona*, Chemnitz, in which case the latter name must have priority. Be this as it may be, *Ach. paritura*, and *involuta*, Gould, *darnaudi* and *sennaarensis*, Pfr., as well as several other species, all from Africa—both East and West coasts—certainly belong to *Glessula*.

STENOGYRA (GLESSULA) OREAS, Benson, MS. Pl. V, Fig. 11 (Copy).

Reeve, Conch. Icon. 1850, fig. 113, as *Achatina oreas*, Nilgiris, long. 15½, diam. 7½ mil., anfr. 7 (ex icone); not *Ach. oreas*, Pfeiffer (as of "Benson"), or of Nevill, Hand-list I, p. 168.

I am indebted to Colonel Beddome for a single specimen of the true *St. oreas*, from Travancore. Anfr. 7; long. 14½, diam. 7¼ mil.

Mr. Hanley in his valuable and careful notes in the Con. Indica, p. 34, has already noticed the confusion of two distinct species under this name.

STENOGYRA (GLESSULA) PSEUDOREAS, n. sp

Pfeiffer, *Mon. Helic.* III, 1853, as *Achatina oreas*, Benson, MS. Nilgiris—anfr. 7 (?), long. 12½, diam. 5 mil., not *Ach. oreas*, Reeve (as of Benson) 1850; Nevill, Handlist, I, p. 168, as *St. oreas*.

Nilgiri specimens collected by Mr. Blanford (which I take for my type) measure—long. 11, diam. 5 [vix] mil. and are of six whorls only.

var. SUBDESHAYESIANA, nov.

Anfr. 6; long. 11, diam. 4¼ mil. Type var. from the Anamullays, coll. Colonel Beddome; also from the Pulney Hills, coll. Rev. Fairbank.

STENOGYRA (GLESSULA) JERDONI, Benson, MS. Pl. V, Fig. 14 (Copy).

Reeve, Conch. Icon. 1850, as *Achatina jerdoni*, Nilgiris—anfr. 7 to 8, long. 16, diam. 6 mil. (*ex icone*).

Pl. 78, fig. 10 of the Con. Indica represents a smaller form, of only 14 mil. and with the spire more produced and the last whorl a little less convex.

STENOGYRA (GLESSULA) NILAGIRICA, Benson, MS. Pl. V, Fig. 15 (Copy).

Reeve, Conch. Icon. 1850, fig. 87, as *Achatina nilagirica*, anfr. 10, long. 28, diam. 9 mil. (*ex icone*); Con. Indica, Pl. 35, fig. 6, as *Ach. perotteti* (not *Ach. perotteti*, Pfr.).

I have no doubt of the distinctness of Reeve's *A. nilagirica* and Pfeiffer's *A. perotteti*, despite the fact that the former has been classed as a variety of the latter by Dr. Pfeiffer; I have now given copies of the original type figures of both, which I think will convince most conchologists who have studied the genus. I have never seen a specimen of the true typical *St. nilagirica*, described by Reeve as "finely crenulate at the suture, then striated" &c. Colonel Beddome has, however, sent me specimens of what I consider a variety, though a very distinct one.

var. KURNOOLENSIS, nov.

Anfr. 11; long. 30, diam 9½ mil.

Distinguished from both *St. nilagirica* and *St. perotteti*, not only by its greater size and more numerous whorls, but especially by the (throughout) regular and prominent striation, not crenulate at the suture; from *St. vadalica*, Blanford, which it perhaps even more closely resembles, in general aspect at any rate, by the more abruptly tapering apical whorls, more arched columella, &c.

Nullaymullay mountains, Kurnool District, at 2500 ft.

STENOGYRA (GLESSULA) PEROTTETI, Pfeiffer, Pl. V, Figs. 17 and 17 *a* (Copies).

Rev. Zool. 1842, Nilgiris—anfr. 8, long. 22, diam. 9. mil. (not of Reeve, the Con. Indica, or Conch.—Cab. II, Pl. 26, figs. 16-17, as *Achatina perotteti*).

I have already remarked, under the preceding species, regarding the confusion of this species with Reeve's *St. nilagirica;* I have given copies of Dr. Pfeiffer's two original figures; he describes the sculpture as "ad suturam striati." The specimens from Neddoowutton in the Nilgiris, recorded in my Handlist, are the only ones I have seen of this species and they are unfortunately in bad condition.

STENOGYRA (GLESSULA) BENSONIANA, Pfeiffer.
Pl. V, Figs. 16 and 16 *a* (Copies).

Zeits. Malac. 1851, Nilgiris, anfr. 8½, long. 18, diam. 6½ mil.; Conch.-Cab. II, Pl. 26, figs. 12 and 13.

I have thought it desirable also to give copies of the original figures of this species, as the one given in the Con. Indica is quite unrecognizable. Besides, Dr. Pfeiffer's figures seem to me to show only 7½ whorls, whereas he describes it as having 8½, he also speaks of the suture as being "*confertim denticulata.*" The Museum specimens from Kotagherry have only 7 whorls—long. 17, diam. 6 mil.; I have lately also received from Colonel Beddome five specimens from the Sispara Ghat, three of these agree well with type figures, the other two are a slight variety with rather more convexly rounded whorls.

STENOGYRA (GLESSULA) FACULA, Benson, Pl. V, Fig. 18 and 18*a*. (Copies).

Ann. Mag. 1860, Nilgiris, anfr. 7½, long. 18, diam. 8 mil. for *Achatina perotteti* of Reeve, fig. 102 (not of Pfr.).

The only specimens in the Museum that I can consider as referable to this species are three from the Pulney Hills—anfr. 9; long. 18, diam. 7¾ mil. In sculpture they agree with Benson's description, "*irregulariter striatula*" &c.; anfr. ult. "*antice leviter remote plicato-striato.*" Mr. Hanley himself points out that his representation of this species in the Con. Indica is not an accurate one.

STENOGYRA (GLESSULA) OROPHILA, Benson, MS. Pl. V, Fig. 19 (Copy).

Reeve, Conch. Icon. 1850, fig. 105, anfr. 7, long. 14 mil., as *Achatina orophila*, Nilgiris and Colombo; fide Pfr. = his *A. ceylanica.*

I give a copy of Reeve's original magnified figure of his *A. orophila*, as I am by no means convinced Dr. Pfeiffer is right in uniting it to his *A. ceylanica;* to judge from the figures, I should say they were quite distinct species. It may be that Reeve confused two distinct forms, the one

figured (probably from the Nilgiris) a good and distinct species, the other from Ceylon a mere variety of *St. ceylanica*, which may have been sent, or shown, to Dr. Pfeiffer as *A. orophila* and caused him to unite the two species. I have not myself seen any species of the group, *St. nitens*, *ceylanica*, *punctogallana* &c., from Continental India; the very distinct *St. oreas* and *pseudoreas* are the nearest I know of. *Ach. orophila* is not mentioned in the Con. Indica.

STENOGYRA (GLESSULA) AMENTUM, Benson, MS. Pl. V, Fig. 20 (Copy).

Reeve, Conch. Icon. 1850, fig. 82, Howrah, as *Achatina amentum*, anfr. 8½, long. 30, diam. 11 *(ex icone)*; Benson, Ann. Mag. 1860, Nerbudda Valley, long. 24 mil.; Pfeiffer, Mon. III, anfr. 9, long. 22, diam. 7 mil.; Con. Indica, pl. 85, fig. 3.

Dr. Pfeiffer in his *Monogr. Helic.* has apparently overlooked Benson's important notice of this species as above quoted. Mr. Hanley's excellent figure of *Ach. amentum* is doubtless from a Nerbudda Valley specimen, with which it agrees exactly in measurements; long. 24, diam. 9 mil.; it appears to be a smaller and slightly different variety from the type Howrah form. I have already recorded that this rare species has also been found at Ganjam by my friend Mr. Valentine Ball of the Geological Survey; it has not, however, been found again in the immediate vicinity of Calcutta.

STENOGYRA (GLESSULA) SUBFUSIFORMIS, Blanford, Pl. V, Fig. 13.

P. Zool. Soc. 1869, Ponsee in Yunnan at 3300′, anfr. 8, long. 17⅜, diam. 5⅜ mil.

I give a figure of the unique type of this very distinct species, for which the Museum is indebted to Dr. J. Anderson's very successful researches during the first Yunnan Expedition. It is the most northerly species of *Glessula* as yet known, no other species having been described from China or Japan; there are three or four species known from the Philippines, Borneo, and Sumatra; in the main, however, the group appears to be essentially an Indo-African one. No species is as yet known from the Andamans, Nicobars, Seychelles, or Mascarene Islands; evidently *Glessula* is a continental rather than an insular genus.

STENOGYRA (GLESSULA) BLANFORDIANA, G. Nevill, Pl. V, Fig. 12.

Journ. Asiat. Soc. Beng. 1877, p. 26, Ponsee in Yunnan.

Shell ovately turreted, solid, of a dark brown colour, two apical whorls smooth, the others sculptured with raised, coarse, longitudinal, nearly perpendicular striæ, much crowded together and slightly flexuous on the last whorl; spire turreted, with very obtuse apex and excavated suture; whorls six, scarcely convex, the last one rounded at base; aperture vertical,

subquadrilateral, with a much thickened white peristome; columella broadly reflected, thickened, white, curved, forming an acute tooth, with a well developed incised notch at its base.

Long. 7, diam. 3 mil.

Hab.—Ponsee (type); also from near Bhamô. This species closely resembles *Glessula peguensis*, Blanford, but is less convex, that is, more slender, and of thicker texture; it can also be easily distinguished by the characteristic, crowded, well-developed, nearly perpendicular, longitudinal striation, varying slightly in direction on each whorl, much as in many species of *Pomatias*. The columella also is peculiar.

Type, Indian Museum, Calcutta.

Stenogyra (Glessula) bollampattiana, Beddome.

Con. Indica, Pl. CLVI, fig. 1, as "*Achatina bollampetana*," Beddome, MS.

Long. 25½, diam. 10 mil.; whorls 7, of unusually solid substance.

I am much indebted to Colonel Beddome for typical specimens of this very distinct and rare species, also for kindly informing me that it is found on the Bollampatty Hill, near Coimbatore at 7000′, and that the name should be spelt as I have now given it, Mr. Hanley having misread the original label.

Balea dohrniana, n. sp.

Shell of seven gradated, cylindrical whorls, increasing very gradually, the last one proportionately very short, apex obtuse; brown, irregularly and indistinctly mottled with blue; almost smooth, the somewhat irregular, rugose striæ being nearly obsolete, even under a lens, except immediately behind the peristome; aperture markedly everted, as broad as high, chestnut-brown within; peristome broadly reflected, white, thickened, regularly rounded below, columella broad, nearly straight, margins of aperture joined with a distint callosity, no parietal tooth. Long. 10¼, diam. 3¾ mil.

Hab.—Peru.

The only other species I know of from Peru, or indeed from South America, is the *B. peruviana* of Philippi, which, however, has 8 to 9 whorls and measures long. 13 to 14, diam. 3 mil.; I have named this interesting form, for which I am indebted to my friend Mons. P. Joly of Algiers, in honour of Dr. Henry Dohrn of Stettin. There are several very interesting new forms of *Clausilia* obtained by the same collector, in Mons. Joly's collection.

Type, Indian Museum, Calcutta; also in coll. Joly and Dohrn.

Balea pyrenaica, Bourguignat.

Rev. and Mag. Zool. 1857, Pyrenees, long. 12, diam. 3 mil.

var. LUCHONENSIS, nov.

Vix perforata, anguste fusiformi-turrita; anfr 8—9 *convexiusculis, ultimo vix majore, basi rotundato; apertura oblonga, superne haud coarctata, peristomate expanso, marginibus callo valido, haud tuberculato, junctis.*

Long. 9, diam. 2¼ mil.

HAB.—Bagnères de Luchon, Pyrenees.

Type var., Indian Museum, Calcutta; coll. G. Nevill, Esq.

VERTIGO PRASLINENSIS, n. sp.

Nevill, Proc. Zool. Soc. 1869, p. 65, as "*Carychium*, n. sp.?"

Shell resembles *Pupa lienardiana*, Crosse, from Rodriguez, but the spire is less produced and there is no trace of the conspicuous parietal tooth; apex remarkably obtuse; 4½ whorls which increase very rapidly, the first three more or less cylindrical, the last one moderately convex; smooth, even under the lens no trace of sculpture is discernible; aperture triangular, regularly rounded at base, external margin somewhat obsoletely sinuate; a strongly developed, transverse columellar tooth, three other palatal teeth, equidistant, the middle one the largest, no parietal tooth.

Long. 2 mil.

HAB.—Island of Praslin, Seychelle Group.

Type, Indian Museum, Calcutta.

SUCCINEA LONGISCATA, Morelet.

Moll. Portugal, 1845, pl. V, fig. 1; Baudon, Journ. Conch. 1877, pl. XI, fig. 2, as *S. elegans*, var. *longiscata* and subvar., *l. c.* 1879, pl. XI, fig. 6, as *S. elegans*, var. *longiscata*, subvar. *Folini*; Bourguignat, Esp. Franc. *Succinea*, p. 20, from Troyes, (as possibly introduced).

The Museum is indebted to Dr. J. Anderson for numerous specimens, preserved in spirit, from Mount Hermon in Palestine of this well characterized and very distinct species. How so many conchologists can have confused it with *S. elegans*, Risso or *S. pfeifferi*, Rossm. seems to me almost incomprehensible. Probably in most instances they had not seen the real species at all, or only examined some wretched isolated specimen. The species has only been hitherto recorded from Portugal, Algiers, Biarritz, and Troyes (?); this indubitable Palestine habitat is therefore very important, more especially as no well authenticated species has been as yet identified from Asia Minor, though the genus has been long known to occur there.

These Mount Hermon specimens are perfectly undistinguishable from numerous specimens I possess from Maison Carrée in the Province of Algiers; the latter again I carefully compared with typical Portuguese specimens

in the collections of MM. Morelet and Crosse and found to be unmistakeably of one and the same species. The variety, so well described and figured by Baudon in the Journ. de Conch. 1879 as var. *Folini*, differs but very slightly, scarcely sufficiently to justify its separation, even as a variety, this was evidently also the opinion of M. Baudon when he wrote, *l. c.* 1877 p. 173, "J'ai reçu de MM. Bérillon and de Folin de nombreux specimens de *S. longiscata* des Basses Pyrénées parfaitement semblables au type de Morelet." I found the variety *Folini* tolerably abundant both at Biarritz and Bayonne. The differences between *S. elegans* and *S. longiscata* are well shown by M. Baudon's excellent figures, *l. c.* 1879, Pl. XI, fig. 6 and fig. 5; the former being *S. longiscata* and the latter *S. elegans*.

SUCCINEA YARKANDENSIS, n. sp. Pl. V, Fig. 10.

Moll. Yarkand Mission, 1878, as S. *pfeifferi*, Rsm., var.

Shell oval, comparatively somewhat thick, of a bright amber colour, last whorl throughout closely, regularly, and undulately striated, striæ though distinct somewhat superficial, or not deeply incised; spire shortly produced, strongly twisted, abruptly and strikingly bent back, apex somewhat obtuse; whorls 2½, the last very large in proportion, narrowly produced, that is not tumid or ventricose; aperture considerably everted, very long in proportion to its breadth, margins joined by a small amber coloured callosity, columellar margin not thickened, nearly straight, beautifully gradually rounded at base.

Long. 11, diam. 6; apert. alt. 7½, lat. 4 mil.

HAB.—Yarkand and Sasak Taka (Kashgar); coll. Dr. Stoliczka. Since I wrote my account of the Mollusca of the Yarkand Expedition, I have been able to collect and carefully examine numerous forms of the European *Succineæ*, and have also had the advantage of studying the excellent and elaborate monographs of the French species by MM. Bourguignat and Baudon (J. de C. 1877 and 1879); I now consider this Yarkand form as a distinct and well characterized species, nearest allied to *S. contortula*, Baudon; the few whorls, the remarkable way in which the spire is abruptly bent back, the distinct and regular, though superficial, striation, especially noticeable near the columellar margin, the everted aperture, &c. all enable the species to be distinguished at a glance from others of the group of *Suc. pfeifferi*.

Type, Indian Museum, Calcutta; also in coll. von Martens and Bouvier.

Genus HYALIMAX, H. and A. Adams.

Gen. Moll. II, 1855, as subgenus of *Limax*, type *Limax perlucidus*, Quoy (insufficiently described); ampl. Fischer, J. de C. 1867, as genus allied to *Succinea*.

In my Hand-list I attributed this genus to Prof. Fischer, which was scarcely strictly accurate. I am indebted to Mr. Wood-Mason for the generic identification of a new slug, lately found at the Andamans by Mr. de Roepstorff, undoubtedly belonging to *Hyalimax*. This, I consider, a very important discovery, especially as bearing upon my statement, in the introduction to this paper, of the remarkable affinities between the land Mollusca of the Mascarene Islands &c. and those of the Andaman and Nicobar groups &c.

Hyalimax is not known from Continental India or Ceylon; whereas three species are known from Mauritius and Bourbon, one from the Nicobars, described by Mörch in 1872 as *Hyalimax reinhardti*, and finally the new Andamanese form, now for the first time recorded. I trust Mr. Wood-Mason will shortly carry out his present intention of giving us a detailed description of this curious "slug." I should not be surprised if *Parmella* of Mr. H. Adams, described from the Fiji Islands in the P. Z. S. for 1867, prove to be an allied form to *Hyalimax?*

LIMNAEA PHILIPPINENSIS, n. sp.

Shell scarcely rimate, small, horn coloured, conically globose, longitudinally striate under the lens; spire short, apex rather pointed; whorls four, the upper ones very small, scarcely convex, the last one very large in proportion, tumidly ventricose; aperture ovate, large, proportionately unusually broad, margins joined by a thin callosity, outer margin boldly, convexly rounded; columella straight, very slightly twisted, broadly reflected, rounded at base.

Long. 8½, diam. 5½; apert. alt. 5¾, lat. 4 mil.

HAB.—Lucban, Luzon (Philippines), coll. R. Hungerford Esq.

This is a small species of the group of *Limnaea peregra*, closely allied to the next species, of which indeed some conchologists may prefer to rank it as a geographical variety. Both perhaps are geographical races, or subspecies, of *L. ollula*, Gould, P. B. S. 1869 from Hongkong, sent me from that place and also from Swatow by Surgeon-Major Hungerford, which again = *L. pervia*, Martens.

LIMNAEA ANDERSONIANA, Nevill, Pl. V, Fig. 9.

J. Asiat. Soc. Bengal, 1877, p. 26, Yunnan at 4000 ft.; var., Nevill, Moll. Yarkand Exp. 1878, p. 9, Yarkand, not the var., *l. c.* from North Tangitan and Kashgar, which is *L. pervia*, Mart. (= *L. ollula*, Gld.).

LIMNAEA YUNNANENSIS, NEVILL, Pl. V, Fig. 8.

J. Asiat. Soc. Bengal, 1877, p. 27, Sanda in Yunnan.

PHYSA HUNGERFORDIANA, n. sp.

Shell convexly ovate, imperforate, moderately thick, scarcely transparent, somewhat obsoletely striate, striæ close, regular, slightly flexuous; yellowish brown, generally covered with a dark coloured deposit; spire turretly produced, suture excavated, apex somewhat obtuse; whorls 3½, increasing rapidly, convexly swollen; aperture narrowly produced, as broad above as below, outer margin gradually rounded: columella somewhat reflected or thickened, twisted, bent a little backwards at base.

Long. 13½ to 14½, diam. 7½; apert. alt. 8, lat. 4 mil.

HAB.—Lucban, Luzon; coll. R. Hungerford Esq.

The only other Philippine, or indeed Malayan, species except *Ph. moluccensis*, Lesson, is *Ph. philippiana*, Martens, Malak. Blät. 1867; long. 19, diam. 12 mil.

Küster's Pl. I, figs. 18—20 will give a rough idea of the general shape of *Ph. hungerfordiana*.

ACMELLA HUNGERFORDIANA, n. sp. Pl. VII, Fig. 11.

Shell, in shape like *Acm. moreletiana*, Nev., but a little less turreted, deeply but narrowly umbilicate, smooth, polished, hyaline, so transparent that often the axis can be traced nearly up the apex. Spire regularly conically pointed, suture excavated, narrowly marginate, or rather shelved, below, apex somewhat acute; whorls 6, increasing very gradually and regularly, the last one convexly globose, faintly depressed near the very characteristic, profoundly excavate, though narrow, umbilicus; aperture ovately rounded, outer margin regularly convexly rounded; columella acutely angled about the middle (at the umbilicus), then straight and gradually rounded at base.

Long. 3½, diam. 2½ mil.

HAB.—Guimaras (Philippines), living on the ground, amongst dead leaves, &c., in company with *Cyclotus pusillus*, Sow., var. nov., *Nanina caducior*, Rv., species of *Cyclophorus* and *Pupina*, &c.; coll. Surgeon-Major R. Hungerford.

This very interesting shell is the finest and largest species of the genus, as yet described; it presents many interesting points of resemblance to my *Acm. moreletiana*, Proc. Zool. Soc. London, 1879, Pl. 59, fig. 4, from Batti Malve (Nicobars).

Type, Indian Museum, Calcutta; also in coll. Dohrn and Hungerford.

CYCLOTUS PUSILLUS, Sowerby.

P. Z. S. 1843, Luzon and Negros.

VAR. NANA, nov.

Differing from the type by its considerably smaller size, non-reflected peristome and comparatively slightly more developed spiral sculpture; the

living animal covers its shell with a thick coating of mud, arranged in a quasi-symmetrical manner, as I have also seen in species of *Succinea Pterocyclus*, &c.; the operculum externally is distinctly concave.

Diam. 6½, alt. 4½ mil.—Cebu.

Diam. 5¾, alt. 3 mil.—Guimaras.

Pfeiffer records typical *C. pusillus*, ex coll. Cuming, as diam. 11, alt. 6 mil.

Hab.—Cebu (type var.) and Guimaras. This small *Cyclotus* was found tolerably abundantly by Surgeon-Major Hungerford, living on the ground, in company with species of *Pupina* and *Acmella*, &c.

Genus Cyathopoma, Blanford.

Colonel Beddome has already pointed out, and I believe it is now generally accepted as correct, that *Jerdonia* and *Mychopoma*, Blanford, can only be retained as sections or subgenera of *Cyathopoma*. Hitherto the genus has been supposed to have a very limited range, but this is not so in fact, as it extends as far as the Pacific Archipelago where the species are known under the name of *Diadema*, Pease (= *Garettia*, in Catal. Paetel and Mus. Godef.); the type species of Pease's *Diadema (Pterocyclos?) parvus*, Pease, 1865, from the Hervey Islands, is, as regards its shell, a true *Cyathopoma*, being wonderfully close to *Cya. filocinctum*, only rather smaller: its operculum is correctly described by Pease as follows:—"*O. subcartilageum, elevatim spiraliter lamellatum, intus concavum, basi late reflexum;*" the very concave shape gives it a striking resemblance to that of many species of *Pterocyclus*. Reference to the original description of the operculum of *Cyathopoma* will at once show that no separation can be effected on this character only: "*O. truncate conoideum, concentricum, multispirum, e duabus laminis compositum; interna membranacea, externa testacea perconcava; anfractuum marginibus externis in lamellam testaceam, versus medium incurvatam, interdum pulchre sculptam, elevatis.*"

I consider therefore that *Diadema* must rank as a subgenus of *Cyathopoma*, distinguished by its *Pterocyclus*—like operculum, and that it is of approximately equal value with *Jerdonia*. The following is Blanford's original description of the operculum of *Jerdonia*:—"*O. concentricum, arctispirum, sulco marginali circumdatum, duplex; interne membranaceum, externe testaceum et ex anfr. vittaeformibus compositum, quoque proximi interioris marginem externum tegente.*"

It is very remarkable that at the Hervey Islands another small shell occurs with all the characters of the shell of *Jerdonia* and closely resembling, indeed, the type species *J. trochlea*; this is the *Cyclostoma biangulatum* of Pease, P. Z. S. 1864, referred to *Cyclophorus* (*Ostodes*) in the *Donum Bismarckianum* and still more correctly, I consider, to *Cyclomorpha* of

Pease, by von Martens in the Zool. Record for 1871, p. 162; I have extracted the operculum and find it to be something like that of *Omphalotropis*, of thin, horny texture, with 4 to 5 well defined whorls.

The operculum of *? Diadema rotella*, Pease, a small smooth form, something like a miniature *Leptopoma luteum*, is not as yet known, and it is not present in our single Museum specimen from Rarotonga.

CYATHOPOMA (JERDONIA) IMPERFORATUM, n. sp.

Beddome, P. Zool. S. 1875, p. 449, as "probably a new species" from the Anamallays at 6600 ft. (under *Cya. elatum*, Bedd.).

There is a single specimen in the Museum, for which we are indebted to Colonel Beddome; the species is at once distinguished by its being the only described species of the genus with an imperforate base; I hope to give a figure and more detailed description later on.

Alt. 2½, diam. 2 mil.

CYATHOPOMA SHEVAROYANUM, Beddome, Pl. VI, Fig. 7.

Proc. Zool. Soc. 1875, Shevaroy and Yellagherry Hills (Salem District).

I have thought it well to publish the three figures of this interesting form which had been prepared under the directions of the late Dr. Stoliczka; the specimens are from the Shevroys. The operculum externally presents a curious analogy to that of some species of Turbo; it is convex, testaceous, smooth, with only a very small and inconspicuous "umbo," or opening, which is situated considerably above the centre, consequently near the top of the aperture.

CYATHOPOMA (JERDONIA) BEDDOMEANUM, Nevill.

Beddome, Proc. Zool. Soc. 1875, as *Cyathopoma (Jerdonia) blanfordi*, Tinnevelly Mns. at 4000 ft., not *Cya. blanfordi*, H. Adams, P. Zool. S. 1868, Seychelles.

PTEROCYCLUS CYCLOPHOROIDEUS, n. sp.

This is a form that has hitherto been confused with *Pt. nanus*, Benson, the shell is more depressed and of thicker substance, resembling more closely *Cyclophorus stenostoma*, Sowerby, both in form and colouration; it can be distinguished at a glance by the apparently constant absence of the conspicuous band at the periphery; I intended, despite all the above, to have merely separated it as a subspecies, when I noticed that all my Anamullay specimens have a much raised, concave operculum, whilst on the other hand in my single operculated specimen of *Pt. nanus* it is only slightly raised, scarcely concave, &c. The Museum is indebted to Colonel Beddome for three operculated specimens from the Anamullays, one of which I take as my type form.

Alt. 8½, diam. 16 mil.

The same valued correspondent has also sent me from the Anamullays two specimens of a light yellow (instead of darkish brown) colour, scarcely if at all streaked or mottled, whereas my type has a more or less reticulate style of painting, for this form I propose the name var. *subluteola*.

Colonel Beddome has further sent two specimens, from the Anamullays at 2000 feet, of a smaller, rather solid form, in colouration &c. presenting a remarkable analogy to *Cyclophorus stenostoma*; this may be known as var. *substenostoma*.

I may mention here that the Colonel has also found in the Anamullays an allied, rather larger species, very strikingly streaked with "tiger-like" markings, with a somewhat similar operculum, but well characterized by the much more highly developed "wing" to the peristome, for which he proposes the name *Pt. comatus*, Beddome, n. sp.

PTEROCYCLUS NANUS, Benson.

Ann. Mag. 1851, Nilgiris, "taken with *Pt. bilabiatus*," diam. 29 mil.

The Museum possesses three specimens from the collection of the late Dr. Stoliczka, unfortunately only labelled "South India." These agree exactly with the original description and with Pfeiffer's figures of a typical specimen, Conchylien Cabinet II, Pl. 49, figs. 31-3, at once characterized by the conspicuous band at the periphery, rather raised spire, and rather simple lip. Looking to the original description of *Pt. bilabiatus*, as a guide to the exact habitat of the type, apparently the neighbourhood of Salem will prove also to be the home of this form.

Mixed with the above was a single specimen of an interesting, rather more richly painted, very flat-spired form, with the whorls increasing a a little more slowly, the umbilicus a trifle more open, &c., this I propose to distinguish as var. *applanata*.

Alt. 7, diam. 13¾ mil.

var. REFLEXILABRIS, nov. (? distinct species).

A white apparently colourless form, with black apex and easily distinguished from the preceding, as well as *Pter. cyclophoroideus*, by the fragile, broadly reflected and duplex peristome, rather differently shaped too above; the operculum, in my single specimen, agrees with what I take to be the typical form; it is very little raised, or concave. This specimen I purchased from the collection of the late Mr. Lombe Taylor, labelled "Khoondah Mountains, coll. Pirie". Mr. H. F. Blanford also possesses two specimens, labelled "Nilgiris;" they are doubtless from the same habitat.

CYCLOPHORUS PEALIANUS, n. sp. Pl. VI, Fig. 3 (vel C. SUBLAEVIGATUS, Blf., var. PEALIANA).

J. A. S. B. 1877, page 28, Naga Hills, axis 30, diam. 56 mil., as *C. sublaevigatus*, Blf. var. *pealiana*.

Openly and deeply umbilicate, conically somewhat depressedly turbinate, solid; under the lens, the lower whorls are most minutely decussately sculptured, the apical 2½ whorls on the other hand possessing characteristic, well marked, distant, longitudinal striation only, these striæ being incised and very obliquely flexuous; above the periphery a broad, white zone, above and below which there are crowded chestnut-brown bands, almost or altogether confluent, umbilical area white; spire moderately raised, with the apex exserted in a "mammillate" manner, suture distinct; whorls 4½, convex, the last one with a raised and somewhat rounded keel at the periphery, which becomes obsolete near the peristome; aperture almost round, oblique, of a bluish-white colour, peristome callously expanded, boldly and evenly rounded, columellar margin also evenly rounded, margins of a very characteristic, brilliant orange-red colour, joined by a well developed callosity of the same shade.

Alt. 40½, diam. 58 mil.

Type, Indian Museum; also in coll. Morelet, von Martens and Dohrn.

Hab.—Naga Hills; coll. S. E. Peal.

This fine form which I have previously described and named in the Journal, I still consider may be better classed as a variety, though a very distinct one, of the smaller, more depressed and white lipped *C. sublævigatus* of Blanford. Nevertheless I have thought it well to give it here a regular specific name, with a detailed description, as a matter of convenience for such conchologists as may deem it worthy of specific rank.

Cyclophorus (Theobaldius) orites, n. sp. Pl. VI, Fig. 4.

Broadly and openly umbilicate, solid, depressed, subdiscoidal, covered with a rather thick, smooth, bright yellow, or horn-coloured, epidermis, throughout under the lens very minutely, closely, obliquely striated; spire perfectly flat, suture excavate; whorls 4, the last one perfectly round, increasing unusually rapidly in size; aperture circular, peristome double, the outer margin above near the body whorl, being slightly subangulately produced, showing a distinct transition to the "wing-like" process of *Pterocyclus*, columellar margin oblique, the duplication of the peristome becoming obsolete.

Operculum thin, horny, slightly immersed, flat, composed of five or six acutely defined volutions.

Alt. 5½, diam. 14$\frac{1}{16}$ mil.

Type, Indian Museum; from Sikkim, Chola Range, at 11,000 ft.

This interesting species, No. 73, page 276, of my Hand-list, is very distinct from its allies of South India and Ceylon.

CYCLOPHORUS SPECIOSUS, Philippi.

Zeits. Mal. 1847, Hab. ?, alt. 35, diam. 61 mil.

var. AUREOLABRIS, Nevill.

Handlist I, 1878, p. 267, Burma (erron.).

I am much indebted to Mr. Wood-Mason for the information necessary to establish the exact home of this well characterized and very beautiful form, almost deserving of specific rank.

A second specimen, in more perfect condition, having been obtained by E. W. Dun, Esq., of H. M.'s 34th Regiment, N. I. (whilst accompanying Major M. O. Boyd on his recent mission to the Lushai Chiefs) on a ridge within 10 miles of Lushai Haut.

Alt. 41½, diam. 59, perist. crass. 8 mil.

CYCLOPHORUS FORMOSAENSIS, n. sp.

Pfeiffer, Nov. Conch. II, 1864, Pl. 68, figs. 14—15, Formosa, as *C. exaltatus*, var.?

Surgeon-Major Hungerford who has lately found numerous living specimens, both of the Formosan form and of the Hongkong *C. exaltatus*, Pfr. considers them undoubtedly specifically separable. With this view, I entirely agree; Pfeiffer himself indeed appears to have been in considerable doubt on the subject.

Type, Indian Museum, Calcutta; also in coll. Beddome, Hungerford, Dohrn, &c.

PUPINA GUIMARASENSIS, n. sp.

Very closely allied to the Cebu *P. bicanaliculata*, Sow.; smaller, more compressed, apex slightly more obtuse, of a light reddish-brown colour, smooth, of a thicker and less transparent substance; the upper whorls a little more convex, the last two (especially the last) markedly less tumidly swollen; aperture smaller, rounder, with the slight deflection of the outer margin above less developed, the parietal plication stronger, less obliquely twisted, columellar characters much the same.

Long. 6, diam. 3⅓ mil.

Cebu specimens of *P. bicanaliculata* measure, long. 7, diam. 4½ mil.

HAB.—Guimaras; coll. Surgeon-Major R. Hungerford.

By some this Guimaras form may be considered as a geographical variety of *P. bicanaliculata*; its characters seem to me, however, to compel specific separation.

PUPINA HUNGERFORDIANA, Nevill, Pl. VI, Fig. 6.

Handlist I, 1878, "Asadden Rv.," long. 8¼, diam. 5 mil.

I have nothing to add to my above given description of this very distinct species, but it is necessary for me to correct my altogether mistaken reading of the original label of the locality sent me by its discoverer—Surgeon-Major R. Hungerford—it should read "Hsaddan Koo, Salween Valley."

CATAULUS TORTUOSUS, Chemnitz.

Conch.-Cab. I, Vol. XI, 1795, figs. 1882-3, "Nicobar Islands," as *Turbo tortuosus.*

Mr. Benson long ago expressed his belief that this most remarkable form would prove to be a native of South India and not of the Nicobars. If this were the case, it could scarcely have escaped the researches of so indefatigable a naturalist as Colonel Beddome; nor has it—the Colonel having lately found a single specimen on the Hills N. E. of Trevandrum at 2500 feet, which he has most generously presented to the Indian Museum; the apical portion is unfortunately broken away, but the remainder agrees well with the somewhat crude original figure and the much better ones of Sowerby in the Thesaurus and Con. Indica.

ALYCAEUS MONTANUS, n. sp. Pl. VI, Fig. 5.

Openly and widely umbilicate, much depressed, solid, bright corneous brown, closely, evenly and regularly ribbed, ribs somewhat superficial, scarcely flexuous, close-set, for a short distance at the sutural tube more crowded and more strongly developed; spire scarcely elevate, apex obtuse; whorls 4, regularly evenly rounded, constriction scarcely defined, sutural tube short (about 1 mil); aperture circular, peristome slightly thickened, but not double; operculum thick, black, and concave.

Hab.—Sikkim, at 11,000 ft.

Diam. $5\frac{1}{4}$, alt. $3\frac{1}{10}$ mil.

A well marked form, reminding one of *A. expatriatus;* the depressed form, very open umbilicus, and scarcely distinguishable constriction are all good characters.

ALYCAEUS HUNGERFORDIANUS, n. sp.

Shell depressed, in shape resembling the preceding, but markedly less openly umbilicate; solid, more or less of a pinkish hue, irregularly spirally striate on the upper two whorls, then distantly ribbed, the ribs becoming gradually more acutely raised, and consequently more prominent, a little more close-set at the sutural tube, the difference not being very noticeable as in the preceding, ribs behind the peristome acute, prominent, distant; spire scarcely elevate, apex obtuse, peculiarly, abruptly and prominently raised, slightly twisted; whorls 4 (or $4\frac{1}{2}$?), compressedly convex, having a slightly subangulate appearance at base, where the sculpture is as well defined as it is above; constriction slightly developed, rather produced, much as in *A. stoliczkii,* sutural tube short as in the preceding; aperture circular, peristome remarkably thickened, generally distinctly triple, but sometimes only double, forming a slight projection over the umbilical area.

Diam. 4, alt. 2 mil.

Found tolerably abundant at Tamsui by Surgeon-Major R Hungerford; the first species described from Formosa belonging to the section *Charax*, the only other species known being *Aly. (Dioryx) swinhoei*, H. Adams.

DIPLOMMATINA HUNGERFORDIANA, n. sp.

Dextral, imperforate, conically ovate, rather solid, of a golden brown colour, sometimes white or nearly so; spire conical, not attenuate, apex obtuse, suture impressed; whorls 6 tumidly, convexly swollen, the upper ones lightly, regularly striate, the striation almost obsolete on the antepenultimate whorl and altogether so on the last one; aperture nearly circular, margins joined with a beautifully arched callosity, conspicuously raised and thus defined on its outer margin, the double peristome usually of a bright orange colour is boldly and evenly rounded, the columellar margin is scarcely oblique, only very slightly subangulate at base, with a tolerably prominent fold or tooth.

Long. 3, diam. 1¾ mil.

Found by Surgeon-Major R. Hungerford at Kulung in Formosa. In sculpture it somewhat resembles *D. semisculpta*, Blf. I know no Indian species with the whorls so regular in shape and evenly rounded, the antepenultimate as usual being a little the broadest; the columellar margin is also more rounded than usual and less distinctly subangulate at its base. J. A. S. B., 1870, pl. 1, fig. 3 A. (*D. sherfaiensis*) gives a fair idea of it; the peristome is, however, very different, being boldly and evenly rounded, very broadly reflected, its duplication giving it a sulcate appearance as in J. A. S. B., 1875, pl. VI, fig. 4, (*D. burti*); viewed from the side this duplication does not show at all, as for instance, *loc. cit.* 1870, fig. 3 B, and the peristome then appears to be simple as *loc. cit.* 1875, fig. 6, (*D. tumida*). J. A. S. B., 1875, pl. IV, fig. 5, I consider quite distinct from *D. sherfaiensis*, and I suggest for it the name *D. japeoensis*; it gives a very good idea of the shape of the whorls of my *D. hungerfordiana*; in the latter, however, the last whorl at base is less prominently ventricose. This is the first species of the genus known from Formosa; from Japan three species have been described by von Martens; Gould described two species of *Paxillus* from Hongkong and the Loo Choo Islands; no species is as yet known from China proper.

CYCLOSTOMA (TROPIDOPHORA) CALDWELLIANUM, Nevill, Pl. VI, Fig. 10.

Hand-list I, 1878, p. 305, Pouce Mn. Mauritius (semifossil), long. 31, diam. 30 mil.

Deeply, though narrowly umbilicate, globosely conical, rather fragile (at least in its subfossil state), colourless, spire conically produced, apex acute, suture more or less subcanaliculate, characteristically "fimbriate" or puckered; whorls 5 to 6, convex, the last one rather more convex above

than at base, the last three whorls closely, acutely, spirally striated, striæ slightly undulating, the interstices obliquely, longitudinally and more or less subobsoletely striated, the penultimate whorl is acutely keeled in the middle and again quite at its base, the last whorl is prominently carinate at the periphery with a second keel half way between it and the suture and a third round the umbilicus, the umbilical area being spirally and irregularly keeled; aperture rather oblique, nearly circular, peristome reflected, above peculiarly and markedly sinuate, the inflection (or "sinus") broad and shallow and at some slight distance from the body whorl, afterwards boldly rounded, columellar margin only slightly reflected above over the umbilicus, oblique, acutely angulate at base.

Measurements of another, rather smaller specimen than the type, Alt. 26, diam. 26¾ mil.

As I have already remarked, a close ally of *C. carinatum*, Born (= *C. tricarinatum*, Sow., not *H. tricarinata*, Müller = *C. tricarinatum*, Lam., a quite different species from Madagascar); it can, however, be always easily distinguished by the more produced spire, much narrower umbilicus (which is more irregularly keeled), the "fimbriate" suture (as in *C. liénardi*, Morelet and *C. fimbriatum*, Lam.), the prominent and close-set spiral striation, &c. The figures in Born, Sowerby, and Reeve all depict the true *C. carinatum*, of which I consider Reeve's figure of *C. unicolor*, Pfr. as a mere variety. The Museum is indebted for two specimens of this latter form to Mr. J. Caldwell, who informs me that one of his specimens of typical *C. carinatum* was found by him with the animal still preserved and only recently dead.

Pfeiffer's figures in the Conch.-Cab. II, pl. 39, figs. 5 to 7, as "*C. unicolor*," represent a quite distinct species, (though also from Mauritius), as can be seen by a reference to his original description, "*anfr. ult. superne et medio acute carinatus*," borne out by Reeve's figure of the type specimen. I presume a similar confusion has arisen to that which I have explained with regard to the *Nanina petrosa* of Hutton and again with the *Helicarion monticola* of Pfeiffer (compare Moll. Yarkand Mission, page 15).

Probably Dr. Pfeiffer rightly supposed that he had erred in describing a mere variety of *C. carinatum*, Born, as a new species *(C. unicolor)*; later on, finding an allied, but very distinct, species, he figured the latter in the Conch.-Cab., giving it the name of his former spurious species.

C. caldwellianum occurs abundantly, in a subfossil state, on the ascent of the Pouce Mountain, together with other extinct species of *Tropidophora* and *Omphalotropis*.

Type, Indian Museum; also in coll. J. Caldwell.

var. SUBLAEVIS, nov.

The spiral and longitudinal striation more or less obsolete, Mauritius.

Type var. Indian Museum; also in coll. Caldwell.

var. SEXCARINATA, nov., Pl. VI, Fig. 10 A.

A very handsome, solid form, with six prominent keels on the last whorl, the interstitional striation obsolete, as in the preceding variety, columellar margin subangulately rounded, instead of oblique.

Alt. 34, diam. 35½ mil.—Mauritius.

Type var. Indian Museum; also in coll. J. Caldwell.

I may take this opportunity of recording that Mr. Caldwell possesses a variety of *C. carinatum* with four keels.

CYCLOSTOMA (TROPIDOPHORA) ERRONEUM, n. sp.

Pfeiffer, Conch.-Cab. II, pl. 39 figs. 5—7, Locality (?), as *C. unicolor* (not *C. unicolor*, Pfr., P. Z. S. 1851, or of Reeve fig. 39).

I take as my type, the abundant form represented by Pfeiffer's above quoted fig. 7; the larger variety seems to be much rarer. Though exceedingly variable, *C. erroneum* can always be easily distinguished from *C. carinatum* and its variety, the "*unicolor*" of Pfeiffer 1851 and of Reeve, by the regular and close-set spiral sulcation, without the prominent and characteristic keels of its ally; though more or less subangulate at the periphery, the whorls are always more convex, and this is especially noticeable at the base of the last whorl, which is also spirally sulcated, instead of being smooth as in *C. carinatum* and as well shown in Reeve's figure of Cuming's type of *C. unicolor;* the umbilicus is always markedly less open, as well shown in Pfeiffer's fig. 6.

Type, Indian Museum.

Alt. 21½, diam. 24 mil.

Keel round the umbilicus almost or altogether obsolete.

M. Morelet in the Journ. de Conch. for 1877, p. 213, describes and separates under three "heads," the forms figured by Reeve and Pfeiffer, &c., which he unites as varieties of *C. unicolor;* if this be done, I consider it impossible to avoid uniting both to *C. carinatum*, from which the type of *C. unicolor* differs less than does the latter from my *C. erroneum*. Undoubtedly we have here an instance of a gradual transition from the extreme form of *C. carinatum* to the *C. unicolor*, var. *C.* of Morelet, intermediate forms of countless variability having been preserved for us in a subfossil state. It is, I think, comparatively immaterial whether we consider *C. carinatum*, *unicolor*, and *erroneum* as distinct species, or the two latter as subspecies of the first; after a careful examination of many hundreds of specimens, I think it better not to separate the true *C. unicolor* from *C. carinatum*, except as a variety, and preferable to separate the (more or less)

keelless form specifically. If the latter be united, it would perhaps lead too far; the umbilicus is sometimes so much covered that *C. barclayanum* could scarcely be separated. Even *C. ligatum*, as hinted by M. Morelet, would become questionably distinct. *C. erroneum* is to be found abundantly, subfossil only, in the coralline sands, near the seashore, on the West Coast of Mauritius. My friend Mr. J. Caldwell possesses a very numerous and fine series.

var. SUBUNICOLOR, nov.

A variety which instead of being subangulate at the periphery is distinctly keeled; two or three of the spiral striae between the keel and the suture are also slightly more prominent than the others, showing a distinct tendency to *C. carinatum* and its variety; the base is, however, persistently and regularly sulcated as in my type form; this is doubtless the var. *B.* of Morelet.

Alt. 23, diam. 24½ mil.

var. SUBOCCLUSA, nov.

The columellar margin broadly reflected, almost covering the umbilicus; spiral striation more acutely raised than usual; scarcely keeled at the periphery.

Alt. 23½, diam. 24 mil.

var. SUBLIGATUM, nov.

Banded below the subangulate periphery; a small form with very fine spiral striation, which is also less developed at base.

Alt. 16¾, diam. 18¾ mil.

OMPHALOTROPIS DUPONTIANA, G. Nevill, Pl. VI, Fig. 8.

Handlist I, 1878, p. 320, Pouce Mn., Mauritius.

Openly and deeply umbilicate, rather solid, colourless and without sculpture, at least in its present subfossil state, ovately conical; spire convexly conical, very acute, with the suture somewhat excavate; whorls 6, convex, short, increasing slowly and regularly, the last one ventricose, remarkable by its shortness (it appears almost round), the base not being produced as is the case almost universally, rounded at the periphery with a very acute and well defined keel boldly and most characteristically encircling the very open umbilicus; aperture ovate, rather contracted above and dilated below, the margin not continuous, peristome scarcely thickened, regularly rounded, columellar margin lightly reflected, oblique, distinctly subangulate below, the basal margin is again indistinctly subangulate where the keel terminates.

Long. 6, diam. 4 mil.

Type, Indian Museum; subfossil, at about ¼ of the ascent of the Pouce Mn., Mauritius.

This shell was a contemporary of the subfossil *Cyclostoma caldwellianum*, Nev., *C. scabrum*, H. Ad., *C. mauritianum*, H. Ad. &c., which I found associated with it, some few inches below the surface of the soil and generally more or less under overhanging large blocks of stones. It is doubtless a remnant of the old fauna of the island and must be at least as old as the Dodo. It is a very important species, as showing one of the characters of the genus (from which indeed its name is derived) in its greatest development so far as is yet known; I allude to the keel round the umbilicus. I have named it in honour of my friend Mr. Evenor Dupont of Mauritius, who is well known for his many discoveries in Natural History in those parts. We now know that the genera *Cyclostoma*, *Omphalotropis*, *Helicina*, *Gibbus*, and *Nanina* are all very ancient inhabitants of the Mascarene Islands, as extinct subfossil forms of all of them have been described. *Helicina* appears to have died out.

OMPHALOTROPIS CALDWELLIANA, n. sp. Pl. VI, Fig. 9.

Hand-list I, 1878, p. 320, No. 7, as *Omphalotropis*, n. sp.

Distinctly umbilicate, rather solid, colourless and without sculpture, pyramidically conical; spire elongately turreted, apex rather acute, suture subcanaliculate; whorls 7, planulate, increasing very slowly and regularly, the last one short, tumidly ventricose, perfectly rounded at the periphery, umbilicus surrounded with a raised and prominent keel; aperture slightly oblique, narrowed anteriorly, margins not continuous, peristome slightly convex only, columellar margin anteriorly inflected, in the middle subangulate, then rounded and again subangulate quite at the base.

Long. 6, diam. 3 mil.

Type, Indian Museum.

Subfossil, on the ascent of the Pouce Mn., Mauritius, with *O. dupontiana*, &c. I have named this species after Mr. J. Caldwell of the Colonial Civil Service, the possessor of one of the finest collections of shells from our Eastern Regions that I know of. In shape there is some resemblance to the *O. clavulus* of Morelet, which is not mentioned in Pfeiffer's monograph!

OMPHALOTROPIS RUBENS, Quoy, Pl. VII, Fig. 12 (Copy).

Voy. Astrol. 1832, Mauritius.

I have thought it well to give a copy of the animal of this genus, taken from Adams' 'Genera,' to enable those interested to see at a glance the great differences from that of *Assiminea*, as the shells of the two genera are constantly confounded, since Dr. Pfeiffer unfortunately united them as '*Hydrocena*.'

PLECOTREMA RAPAX, Dohrn.

Malak. Blätter, 1859, Arabia, long. 6, diam. 3 mil ; Jickeli, Moll. Nord Afr., pl 7, fig. 7.

var. PRODUCTA, nov. Pl. V, Fig. 7.

A single specimen of this interesting form was found by Mr. W. T. Blanford at Annesley Bay ; the spire is more cylindrical and markedly more produced in proportion, the last whorl less convexly swollen than in the typical form. The minute, longitudinal striæ, under a lens, are more distinct than usual. Anfr. 7 ; long. 5¼, diam. 2½ mil.

MARGARYA MELANIOIDES, Nevill, Pl. V, Fig. 1.

J. A. S. B., 1877, p. 30, Lake Tali in Yunnan, anfr. 4, long. 67, diam. 47 mil.

I have nothing to add to my original description of this remarkable form, altogether unlike any other known mollusk. I take this opportunity of recording the obligation I am under to my friend Mr. J. Schaumberg of the Geological Survey of India, for the great trouble he has been good enough to take in improving the rather crude drawings of this and of some other species represented in the plates accompanying this paper. This species has also been figured by Dr. J. Anderson, F. R. S., in his large and valuable quarto on the Zoology of Yunnan.

AMPULLARIA STOLICZKANA, Nevill, Pl. VI, Figs. 11 and 11 A.

Cat Moll. Fasc. E, 1877, Penang, alt 54, diam. 41 mil.

I have not met with any fresh specimens of this interesting species ; its nearest ally appears to be Reeve's *A. javanica*, which apparently represents an immature specimen ; it is also not unlike his *A. turbinoides* from Australia (?).

PALUDINA HUNGERFORDIANA, n. sp.

Closely allied to *P. jullieni*, Deshayes, from Cambodia, the type of Mekongia, Crosse and Fischer.

Imperforate, spire short (as in *P. jullieni*), the large whorl proportionately large and tumidly swollen, scarcely (if at all) subangulate at the periphery ; whorls spirally ribbed, ribs numerous, flat, more or less inclined to become obsolete ; columella remarkable, being very short, almost perpendicular, pure white, very broadly and characteristically reflected.

Long. 33, diam. 26 mil.

Hab.—Canton.

Type, Indian Museum ; also in coll. Surgeon-Major R. Hungerford.

PALUDINA MARTENSIANA, n. sp.

Imperforate, spire more or less shortly produced, moderately thick, of greenish brown colouration, suture rather indistinct, apex obtuse; whorls 3 to 4, planulately turreted (almost concavely), the last whorl about twice the size of the others, rounded at base, with one acute and raised spiral keel immediately below the suture and three or four others crowded together at the periphery, the preceding whorl has two of these prominent keels and both have besides, under the lens, a very minute, subobsolete, spiral striation; aperture oval, relatively rather small, not oblique, peristome scarcely thickened, but slightly convex, having a very slight subangulate appearance about the middle, columellar margin a little reflected, evenly rounded.

Long. 13½, diam. 10 mil.

Khasing District, N. China.

Type, Indian Museum; also in coll Hungerford.

I have named this species after Prof. Ed. von Martens of Berlin.

STENOTHYRA WOODMASONIANA, Nevill, Pl. VII, Fig. 8.

J. A. S. B. 1880, p. 159, Port Canning, long. 3½, diam. 2 mil.

STENOTHYRA HUNGERFORDIANA, Nevill, Pl. VII, Fig. 9.

J. A. S. B. 1880, p. 159, Andaman Islands, long. 2½, diam. 1⅓ mil.

STENOTHYRA BLANFORDIANA, Nevill, Pl. VII, Fig. 10.

J. A. S. B. 1880, p. 160, Chilka Lake, Port Canning and Madras, long. 3 1/10, diam. 2 1/10 mil.

BYTHINEA MORELETIANA, Nevill, Pl. VI, Fig. 14.

J. A. S. B. 1877, Yaylaymaw in Yunnan.

I have thought it advisable to give a figure of this very distinct, imperforate species, for which the Museum is indebted to Dr. J. Anderson, although there is no species which I know of with which it could possibly be confused.

BYTHINEA PHILIPPINENSIS, n. sp.

Somewhat closely resembling *B. lutea*, Gray = *B. goniostoma*, Hutton; slightly decollate, distinctly umbilicate, spire variable, sometimes very short, as in Con. Indica, Pl. XXXVII, fig. 7 (*B. goniostoma*), sometimes moderately produced as *l. c.* fig. 6 (*B. inconspicua*); horn-brown colour, moderately solid, suture distinct, whorls 3 to 4, convex, the last one globosely and tumidly swollen, rounded at the periphery, more or less angulate round the deep, open umbilicus; under the lens spirally, very closely striated, striæ almost microscopic, slightly undulating, subobsoletely decussated or crossed with fine, very oblique lines of growth; aperture everted, nearly

round, with a more or less double peristome, which is boldly, though somewhat irregularly convex, the columellar margin is more distinctly double and slightly angulate at base, all the margins are of a not very pronounced shade of black.

Type, anfr. 2½; alt. 8, diam. 6½ mil.; another, anfr. 3½, alt. 8, diam. 6 mil.

Type, Indian Museum; also in coll. Hungerford and Dohrn.

S. Cruz, in Luzon, collected by Surgeon-Major R. Hungerford; Prof. von Martens has also, I believe, mentioned this species in the Mal. Bl. 1865.

BYTHINIA SUBPULCHELLA, n. sp., Pl. VI, Fig. 12.

Narrowly rimate, conically ventricose, of rather thin substance, slightly transparent, without sculpture, almost white, with a very slight brownish tinge here and there, suture very distinct, spire elongately drawn out, apex rather obtuse; whorls 4½, convexly ventricose, the last one tumidly and globosely swollen, about the same size as the others together, a distinct, opaque varex on the left hand side (away from the aperture) on each of the two last whorls; aperture nearly round, not oblique, with scarcely thickened, convex peristome and columellar margin nearly straight, subangulate at base.

Very variable in size; type, long. 6, diam. 4 mil.

Abundant at Kutch, where there also occurs a "var. *tenuior*."

Type, Indian Museum; also in coll. Dohrn, Temple, Joly, Blanford &c.

I have hesitated a long time as to separating this form from *B. pulchella*, Hutton. Even now, I am by no means sure it would not be better classed as a "subspecies" of it.

BYTHINEA EVEZARDI, Blanford, Pl. VI, Fig. 13.

J. A. S. B., 1880, p. 220, Lanowlee, long. 3¾, diam. 2 mil.

This is a remarkable species of the genus, well distinguished by the peculiar sculpture and umbilicus. The figure is taken from a specimen in the Museum collected by the Rev. S. B. Fairbank and labelled "Mahabaleshwar."

BYTHINEA (?) TURRITA, Blanford, Pl. VI, Fig. 15.

P. Zool. S. 1869, p. 446, "Kyoukpong," long. 6¼, diam. 3 mil., as "*Fairbankia ?* (an *Bithynia ?*) *turrita*."

As the animal and operculum are still unknown, the generic classification of this well marked form is still open to question. The peristome is not "sinuate" above, as in the genus *Lartetia*.

FAIRBANKIA (?) FEDDENIANA, n. sp.

Imperforate, solid, turretly conoidal, white, upper whorls subacutely, spirally striate, striation on the last two whorls more or less obsolete, imparting a "quasi" malleate appearance. Spire turreted, apex broken off in all the specimens seen, suture very distinct; 5 whorls remaining, probably there would be about 8 in a quite perfect specimen, scarcely convex, increasing regularly and slowly in size, the last whorl produced at base; aperture rather small, subquadrangular, nearly perpendicular, moderately dilated at base, outer lip not reflected, bordered with a very broad and callous rib, columellar margin perpendicular, distinctly subangulate above and below, margins joined with a thick callosity.

Long. 6 (vix), diam. 2½ mil. (anfr. 5 only).

Type, Indian Museum; also in coll. Fedden.

I am indebted to Mr. F. Fedden of the Geological Survey of India for an opportunity of describing this interesting form; one of the specimens is from the coast of Kathiawar, all the others are part of a small, but remarkable collection made by the above mentioned gentleman "10 feet below the surface of the Little Rann, at the Kura salt works in northern Kathiawar."

HYDROBIA (BELGRANDIA) MILIACEA, Nevill, Pl. VII, Fig. 7.

J. A. S. B. 1880, p. 161, Port Canning, long. 2¾, diam. 1¾ mil. and var. minor, long. 2, diam. 1½ mil.

ASSIMINEA WOODMASONIANA, Nevill, Pl. VII, Fig. 1.

J. A. S. B. 1880, p. 163, Port Canning, long. 4, diam. 2½ mil.

I have lately received a single specimen of a closely allied new form from the Andamans, discovered by Mr. F. A. de Roepstorff.

ASSIMINEA HUNGERFORDIANA, Nevill, Pl. VII, Fig. 2.

J. A. S. B. 1880, p. 165, Mouth of the Rangoon River, long. 4, diam. 2½ mil.

ASSIMINEA BEDDOMEANA, Nevill, Pl. VII, Fig. 3.

J. A. S. B. 1880, p. 164, Port Canning, long. 3, diam. 3½ mil.

The second species, only, as yet known of the short spired, or "Helicoid," section of the Genus, the other being *A. helicoides*, Gundl. from Cuba.

ASSIMINEA THEOBALDIANA, Nevill, Pl. VII, Fig. 4.

J. A. S. B. 1880, p. 164, Port Canning, long. 4½, diam. 3 mil.

ASSIMINEA MICROSCULPTA, Nevill, Pl. VII, Fig. 5.

J. A. S. B. 1880, p. 165, Port Canning, long. 2¾, diam. 1¾ mil.

Mr. de Roepstorff has also sent me from the Andamans a single, but unfortunately not adult, specimen of a species allied to *A. theobaldiana* and

A. microsculpta. This specimen somewhat answers to Mr. Blanford's description of *Realia decussata.*

ASSIMINEA BREVICULA, Pfeiffer, Pl. VII, Figs. 6—6 A.

P. Zool. S. 1854, as *Hydrocena brevicula*, from Singapore; var. = *A. miniata*, Martens, Ann. Mag. XVII, 1866, p. 206, Singapore, long. 9, diam. 4½ mil.; var. = *A. rubella*, Blf., Ann. Mag. 1867, Irawady Delta, long. 5, diam. 4 mil.; var. = *Hydrocena marginata*, Morelet, J. de C. 1855, Bangkok, long. 6—8, diam. 4—5½ mil.; var.? = *A. rubida*, Gould, P. Bost. S. 1859, Loo Choo Islands.

A very abundant, variable and widely distributed species; there are specimens in the Museum from Singapore, Malacca, Andamans, Borneo, Irawady Delta, Arakan, Philippines, and Amoy.

The Port Canning specimens are mostly of the typical colouration "*corneo-fulva*," and measure—long. 7, diam. 5 mil.; there are also subvarieties, *bicolor* and *bibalteata*. Mons. Morelet's remarks on this species, Sér Conch. IV, p. 294, are excellent "*cette coquille peut varier de 6 à 9½ mil., de couleur fauve ou rougeâtre;*" I will add that it varies also with regard to the infrasutural impressed lines, of which there are sometimes two, as in typical *A. rubella* and *miniata*, sometimes only one, as in *A. brevicula* and *marginata;* at Port Canning both exist together, with every possible intervening form. I am indebted to Mr. Wood-Mason for the figures now given of this small mollusk. Von Martens describes his *A. miniata* as having the head and foot of a pale red colour.

PALUDOMUS BLANFORDIANA, G. Nevill, Pl. V, Figs. 3—3 A.

J. A. S. B. 1877, p. 37, Ava, long. 19, diam. 15 and var. from Gowhatty, long. 20, diam. 15 mil.; Con. Indica, pl. 108, fig. 9, "Tongoop," as "*P. labiosa*" (not of Benson).

I think the figures now given will prevent this species ever again being confused with its undoubtedly distinct Tenasserim ally, the true *P. labiosa* of Benson. I named the species after Mr. H. F. Blanford, to whom I am much indebted for permission to make free use of his collection, which he has temporarily deposited under my charge in the Museum, a privilege I much value owing to the great care and accuracy with which the exact localities of the species have been recorded.

PALUDOMUS PETROSA, Gould, Pl. V, Fig. 5.

P. Boston Soc. 1843, Tavoy, as *Paludina petrosa;* = *Paludomus labiosa*, Benson, Ann. Mag. 1856, Tenasserim Valley, long. 13, diam. 11 mil. (not of the Con. Indica, or Conch.-Cab.).

After a careful study of Gould's original description, I have no hesitation in uniting his species to Benson's, especially as both are from the Province of Tenasserim; Benson probably overlooked it, owing to its having

been described as a species of *Paludina*. My figure is from an original, typical specimen of *P. labiosa*; evidently the form was unknown to Mr. Hanley, or it would, I feel sure, have been separated by him from the preceding species; this is the more to be regretted as Mr. Theobald, his colleague, was in possession of typical specimens of *P. labiosa*.

PALUDOMUS ANDERSONIANA, G. Nevill, Pl. V, Fig. 2.

J. A. S. B. 1877, p. 35, Ava &c., anfr. 7—long. 29, diam. 22 mil.

The type form of this fine and well marked species is not represented in M. Brot's Monograph; it was found by Dr. J. Anderson, in whose honour I have named it, in tolerable abundance in Upper Burma.

var. MYADOUNGENSIS, nov.

A small, decollate, and prettily marked variety, with the whorls markedly more rounded, found by Dr. Anderson at Myadoung, near the Yunnan frontier.

Long. 15, diam. 12 mil.

subspecies PEGUENSIS, G. Nevill.

J. A. S. B. 1877, p. 35, Pegu, long. 21, diam. 16 mil.; Con. Indica, pl. 108, fig. 6, as "*P. regulata*, Bens. var."; Brot, Conch.-Cab. II, 1877, pl. 7, figs. 2—3, as "*P. andersoniana*, Nev. var."

M. Brot has given a full account of this form in his valuable and important monograph of the genus, which, with his equally carefully and fully worked out monograph of *Melania*, I have found of the greatest assistance in cataloguing the Museum species of these difficult genera. Specimens of this variety, or rather species, are labelled from "Pegu Yoma," in Mr. H. F. Blanford's fine collection of *Paludomus*.

subvar. NANA, nov.

Spiral sculpture a trifle less distinct; long. 15, diam. 11 mil.; also from Pegu.

PALUDOMUS BURMANICA, G. Nevill, Pl. V, Fig. 4.

J. A. S. B. 1877, Yaylaymaw and Mandalay; Brot, Conch.-Cab. II, pl. 8, fig. 12 (spec. juven.).

It is probably a young specimen from Mandalay, which M. Brot has figured as above; Dr. Stoliczka sent a few indifferent specimens in exchange to the dealer Landauer, together with some of Blanford's *Melania irawadica*, a young specimen of which has also been figured by M. Brot.

LARINA CINCTA, G. Nevill, Pl V, Fig. 6.

Cat. Moll. Fasc. E, 1877, Pooree, alt. 5½, diam. 3½ mil.

I have nothing to add to my original description of this species; with regard, however, to *Larina*, I may point out as a synonym of it the genus described under the name of '*Robinsonia*' by my brother, Hugh Nevill (Proc. Ceylon Asiat. Soc., 1869), the two typical species of which I figured in this Journal for 1871, pl. 1, figs. 5 and 6; the latter, *Larina* (= *Robinsonia*) *pusilla*, Nev., is evidently very closely allied to my *L. cincta*, but can apparently be distinguished by the less produced spire (the apical whorls especially being less prominently exserted), the larger and less deflected aperture, and the more ventricose last whorl. *Larina* (= *Robinsonia*) *ceylonica*, Nev. is exceedingly close to Blanford's figure of *L. burmana* in this Journal for 1867, pl. 13, fig. 1 and appears to be only distinguished by its more broadly transverse shape, and it is probably only a variety of it.

RISSOINA BAXTERIANA, n. sp.

Thick, solid, smooth and shining, shortly turreted, white, spire conically ovate, moderately produced, suture excavate, apex somewhat bluntly pointed; whorls 5½, turretedly planulate, the last four distantly ribbed longitudinally, ribs nearly perpendicular, except on the last whorl, where they are subabruptly and obliquely angled at the periphery, disappearing altogether at some little distance from the base in a broad, somewhat superficial groove, which is below encircled with a rather indistinct, raised, transverse keel, throughout the ribs are bisected with transverse striæ, well developed at the points of intersection, which thus become nodulose; the aperture is perpendicular, without basal canaliculation, broader at base, with the peristome rather acute, but slightly convex and the columellar margin straight, subangulate at base; I can perceive no callosity joining the margins in the specimens I have examined.

Long. 3, diam. 1½ mil.

Found in sand from Roweiah, Red Sea, rare, by Mr. J. B. Baxter, F. Z. S., in whose honour I have named this most distinct small form, altogether unlike any species I know; in sculpture, the *R. nodicincta* of A. Adams, from the Philippines, is the only one at all resembling it.

Type, Indian Museum; also in coll. Baxter and Weinkauff.

RISSOINA ORIENTALIS, n. sp.

Thick, smooth, polished and shining; white, sometimes encircled with a single brown band, spire conically ovate, not much produced, with the suture distinct and the apex obtusely mammillate; whorls 6½ to 7, convex, the first three without sculpture, the other four longitudinally rather distantly and

regularly ribbed, ribs continuous (or almost so), very broad and massive, slightly flexuous, the last whorl has 11 of these ribs, continued to its base; aperture ovate, slightly oblique, without any basal canaliculation, with the margins much thickened and continuous, joined by a well marked callosity.

Long. 2¾, diam. 1 mil.

Abundant at Ceylon, also Mauritius, Andamans, Bourbon, Aden, and Roweiah.

Type, Indian Museum (from Ceylon); also in coll. Weinkauff, Dohrn, Hungerford, and Baxter.

This pretty little species is the type of my section, or subgenus, *Schwartziella; R. orientalis* has hitherto been confused by Herr Schwartz von Mohrenstern and other conchologists with its close ally, the *R. scalariformis*, C. B. Adams, from Panama. It can, however, be sufficiently distinguished by its less elongate form, of one whorl less, and especially by the mammillate instead of "acute" apex, the aperture is less oblique, the ribs bluntly broad, instead of "acute," &c.

After a long examination under a lens, I am unable to detect any signs of transverse striation in my Ceylon specimens, though they are in fresh and perfect condition.

RISSOINA BLANFORDIANA, n. sp. Pl. VI, Fig. 16.

Lanceolately produced, in shape resembling *R. deshayesi*, Schwartz, but the more convex whorls give it a less turreted appearance; white, rather solid, spire conically elongate, very acute, apex not mammillate, suture rather indistinct, especially on the upper whorls; whorls 10 to 11, convexly turreted, longitudinally ribbed with rather distant, acutely raised, almost straight ribs, which are evenly decussated with a transverse, rather distant striation, the striæ of approximately the same developement as the ribs, but slightly subnodulose at the points of intersection, the last whorl is short and convex much as in *R. deshayesi*, but with only 13—14 ribs instead of "22—24," there are 6 of the regular, well developed transverse striæ and two others much finer and more crowded together next the suture, the basal transverse rib is evenly granulose, moderately developed; aperture rather large, with the peristome boldly rounded, somewhat dilated towards the base, the columellar emargination is broad, but shallow and very unlike the markedly incised one of its ally, compared by Herr Schwartz to that of a *Cerithium*; the outer lip is only moderately thickened.

Long. 9¼, diam. 3¾ mil.

Annesley Bay, Red Sea; rare.

Type, Indian Museum.

RISSOINA WEINKAUFFIANA, n. sp.

Lanceolately and turretly produced, of a brownish-white colour, spire acuminate, with the apex minutely mammillate, composed of 2½ nucleolar whorls, which are perfectly smooth and of a milky white colour; whorls 9½ (except the first 2½) longitudinally, evenly ribbed, ribs close-set, slightly flexuous, a little more numerous and less developed on the last whorl, which under the lens shows two spiral, subobsolete striæ, the upper one of which starts from the top of the peristome, otherwise there is no spiral sculpture, no groove at base but girt with a very thick callous rib, apparently smooth, but under a powerful lens very minutely striate with a slight "beading" at the top; aperture polished, shining, thickened, broadly emarginate at columellar base, peristome evenly rounded, with a thick callosity behind it.

Long. 6¾, diam. 2½ mil.

I only know of one closely allied species, a smaller form, *R. funiculata*, Souverbie, 1865, from New Caledonia, this species is also found at the Andamans; I have named this well marked form in honour of Dr. H. C. Weinkauff of Kreuznach, who is now editing a Monograph of the genus for the new edition of the Conchylien-Cabinet; I found the species alive under stones at Port Blair, at extreme low water; it was tolerably abundant.

RISSOINA NEVILLIANA, Weinkauff.

Conch.-Cab. II, 1881, Kowloon.

Shell large, very thick and solid, lanceolately produced; apical whorls wanting, 7½ remaining, regularly pyramidally turreted, the last one relatively very little larger or more tumid than the penultimate, the upper three whorls regularly, and evenly longitudinally ribbed, ribs thick, close-set, slightly flexuous, the last four whorls with similar, but thicker, less flexuous and more unequal ribs, each of the last two having also, in a line with the outer lip, two of these ribs united forming very broad and thickened varices, the last whorl but two has a similar but less prominent one, out of the line of the others and quite at the back of the shell, the whorl above it again has a similar but more developed varex in front, almost in a line with the columella; throughout, under the lens, regularly and very finely tranversely striated, at the base of the last whorl the ribs become obsolete and the transverse striæ incised and well developed sulcations, on the upper portion of the same whorl the longitudinal ribs are distinctly and characteristically, though somewhat obsoletely, biangulate; aperture shallow and small, not everted, within polished and shining, with two or three denticulations, not canaliculate; columellar margin nearly upright, slightly twisted, a trifle bent back and rounded at base, outer lip

thickened, smooth and evenly rounded, margins joined with a well developed callosity, the peristome behind is much thickened and forms a similar varex to those already described.

Long. 13½, diam. 4½ mil. (wanting the apical whorls).

Kowloon, opposite Hongkong.

As will be seen from the above, this fine species, for which I am indebted to Surgeon-Major R. Hungerford, belongs to the typical section of *Rissoina*, that is there is no canaliculation at base of the aperture.

The *R. villica* of Gould, as figured by Sowerby, appears to be its nearest ally. *R. pyramidalis* is also of a somewhat similar type.

RISSOINA SUBLAEVIGATA, n. sp.

Shell rather stout, smooth, shining, pellucid; spire relatively rather short, apex very remarkable, mammillate, strongly inclined to the left, as in the family *Pyramellidæ*; an opaque, rather broad, not incised band, relatively unusually remote from the suture, so much so that it is almost exactly central in the penultimate whorl; six whorls, much more convexly swollen than in the preceding; aperture unusually straight, that is not everted, peristome thickened, columella callously reflected, considerably more perpendicular than in Schwartz's fig. 79 *R. laevigata*, which otherwise, except for the characters of the apex and opaque submarginate band, well represents the species.

Long. 3½, diam. 1½ mil.

Andamans; coll. G. Nevill, Esq.

Under coral blocks, at low-water, Ross Island; Herr Schwartz considered this form a variety of *R. laevigata*, C. B. Adams, from Jamaica. The species probably has a wide range, it will very likely prove to be the shell mentioned by Herr Schwartz, page 111, as *R. laevigata*, from Steward's Island (E. of Solomon Islands).

RISSOINA PSEUDOBRYEREA, n. sp.

? Schwartz, *Mon. Rissoina*, pl. 5, fig. 36 A., Mauritius, as *R. bryerea*, var. (not fig. 36, *R. bryerea*, Mtg., West Indies).

Turreted, very thick and solid, white; spire conical, abruptly pointed, suture excavate, apex rather obtuse; whorls 6, turretly planulate, the last four evenly ribbed longitudinally, the ribs very massive and broad, rather distant, quite perpendicular, terminating some little distance from the base (not the case in *R. bryerea*), finely and rather closely decussated with a transverse striation, especially noticeable in the interstices, towards the base where the longitudinal ribs cease, there are three (or four?) well developed transverse ribs, but slightly (if at all) subnodulose, the last whorl is proportionately long, more so than in the above quoted figure, it has 11 ribs (18 to 22 in *R. bryerea*, fide Schw.); aperture small, subqua-

drate, no basal emargination, outer lip very much thickened, not dilated, evenly rounded at base.

Long. 5½, diam. 2 mil.

Rare, in sand from Roweiah, Red Sea.

Type, Indian Museum.

This species discovered by my friend Mr. J. B. Baxter, is an interesting addition to the group II, section B. of Schwartz, which I now propose to distinguish by the name of *Schwartziella*, at once recognizable by the absence of any basal emargination within the aperture. The differences from true *R. bryerea*, as can be seen from the above, are too many and too marked to require special, further reference; but it becomes a question whether Schwartz's above quoted fig. A represents or not the present species? I am inclined to believe from the acute peristome &c., that it represents a not adult specimen, readily distinguished by the different shape, transverse striation, less numerous ribs &c. from *R. bryerea*. The most important difference in it from the Roweiah form is the absence of the basal three transverse ribs and corresponding abrupt termination of the longitudinal ribs; these latter are also thicker, straighter &c., the peristome much broader and aperture smaller.

AMPHITHALMUS PELLYÆ, n. sp.

Of almost microscopic size, imperforate, solid, smooth, polished and shining, of a rich chesnut-brown colour, ovately oblong; spire shortly and ventricosely conical, suture distinct, apex exceedingly obtuse; whorls 3½, very convex, last whorl produced, regularly ovate, about ⅔ the size of the whole shell, brought forward at the aperture in a highly characteristic manner, exactly as in the genus *Stenothyra*; aperture almost circular, with continuous and much thickened margins, stained of a very dark mahogany colour within the aperture, behind the peristome there is a "rib-like" thickening, showing through externally in an opaque manner.

Long. 1½, diam. ½ mil.

In sand, from near Adelaide, South Australia.

Type, Indian Museum.

This very interesting minute form, of a little known genus, I have named after its discoverer, Miss Pelly, to whom I am indebted for the type specimen. The other shells found with it were all of a purely marine type, there being no brackish-water forms amongst them. *Barleeia (?) microthyra*, Martens, Möbius Reise &c., Pl. XX, fig. 18, from Mauritius is another and most closely allied species of *Amphithalmus*; *A. pellyæ* is readily distinguished by the fewer whorls, more obtuse apex, more convex whorls, the last especially being much more regularly, ovately produced and much longer in proportion, its *Stenothyra*-like deflection in front of the aperture,

so accurately pointed out by Professor von Martens, is still more prominent in the Australian species. Another close ally is the *Amphithalmus pupoides*, H. Adams, P. Z. S., 1865, from Lord Hood's Island, my late much regretted friend in his description also remarks on the resemblance to *Stenothyra*. Our Museum possesses specimens of this last, also of *A. obesus*, H. Adams, *l. c.*, and of the type species, *A. inclusus*, described by Carpenter in the Annals and Mag. XV, 1865, from California.

EXPLANATION OF THE PLATES.

Plate V.

Fig. 1. *Margarya melanioides*, Nev., p. 155.
Fig. 2. *Paludomus andersoniana*, Nev., p. 160.
Fig. 3. *Paludomus blanfordiana*, Nev., p. 159.
Fig. 4. *Paludomus burmanica*, Nev., p. 160.
Fig. 5. *Paludomus petrosa*, Gld., p. 159.
Fig. 6. *Larina cincta*, Nev., p. 161.
Fig. 7. *Plecotrema rapax*, Dohrn, var. *producta*, Nev., p. 155.
Fig. 8. *Limnæa yunnanensis*, Nev., p. 142.
Fig. 9. *Limnæa andersoniana*, Nev., p. 142.
Fig. 10. *Succinea yarkandensis*, Nev., p. 144.
Fig. 11. *Stenogyra* [*Glessula*] *oreas*, Bens., p. 135.
Fig. 12. *Stenogyra* [*Glessula*] *blanfordiana*, Nev., p. 138.
Fig. 13. *Stenogyra* [*Glessula*] *subfusiformis*, W. T. Blf., p. 138.
Fig. 14. *Stenogyra* [*Glessula*] *jerdoni*, Bens., p. 136.
Fig. 15. *Stenogyra* [*Glessula*] *nilagirica*, Bens., p. 136.
Fig. 16*a* et *b*. *Stenogyra* [*Glessula*] *bensoniana*, Pfr., p 137.
Fig. 17*a* et *b*. *Stenogyra* [*Glessula*] *perotteti*, Pfr., p. 137.
Fig. 18*a* et *b*. *Stenogyra* [*Glessula*] *facula*, Bens., p. 137.
Fig. 19. *Stenogyra* [*Glessula*] *orophila*, Bens., p. 137.
Fig. 20. *Stenogyra* [*Glessula*] *amentum*, Bens., p. 138.
Fig. 21. *Helix* [*Ægista*] *perplanata*, Nev., p. 133.
Fig. 22. *Trochomorpha percompressa*, W. T. Blf., p. 133.
Fig. 23. *Helicarion* [*Austenia*] *magnificus*, G.-A. & Nev., p. 129.
Fig. 24. *Helicarion* [*Austenia*] *resplendens*, Nev., p. 129.

Plate VI.

Fig. 1. *Gibbus dupontianus*, Nev., p. 130.
Fig. 2. *Buliminus* [*Cerastus*] *jickelianus*, Nev., p. 135.
Fig. 3. *Cyclophorus pealianus*, n. sp., p. 146.
The apical 2½ whorls are incorrectly represented in the figure.
Fig. 4. *Cyclophorus orites*, n. sp., p. 147.
The left-hand figure is by no means good; the last whorl is not contorted.

Fig. 5. *Alycaeus montanus*, n. sp., p. 149.
The minute sculpture is not sufficiently indicated!
Fig. 6. *Pupina hungerfordiana*, Nev., p. 148.
Fig. 7. *Cyathopoma shevaroyanum*, Bedd., p. 145.
The spiral striation is incorrectly represented on the two upper figures!
Fig. 8. *Omphalotropis dupontiana*, Nev., p. 153.
Fig. 9. *Omphalotropis caldwelliana*, n. sp., p. 154.
The spire should be more evenly planulate, the whorls are not turreted. The columella is also not reflected over the umbilicus, as in the figure.
Fig. 10. *Cyclostoma caldwellianum*, Nev., p. 150.
Fig. 10*a*. „ „ var. *sexcarinata*, Nev., p. 152.
Fig. 11, 11*a*. *Ampullaria stoliczkana*, Nev., p. 155.
Fig. 12. *Bythinea subpulchella*, n. sp., p. 157.
Fig. 13. *Bythinea evezardi*, W. T. Blf., p. 157.
Fig. 14. *Bythinea moreletiana*, Nev., p. 156.
The magnified figure and that of the natural size are from different specimens.
Fig. 15. *Bythinea (?) turrita*, W. T. Blf., p. 157.
The figure denoting the natural size has been overlooked by the lithographer.
Fig. 16. *Rissoina blanfordiana*, n. sp., p. 162.
Fig. 17. *Melania variabilis*, Benson, var. *pseudospinosa*, Nev.
From Samaguting in Assam.

Plate VII.

Fig. 1. *Assiminea woodmasoniana*, Nev., p. 158.
Fig. 2. ——— *hungerfordiana*, Nev., p. 158.
Fig. 3. ——— *beddomeana*, Nev., p. 158.
Fig. 4. ——— *theobaldiana*, Nev., p. 158.
Fig. 5. ——— *microsculpta*, Nev., p. 158.
Fig. 6, 6*a*. ——— *brevicula*, Pfr., p. 159.
Fig. 7. *Hydrobia (Belgrandia) miliacea*, Nev., p. 158.
Fig. 8. *Stenothyra woodmasoniana*, Nev., p. 156.
Fig. 9. ——— *hungerfordiana*, Nev., p. 156.
Fig. 10. ——— *blanfordiana*, Nev., p. 156.
Fig. 11. *Acmella hungerfordiana*, n. sp., p. 145.
Fig. 12. *Omphalotropis rubens*, Quoy, p. 154.

XII.—*A sketch of the history of the fossils of the Indian Gondwána system.*—*By* OTTOKAR FEISTMANTEL, M. D., *Palæontologist, Geological Survey of India.*

[Received 24th June; Read 6th July, 1881.]

In a late number of this Journal* Mr. Lydekker published a sketch of the history of the fossil Vertebrata of India, and it is my intention now to give a similar sketch of the fossils of the Gondwána system, for the same reasons as those which Mr. Lydekker indicated in the beginning of his paper.

Before proceeding to discuss the details it will be necessary to make a few general remarks upon the Gondwána system, its importance, extent and classification. By the name Gondwána system the Geological Survey now designates what was formerly known as the Plant-bearing series.

The title was proposed by Mr. H. B. Medlicott, about 9 years ago (1872), but was not then admitted into publicity though more or less current on the Survey; since 1876 it has come into general use in print also.†

This system of sedimentary rocks is the most important in the peninsula, for two reasons, first because it is prominently fossiliferous and secondly because it includes the rich coal deposits for which India is so famous.

As regards the distribution of these rocks, I refer to my paper in the Records of the Geological Survey of India, just quoted, as well as to the Manual of the Geology of India, 1879 (Vol. 1, and map), from which the following may be extracted:‡

From Raniganj§ these deposits stretch in detached basins up the Damuda valley,‖ into the highlands of Chutia Nágpur.¶ To the north of this area smaller patches also occur, as especially the Rájmahál area,** the Deogarh coalfields†† and the Karharbári coalfield.‡‡

* J. A. S. B., Vol. XLIX, Pt. II, 1880.

† Feistmantel: Notes on the age of some fossil Floras in India; R. G. S. Ind. Vol. IX, p. 28, 1886.

‡ I refer here to the distribution, because when quoting the fossils I shall have ample opportunity to mention the various deposits.

§ This shall be hereafter always mentioned as Raniganj coalfield.

‖ Here we have in a consecutive order from E. to W. the Jharia coalfield, the Bokharo and Ramgurh and the Káranpúra coalfields.

¶ Of these I shall have opportunity to mention the Aurunga coalfield (Palamow)

** Rájmahál hills.

†† Or Kuraun coalfield near Khurmatar, E. I. R.

‡‡ In Hazáribágh district, near Giridhi station.

From Chutia Nágpur these rocks stretch into the valley of the Sone, constituting the great South Rewah basin. By a narrow band of the topmost group passing by Jabalpur, this area is connected with the large basin in the Sátpura range* on the west side of which the stratified series passes under the trap rocks of the Deccan. Some few inliers have also been detected beneath the trap further to the west in the Narbada valley.

Far to the west, plant-bearing rocks of the Gondwána system (the Umia group) have long been known to exist in Cutch (Kach), while recently rocks of the same age were discovered in the peninsula of Kathiawár by Mr. Fedden.†

This northern main area of the Gondwána deposits has two southern extensions. The South-Rewah basin continues through Sirguja‡ into the Raigarh and Hingir coalfields, S. W. Bengal, towards the Talchir coalfield (Orissa) and the Athgarh§ area below Cuttack (Katák).

From the Sátpura basin in a southern direction we meet with rocks of this system in the neighbourhood of Nágpur,‖ whence they extend into the valleys of the Wardah¶ and Godavari rivers,** down to Rajamahendri.

From the Delta of the Godávari detached patches of these rocks occur also along the coast of the Carnatic (Karnatik) to Trichinopoli.†† All these deposits are within the peninsular area of India.

Only a small portion are found in the extra-peninsular area, *i. e.*, along the base of the Eastern Himálayas, in Sikkim and Upper Assam.

The proper knowledge of this system is almost entirely due to the labours and exertions of the officers of the Geological Survey, as the number of writers, unconnected with the Survey, who have worked at either the geology or palæontology, or contributed to the collections is but a limited one. To these latter I shall refer at first. In 1828 A. Brongniart described in his "Histoire des végétaux fossiles," two species of *Glossopteris*, this was the earliest mention of this interesting genus. Professor Göppert in his "Systema filicum fossilium 1836," also described *Glossopteris*. Professor Royle in his Illustrations of the Botany &c., Himalayan Mountains, 1839, established four species from the coal-bearing rocks of the Raniganj coalfield, all four of more or less interest. Professor Morris in

* Quoted hereafter always as Sátpura basin.

† Feistmantel, Records G. S. India, Vol. XIII, p. 1, pp. 62-64.

‡ The Ramkola-Tatapáni coalfields.

§ Atgarh sandstone.

‖ Nágpur area.

¶ Wardha valley coalfield (Upper Godávari basin.)

** Middle and lower Godávari basin.

†† Here we have the South Kistna district (Vemáveram) the Sripermatur area (near Madras) and the Trichinopoli plantbeds (Utatúr plantbeds).

1840 described in Capt. Grant's paper on the geology of Cutch* some plant-remains from beds, which are at present known to be the highest of the Jurassic rocks in Cutch (Kach). Among these were two species of *Ptilophyllum*, a fossil very characteristic of the upper groups of the Gondwána system. The animal fossils were described by Sowerby, some of which, as was shown later, came also from the highest Jurassic beds. An addition to these latter was made by Capt. W. Smee.† In a paper on recent and fossil cycadeæ 1841‡ Professor Morris again describes the two species of *Ptilophyllum* from India. In Professor Ungers' "Genera et species plantarum fossilium" (1850) we also find all the species of Indian Gondwána plants, known up to that date, although some of them were differently classed. In 1850 appeared also Dr. McClelland's Report on the Geological Survey of India, 1848-49; as it, however, was not published under the present arrangement of the Geological Survey, I quote it amongst these papers. It contains figures of plants from the upper and the lower (coal-bearing) groups of the Gondwána system, amongst the latter, several forms of great interest (as ascertained later by the originals) but the drawings are so utterly wrong, that the figures are of absolutely no use for those who cannot compare the originals. The most interesting fossil was the *Zamia burdwanensis*, which from the original specimen proved to be really a *Zamieae* of the *Pterophyllum*-tribe.

Sir P. Egerton described in 1851§ a fossil fish (*Lepidotus*) from the tableland of the Deccan, in the Peninsula of India collected by Col. Sykes, to which in 1853 another species was added by Mr. Bell‖ and in 1857 two species again by Sir P. Egerton.¶

Of much greater importance were the labours of the late Rev. Mr. Hislop, in the Gondwána rocks of the vicinity of Nágpur. He collected first the very interesting *Ceratodus* teeth, which were afterwards described by the late Dr. Oldham,** he collected a reptilian skull near Mángli, south of Nágpur, which was described by Professor Owen as *Brachyops laticeps*,†† and he also collected numerous fossil plants near Nágpur, (Kámthi), Bháratwáda, Silewára and Mángli, which were described by Sir Charles Bunbury in 1861.‡‡ Of the many papers by Mr. Hislop I need only mention those

* Transact. Geol. Soc. Lond. Ser. 2, Vol. V.
† Transact. Geol. Soc. Lond. Vol. V, 2d. Ser.
‡ Ann. and Mag. Nat. H. Vol. VII, p. 110.
§ Qu. J. Geol. Soc. London, Vol. VII, p. 272, pl. XV.
‖ Qu. J. Geol. Soc. London, Vol. IX, p. 351.
¶ Ibidem, Vol. X, p. 371.
** Mem. Geol. Surv. of India, Vol. I, 296, et seq. Plates.
†† Qu. J. G. Soc. Lond. Vol. XI, p. 37, Pl. II.
‡‡ Ibidem Vol. XVII, p. 325, seq. Pls. VIII-XII.

on the age of the coal strata in Western Bengal and Central India;* on the geology and fossils of the neighbourhood of Nágpur,† which he wrote together with Mr. Hunter; that on the connection of the Umrét coalbeds with the plantbeds of Nágpur,‡ and that on the age of the fossiliferous, thin-bedded sandstones and coal of the province of Nágpur in India,§ which was followed by a supplemental note in 1862.

In a paper by Baron de Zigno, entitled "Observations on the Flora of the Oolites,"‖ he also makes general remarks on the Indian fossil Floras placing them all with the Oolite formation.

In the Proceedings of the Austrian Geological Institute (Verhandlungen der k. k. Geologischen Reichsanstalt) for the year 1861-62, there is a note upon the first 35 plates of the Rájmahál plants, which states, that the figures of *Zamites*, *Pterophyllum*, *Pecopteris*, *Taeniopteris* etc., agree with Austrian Keuper plants.

In another paper entitled "Sopra depositi di piante fossili del America settentrionale delle Inde e dell Australia, etc." 1862, Baron de Zigno has attributed a liassic age to the flora of the Rájmahál group.

In the same year (1862) Professor R. Jones published his Monograph of fossil Estheriae¶ wherein also the *Estheriae* of the Indian Gondwána system are described, especially *E. mangaliensis*, Jon., which is so abundant in the Mángli shales.

Here I have also to mention Professor Morris as co-author of a work on the Rájmahál Flora (1862) for although it was published in the Palæontologia Indica, he was not connected with the Geological Survey.

In 1864 a reptilian fossil, said to belong to the genus *Archegosaurus* was collected by Major Gowan near Bijori in the Sátpura basin.**

Ettingshausen in his great work on the comparison of living with fossil ferns,†† classes our *Taeniopteris lata* and *T. morrisi* (now *Macrotaeniopteris*) from the Rájmahál group, with *Acrostichum*, and writes of that formation as being liassic.

I should also refer here to Professor Huxley's paper "on the vertebrate fossils from the Panchet rocks near Raniganj, Bengal,‡‡ for although the

* J. As. Soc. Bengal, 1855, Vol. XXIV, p. 347.

† Qu. J. Geol. Soc. London, Vol. XI, with map.

‡ Ibid. Geol. Soc. London, Vol. XI, p. 555.

§ Ibid. Vol. XVII, p. 346; supplm. note, in Vol. XVIII, p. 36.

‖ Ibid. Vol. XVI, p. 110.

¶ Palæontographical Society, 1862. An abstract of the same is in Qu. J. G. Soc. London, Vol. XIX, p. 140 &c.

** J. A. S. B. XXXIII, 1864, pp. 336, 442.

†† Die Farrenkräuter der Jetztwelt &c., Wien. 1865.

‡‡ Pal. Indica, Ser. IV. 1. 1865.

specimens were collected by officers of the Geological Survey and were described in the Palæontologia Indica, yet the paper is by an author unconnected with the Survey.

In a later paper on *Hyperodapedon** Professor Huxley also refers to the same genus in India where it occurs in beds together with the before mentioned *Ceratodus;* in a further paper on the classification of the *Dinosauria*, with observations on the Dinosauria of the Trias,† he also discusses (p. 48), the Indian *Dinosauria*, and in a still more recent paper on *Stagonolepis Robertsoni* and on the evolution of *Crocodilia*‡ he mentions the Indian *Parasuchus* stating that it is very close to *Belodon*.

In Professor Schimper's "Traité de Paléont. végétale," 1869-1874, most of the fossil plants, known up to that date from the Gondwána system, are also quoted, but those of the Rájmahál and Damuda series are wrongly classed as being of the same (oolitic) age.

Sir Philip Egerton and Professor Miall, have recently (1878) examined, the former the ganoid fishes from the Deccan and the latter the *Ceratodus* teeth from Malédi and the results are published in the Palæontologia Indica, Ser. IV, 2, 1878.

These are about the most important papers wherein plants or animals of the Gondwána system have been referred to or described by authors who were not connected with the Geological Survey.

Quite recently we have a paper by Dr. W. Saise on "the Kurhurbali coalfield."

Those who have contributed to the collections of the Survey, are not numerous. The first is the late Rev. Mr. Hislop, who contributed fossil fish and plants; and I have especially to mention the contributions in recent times of Mr. J. I. Whitty, C. E., late Superintendent, Kurhurbali (Karharbári) collieries, Giridhi, Mr W. G. Olpherts, C. E., the present manager, and Mr. N. Miller, inspector of the collieries at the same place.

If only some of the other managers and inspectors of collieries in India or others who have an opportunity of doing so, would pay a little attention to the fossil remains contained in the rocks accompanying the coal-seams, many an interesting specimen might be procured. But as the matter now stands the greatest portion of the collection of fossils from this system has been brought together by the officers of the Survey, to whom also the knowledge of the numerous deposits of this system is solely due.

* Qu. J. G. Soc. London, Vol. XXV, p. 138, &c.

† Qu J. G. Soc. London, Vol. XXVI, pp. 32, et seq. 1870.

‡ Ibid. Vol. XXXI, p. 423, &c.

Most of them who have visited areas where rocks belonging to the system occur, have collected fossils and contributed papers towards the knowledge of its geology, others again towards that of its palæontology. As the respective papers are chiefly contained in the publications of the Geological Survey, it is sufficient to refer to these without enumerating the papers in detail. They are contained in the Records and Memoirs of the Geological Survey as well as in some of the volumes of the Palæontologia Indica. I may especially mention the papers of Mr. W. T. Blanford (in Memoirs and Records), W. Theobald (Memoirs and Records), Thomas Oldham (Memoirs, Records and Palæontologia) J. G. Medlicott (Memoirs), T. W. H. Hughes (Memoirs and Records), H. B. Medlicott (Records and Memoirs) V. Ball (Memoirs and Records) A. B. Wynne (Memoirs and Records) W. King (Records and Memoirs) R. B. Foote (Memoirs and Records) F. R. Mallet (Memoirs) C. L. Griesbach (Memoirs). I have myself contributed papers on Gondwána fossils to the Records and to the Palæontologia Indica and Mr. Lydekker has described some of the vertebrate animals of this system, also in Records and Palæontologia Indica.

A detailed account of the various features of this system, as known up to 1879, is to be found in the Manual of Geology of India, to which I particularly refer. Of papers referring to the Gondwána system, published by officers of the Geological Survey elsewhere than in the Survey publications, I have especially to mention Mr. V. Ball's "Jungle life" 1879, and his paper "On the coalfields and coal production of India" 1879.* I have already contributed a paper on Raniganj plants to the Society's Journal in 1876† and Mr. R. Lydekker, as mentioned above, published in the same Journal a Sketch of the history of the fossil Vertebrata of India where also the Vertebrate fossils of the Gondwána system (*Pisces, Batrachia* and *Reptilia*) are referred to.

I have to mention at last, that some officers of the survey collected fossils in various districts, though they have not published papers on the same, thus Mr. V. Ball collected largely in the Raniganj field (Raniganj and Panchet groups) also in the Sátpura basin; Mr. F. Fedden near Nágpur, Isapur, south of Chanda (Wardha valley coalfield), in Kathiawár and in Kach, and Mr. C. A. Hacket in the Sátpura and South Rewah basins.

I shall now make a few remarks on the stratigraphical divisions, as I shall have to refer to them, when enumerating hereafter the plants.

We have at first divisions into "upper" and "lower" portions of the Gondwána system; but here it must be remembered that this classification is not to be taken in the rigid sense, which formerly used to be the case with

* Scientific Proceedings of the Royal Dublin Society, 21st April 1879.

† Vol. XLV. Based upon a collection of plants made by Mr. J. Wood-Mason.

reference to the Mahádeva and Damuda series; for we know now that one (and probably two) of the most characteristic plants of the "lower" Gondwána portion *i. e.*, *Glossopteris* passes freely into the "upper" portion, so that from this point of view there is a passage from the "lower" into the "upper" which view is also borne out in several basins by the geological relations. On the other hand, however, it is only fair to state, that the most characteristic plant of the "upper" Gondwánas, *i. e.*, the small cycadaceous plant *Ptilophyllum*, has not hitherto been observed in any bed of the "lower" Gondwánas.

Within these two broad divisions of the Gondwána system minor groups have been distinguished in the various basins of the system, of which a synopsis may be thus represented.

A. *Upper portion of the Gondwána system.*

Jabalpur division.*	Umia group = Tripetty sandstones. Chikiala sandstones. Jabalpur group. Bagra group.
Intermediate groups.*	Kota-Maléri beds = Denwa group. ? Chari group. Ragavapuram = Vemáveram = Sripermatúr = Utatúr plantbeds.
Rájmahál division.*	Rájmahál group = Athgarh sandstones = Budawáda group = Sironcha sandstone = Pachmari sandstone = Dubrájpur group.

B. *Lower portion of the Gondwána system.*

a. Panchet division.†	Panchet group and = Almod beds.
b. Damuda division.†	Mángli shales, Kámthi and Raniganj group and Bijori horizon. Iron shales (Motur horizon.) Barákar group.
c. Talchir division.†	Karharbári beds— Talchir shales— Boulder bed } Talchir group.

* These three divisions are proposed by myself.

† These three divisions were introduced by Mr. W. T. Blanford, 1878.

With regard to the fossil contents of these several groups, I have to make the following remarks:

a. Jabalpur division.

Umia group.—A name proposed by Dr. Stoliczka, for the uppermost Jurassic beds in Kach. It contains marine animals, plants (*Ptilophyllum*); a jaw of *Plesiosaurus* (*indicus*) was also found.

Recently Mr. Fedden recognised the same group in Kathiawár, although it shows there a somewhat closer relation to the next group.

Marine representatives of it are the Tripetty sandstones of Mr. W. King; and the Chikiala sandstones (unfossiliferous) of the Upper Godávari basin (C. Pr.) are probably representatives of these latter.

Jabalpur group.—1871. Oldham, Geology of the Central Provinces, Rec. Geol. Survey of India, Vol. IV, p. 75.

The uppermost group of the Gondwána system in the South Rewah and Sátpura basin, called so from the town of Jabalpur, the terminus of the East Indian Railway. It contains plant-remains only. In South Rewah it contains some species which afterwards become very numerous in the next lower group (*Sripermatur*, *Vemáveram*), and in shales from the Sher river, Sátpura basin, specimens of *Glossopteris*, a lower Gondwána fossil, were identified.

Bágra group.—1872, H. B. Medlicott: Notes on the Sátpura Basin, Mem. G. S. I. Vol. X, pp. 133, 150.

No fossils have been found hitherto in this group; and no representatives of it have been met with elsewhere; called so from fort Bagra on the G. I. P. Railway.

b. Intermediate Groups.

Kota-Maléri group.—1876, Hughes: Rec. G. S. I. Vol. IX, Pt. 3.

1877, Hughes: The Wardha valley coalfield, Mem. G. S. I. Vol. XIII, Pt. 1, p. 81.

1877, W. King, Rec. G. S. I. Vol. X, Pt. 2, p. 58.

This group (composed of two horizons) contains interesting terrestrial and freshwater fossils (reptiles and fishes). The red clays at Maléri (with reptiles and Ceratodus teeth) are, however, considered lower than the limestones of Kota (with ganoid fishes). The group takes its name from the localities Kota (near Sironcha, Cent. Prov.) and Maléri middle Godávari basin, south of Chanda.

The plant-beds of Chirakunt, (middle Godávari basin, Cent. Prov.), are on the same horizon and these plants are of the same character as those of some other groups to be mentioned presently.

This group has hitherto been only known from the C. Provinces (upper and middle Godávari basin), till quite recently, when, Mr. Hughes discovered

representatives of the Maléri clays in the South Rewah basin (near Tiki, 81° 25′ long.; 23° 56′ lat.), with the same reptiles, but without *Ceratodus*.

The Denwa group of the Sátpura basin* appears to be a representative of the (Kota) Maléri group; a *Parasuchian*† scute was procured from the same.

There are several other groups which have probably to be placed on the same horizon, which I shall also quote under special headings.

Chari group.—Another group, the third from above, of the Kach Jura, proposed by Dr. Stoliczka. Vertebrae of a *Parasuchian* crocodile‡ were found, which tend to correlate this group with the Denwa group.

Sripermatúr group.—1873, Foote, Geology of Madras, Mem. G. S. I. Vol. X, p. 63, et seq.

A group of rocks in the neighbourhood of Madras, which contains marine animals and plants. By its fossil remains this group is correlated with the Vemáveram shales§ (Vemáveram, 12 miles north north-east of Ongole, S. Kistna country), the Utatúr plant beds‖ (Utatúr, Trichinopoly district) and the Ragavapuram shales¶ (Ragavapuram 27 miles north-east of Ellore and West of Rajamahendry, Lower Godávari.) With these latter the plant beds of Chirakunt (see ante) have to be correlated and from the geological position of these two latter groups, one must also judge of that of the others. They are all, I think somewhat higher than the Rájmahál group proper.

c. Rájmahál Division.

*Rájmahál group*** (in the restricted sense).

1877, V. Ball, Geology of the Rájmahál hills, Mem. G. S. I. Vol. XIII, p. 55, (209).

This is the lowest group of the fossiliferous beds of the Upper Gondwánas. It is developed typically in the Rájmahál hills, where it is highly fossiliferous, containing a rich and varied Flora.††

The sandstones of Golapili (near Ellore,) South Godávari district‡‡ are true representatives of the typical Rájmahál group. They contain a Flora only.

* H. B. Medlicott, Mem. G. S. I. Vol. X.

† Lydekker, Pal. Indica, Ser. IV, 2, p. 30, Pl. VI, fig. 8.

‡ Lydekker, ibid. p. 31.

§ 1879, Foote, Mem. G. S. I. Vol. XVI, pt. 1, pp. 60, 66.

‖ 1873, Foote, Mem. G. S. I. Vol. X, p. 63, and 1878, Rec. G. S. I. Vol. XI, p. 258.

¶ 1879, Foote, Mem. G. S. I. Vol. XVI, pt. 1, p. 76.

** This group is not to be mistaken for "Rájmahál Series" which included several groups and was almost tantamount with what now is known as Upper Gondwánas minus the Mahádevas, then considered distinct.

†† Palæontol. ind., Ser. II, 1862-1877 Gondwána flora, Vol. I, 1880.

‡‡ 1874, King Rec. G. S. I. Vol. VII, p. 159; Gondw. Flora, Vol. I.

The Athgarh sandstone (near Katák in Orissa) also represents the Rájmahál group.

On about the same horizon the following have most probably to be placed:

The "Pachmari sandstones,"* base of the Mahádeva in the Sátpura basin without fossils; the "Dubrajpúr group"† of the Rájmahál hills, which so far as is known with certainty, contains the genus *Ptilophyllum* only; the Sironcha sandstones,‡ near Anáram, on the Pranhita river, Central Provinces, with fragmentary plant remains (conifers); and lastly, from its geological position (below the Vemáveram shales), the Budaváda group,§ is probably also to be classed here although containing plants and marine animals.

Certain red shales on the Northern face of the Latiahar hill, in the Aurunga coalfield, and containing Lower Gondawána fossils (*Glossopteris, Vertebraria* &c.,) should most probably be included here also.

a. Panchet Division.

Panchet group.—1861, Blanford (W. T.) Report on the Raniganj coalfield Mem. G. S. I. Vol. III, p. 126.

The uppermost group of the Lower Gondwánas is typically developed in the Raniganj coalfield, from whence it was first described. It is here fossiliferous, containing *Labyrinthodontia* and *Dicynodontia* and plants. It has its name from the Panchet hill, Bengal

This group is also developed in several other basins but is scarcely fossiliferous; and the Almod beds (H. B. Medlicott) in the Sátpura basin are representatives of this group.

b. Damuda Division.

Raniganj group.—1861, W. T. Blanford, M. G. S. I. Vol. III.

Top-group of the Damuda series, highly fossiliferous and coal-bearing.

At first described from the Raniganj coalfield, where it is typically developed.

It was afterwards recognised in all the Damuda valley coal-basins, but also beyond this region it is developed; in the Aurunga coalfield, Ramkola and Tatapáni coalfields and quite typically also in the South Rewah basin.

* H. B. Medlicott, Mem. G. S. I. Vol. X, p. 155.

† V. Ball, ib. Vol. XIII, Pt. 2, p. 44, etc.

‡ 1877 King, Rec. G. S. I. Vol. X, Pt. 2, p. 56, et seq.

§ Foote, Mem. G. S. I. Vol. XVI, Pt. 1, pp. 69-71.

It is represented by some other groups in other coalfields, *viz.*, the Kamthi group* of the Nágpur area and of the Raigarh-Hingir coalfields,† and the Bijori horizon of the Sátpura basin,‡; both are fossiliferous.

The Mángli shales of the Cent. Provinces, (South of Nágpur) are also placed here although I was (and I must say, I am still so) very much inclined to believe them to be more closely related to the Panchet group.

Ironstone shales.—1861, W. T. Blanford. On the Geology etc., of the Raniganj coalfield, Mem. G. S. I. Vol. III, p. 28.

This group, from a stratigraphical point of view belongs to the Raniganj group, though on account of the occurrence of ironstone it is easily separable. It is present in most of the Bengal coal-fields and both the ironstones as well as the carbonaceous shales in which they are imbedded, or with which they alternate, are fossiliferous, the fossils being very much the same as in the other groups of the Damuda division.

The Motúr horizon§ of the Sátpura basin is most probably the representative of the ironstone shales.

Barákar group.—1861 Oldham (T.) Additional remarks on the geology, relations etc., of the rocks in Bengal etc., M. G. S. I. Vol. III, p. 42.

For the lowest group of the Damuda division (series), which was at first simply called "lower Damudas," the above name was proposed by Dr. Oldham (1861), since the corresponding term "upper Damudas," had also to be replaced by another name (the present Jabalpur group) as it was employed for a group of the upper Gondwána portion.

The Barákar group, like the Raniganj group, is rich in coal, and is present in most of the coalfields; it contains also numerous fossils, which, however, on the whole do not differ much from those of the two higher groups.

c. Talchir Division.

Karharbari beds (coalbearing.)—1877, Feistmantel, Rec. G. S. I. Vol. X, Pt. 3, p. 137-139.

1878, W. T. Blanford, Rec. G S. I, Vol. XI, Pt. 1.

The coalbeds of the Karharbári coalfield were formerly included in the Barákar group; but the examination of the Flora has shewn their closer connexion with the Talchirs. They are with certainty known from the above coalfield and from the Mopáni coalfield, Sátpura basin.

* 1870, W. T. Blanford, Rec. G. S. I. Vol. IV, p 50; Mem. G. S. Ind. Vol. IX, p. 11, et seq.

† V. Ball, Rec. G. S. India, Vol. VIII, p. 113, etc.

‡ H. B. Medlicott, Mem. G. S. I. Vol. X, p. 27.

§ H. B. Medlicott, Mem. G. S. I. Vol. X, p. 29, (161.)

In these beds *Vertebraria* appears for the first time, *Glossopteris* is largely enough developed, *Gangamopteris* predominates.

Talchir group.—1859. Talchir coalfield, M. G. S. I. Vol. I.

This peculiar group which is at the base of the whole Gondwána system is met with in all the various basins. It consists of shales (bluish grey or olive green, fine earthy), sandstones and a boulder bed, which is believed to have been formed by floating ice. The shales are fossiliferous; fossils are known hitherto from three basins, in two of which I have collected and found the fossils to be numerous.

Here *Glossopteris* takes its origin in India; among other fossils the genus *Gangamopteris* is the most numerous. There is also a fragment of an insect wing, but too fragmentary to allow of an identification or classification.

I shall now proceed to enumerate the Gondwána fossils hitherto known, from the entire system, in systematic (biological) order giving with each genus and species its distribution. I begin with the lowest plants passing then to the animals. Of references to the species I shall give only such where there is a figure of the species or the latest description. I have also added, for sake of convenience, the etymological derivation of all the names.

PLANTAE.

Class: ALGAE.*

Genus *Chondrites*,† Stbg.

There is only one Alge mentioned from the Gondwána system, and even its occurrence is very doubtful.

Chondrites (?), dichotomus, Morr. sp.

1840. *Fucoides*, Morris, Transact. Geol. Soc. Lond. Vol. V, 2 Ser. Tab. XXI, fig. 1.

1876. *Chondrites*, Feistmantel, Kach Flora, Gondwána Flora. Vol. II, p. 6.

Group and locality uncertain, as is the species itself.

Class: EQUISETACEÆ.‡

This order is well represented, though almost entirely in the Lower Gondwánas.

* The seaweed family.

† From Chondrus, name of a living genus of seaweeds.

‡ Horse-tail family.

Genus *Equisetum*, Lin.

The stem articulated, the internodes striated, the leaves connected to a sheath, placed round the joints.

Only one species from the Upper Gondwánas.

Equisetum rajmahalense,* Oldh. and Morr. sp. (Schimp.)

1862. *Equisetites*, Oldham and Morris, Rájmahál Flora (Gondwána Flora, Vol. I,) Pl. II, figs. 2-5, Pl. XXXV, figs. 3, 4.

1877. Feistmantel, Rájmahál Flora, Gondwána Flora, Vol. I, p. 63.

Resembles *Equisetum münsteri*, Schimp.

Rájmahál group: Belátikur near Burio, Rájmahál hills.

Genus *Schizoneura*,† Schimp. et Moug. 1844.

This genus occurs in Europe in Triassic and rhaetic beds only.

Schizoneura gondwanensis,‡ Fstm.

1876. Feistmantel, Rec. G. S. I. Vol. IX, p. 69.

1880. Pal. indica, Gondwána Flora, Vol. III, p. 61, Pls. I A.—IX. A.

The stem articulated, striated and branched; the leaflets about 12-22, long and with a middle vein, are joined into a sheath which splits into two or more portions, placed round the joint.

Differs from the European form by the greater number and the somewhat coarser consistence of the leaflets.

Range:—

Upper Gondwánas: Certain red shales of apparently Lower Mahádeva (lower Upper Gondwánas) age, on north face of Latiahar hill, (close to the top) Aurunga coalfield.

Lower Gondwánas: Panchet group: near Maitúr, north-west of Assensole, Raniganj coalfield.

Raniganj group: Raniganj and Jharia coalfields; Hurdeeamo, N. W. of Sarum, Bokaro coalfield; Ramkola coalfield; Garjan hills, Raigarh coalfield; South Rewah basin (several places); Baricondam, Sátpura basin.

Barákar group: Lumki hill, Karharbári coalfield.

Karharbári beds: ? Karharbári coalfield; Mohpáni coalfield (Sátpura basin).

* Rájmahál hills.

† Schizo (gr) = to slit; neura (gr) = the vein.

‡ Called so from the Gondwána system.

Schizoneura comp. *meriani*,* Schimp.

1879. Feistmantel, Pal. ind., Talchír-Karharbári flora, Pl. I, figs. 6-7.
1880. Damuda-Panchet flora, ibid. p. 64, Pl. VIII A. 4; IX A. 3-6.

Some specimens from the Karharbári and Raniganj coalfield appear to belong to this species.

Some other equisetaceous stalks from the Talchir shales appear also to belong to *Schizoneura*, so that in India this genus ranges from the Talchir to the Panchet groups.

Genus *Phyllotheca*,† Bgt.

A genus at first described from the upper coalmeasures in Australia (*Ph. australis*, McCoy) then from the Italian Oolite (by Zigno), then from India and lately from the Siberian Jura.

Phyllotheca indica,‡ Bunb.

1862. Bunbury, Nágpur plants, Qu. J. G. S. Vol. XVII, p. 355. Pls. X, XI.
1880. Feistmantel, Pal. ind., Gondwána Flora, Vol. III, p. 67, Pl. XII A fig. 3-9.

Lower Gondwánas: Raniganj (Kámthi) group: Raniganj coalfield and Nágpur area.

Phyllotheca robusta,§ Feistm.

1880. Pal. ind., Gondwána Flora, Vol. III, pp. 68-69, Pl. XIV A, figs. 1-2.

Lower Gondwánas: Raniganj group (?) near Dubrajpur, Gopicándar area, Rájmahál hills.

Another *Phyllotheca* was recently brought by myself from the Talchir shales, Kárampúra coalfield, but it is not yet figured.

Genus *Trizygia*,‖ Royle.

Like *Sphenophyllum* of the palaeozoic period, but the leaves in *three* pairs on one side of the articulation, always *six* leaves only.

Trizygia speciosa,¶ Royle.

1839. Royle, Botany etc., Himalayan Mts. p. 431, Pl. II, fig. 8.
1876. Feistmantel, J. A. S. Beng., Vol. XLV, p. 342, Pl. XV, fig. 1-2.

a. Lower Gondwánas: Barákar group in the Bokáro coalfield (near Layo); Aurunga coalfield (near Murup) and in the Talchir coalfield (near Gopálprasád).

* Proper name.
† Phyllon (gr) = a leaf; theca (gr) = a sheath.
‡ Indicus (lat) = indian.
§ Robustus (lat) = strong.
‖ Threis (gr) = three; Zeugos (gr) = a pair.
¶ Speciosus (lat) = handsome.

b. Raniganj group: Raniganj coalfield; Sátpura basin; Sikkim (according to Sir J. D. Hooker).

Genus *Vertebraria*,* Royle.

A very peculiar genus, hitherto with certainty known only from India and Australia.

Vertebraria indica, Royle.

1839. Royle, *l. c.*, p. XXIX, Pl. II, fig. 1-7.
1880. Feistmantel, Pal. ind. Gondwána Flora, Vol. III.

This fossil is very abundant and has a very wide distribution.

Upper Gondwánas: In the red shales, mentioned above, from the Latiahar hill, Auranga coalfield.

Lower Gondwánas: Raniganj (Kámthi) group in most of the coalfields.
Barákar group: in most of the coalfields.
Karharbári beds: Karharbári coalfield, rare.

Class FILICES.

Ferns are very numerous both in the upper and lower portion of the Gondwána system.

Order GLEICHENIACEÆ.

Several forms, described at first with other generic names, appear to belong here.

Gleichenia† *bindrabunensis*,‡ Schimp.

1862 *Pecopt. gleichenioides*, Old. and Morr. Rájmahál flora, Pal. ind., Gondwána Flora, Vol. I, pp. 45, 46, Pls. XXV, XXVI, fig 1, 3.
1869. Schimper, Trait. d. Pal. vég. I, p. 670.

Upper Gondwánas: Rájmahál group in the Rájmahál hills.

Pecopteris§ *tenera*,‖ Feistm.

1876. Feistmantel, Kach Flora, Pal. ind., Gondwána Flora, Vol. II, p. 26, Pl. III, fig. 5.

Upper Gondwánas: Umia group, Dudye in Kach.

Order MARATTIACEÆ.

Genus *Danaeopsis*,¶ Heer.

Danaeopsis rajmahalensis,** Feistm.

1877. Feistmantel, Pal. ind., Gondwána Flora, Vol I, p. 105, Pl. XXXVIII, fig. 4

* Vertebra (lat) = a joint of the back-bone.
† A living genus.
‡ From Bindrabun.
§ Peko (gr) = to comb; pteris (gr) = fern.
‖ Tener (lat) = tender.
¶ Like Danaea.
** Rájmahál hills.

Upper Gondwánas: Rájmahál group in the Rájmahál hills.

Another *Danaeopsis* will be described by myself on the next opportunity from the S. Rewah basin.

Order CYATHEACEÆ

Genus *Cyathea*,* Lin.

Cyathea comp. *Tchihatcheffi*†, Schmalh.

1880. Feistmantel, Pal. ind., Gondwána Flora, Vol. III, p. 75, Pl. XVI, A. figs. 1, 2, 4.

Lower Gondwánas: Barákar group, near Talchir, Talchir coalfield.

This species is otherwise known from the Jura of the Altai Mountains.

Sphenopteris‡ *polymorpha*,§ Fstm.

1876. Journ. As. Soc. Beng., Vol. XLV, pp. 356-358, Pl. XVI, figs. 5-7, XVII.

1880. Pal. ind., Gondw. Flora, Vol. III, p. 76, Pls. XV A, XVI A, fig. 3, XVI A *bis*, figs. 1-6.

Lower Gondwánas: a. Barákar group: Lumki hill, Karharbári coalfield.

b. Raniganj group: Raniganj coalfield.

Genus *Dicksonia*,‖ L'Hérit.

In this genus have, I think, to be placed besides others, also several forms which were formerly classed with other genera.

Dicksonia hughesi,¶ Fstm.

1880. Pal. indica, Gondwána Flora, Vol. III, p. 52.

Lower Gondwánas: Raniganj group of the Jharia coalfield, and of the Sátpura basin (Bijori horizon).

Dicksonia bindrabunensis,** Feistm.

1877. Feistmantel, Rájmahál Flora, Gondwána Flora, Vol. I, p. 76, Pl. XXXVII fig. 2.

Upper Gondwánas: Rájmahál group, at Bindrabun, Rájmahál hills.

Other ferns, from the upper Gondwána portion, to be placed with this genus, are: *Dicksonia*†† sp. (Jabalpur group), *Sphenopteris*, comp. *arguta*,‡‡

* A living genus.

† Proper name.

‡ Sphen (gr) = wedge; pteris (gr) = fern.

§ Polys (gr) = many-fold; morphe (gr) = form, aspect.

‖ A living genus; from a proper name.

¶ Proper name (Mr. Th. Hughes).

** Name of a locality

†† 1877. Pal. ind. Gondwána Flora, Vol. II, p. 86.

‡‡ 1877. Pal. ind. Gondwána Flora, Vol. I, pp. 71-72.

Lindl. and Hutt., (Katrol group, Jabalpúr group and Rájmahál group), and *Hymenophyllites bunburyanus*,* Oldh. and Morr. sp. (Rájmahál group). Of more importance is the following.

Pecopteris lobata, Oldh. and Morr.

1877. Pal. Gondwána Flora Vol. I, p. 92.
1881. Rec. Geol. Survey India, Vols. XIV, p. 149, figures.

This species I have quite recently united with *Dicksonia* also.

Upper Gondwánas: Rájmahál group in the Rájmahál hills.

Order POLYPODIACEAE.

Type *Asplenium*, Lin.

Asplenium whitbyense, Heer.

1876-79. Pal. ind. Gondwána Flora, Vols. I and II.
1880. Pal. ind. Gondw. Flora, Vol. III, p. 52.

This species was at first described as an *Alethopteris*, but the discovery of specimens with fructification, caused it to be placed with *Asplenium*.

Upper Gondwánas: Umia group, Katrol group (Kach.); *Jabalpur group* (Sátpura and S. Rewah basin); *Sripermatur* (*Vemáveram*) group.

Lower Gondwánas: Raniganj group, Raniganj coalfield; Jharia coalfield; S. Rewah basin. To this very probably also belongs:

Alethopteris† *indica*, Oldh. and Morris.

1862-79. Pal. ind. Gondwána Flora Vol. I.

Upper Gondwánas: Jabalpur group (S Rewah basin); *Sripermatur group* (Sripermatur area; S. Kistna area; Utatúr plant beds); *Rájmahál group*.

Alethopteris medlicottiana,‡ Feistm.

1877. Pal. ind. Gondwána Flora, Vol. IX, p. 87.

This form has probably also to be classed with this group.

Upper Gondwánas: Jabalpur group (Sátpura and S. Rewah basin).

Type *Polypodium*, Linn.

Alethopteris lindleyana,§ Royle.

1869. Royle, *l. c.*, Tab. II, fig. 4.

Although the appearance of the fronds would place this form in proximity with *Aspl. whitbyense* and *Aspl. indicum*, yet, fructificating specimens,

* 1877. Pal. ind. ib. p. 88.
† Alethes (gr) = true, and pteris = true fern.
‡ Proper name.
§ Proper name.

which I believe belong to this species force us to class it with *Polypodium*, keeping it still with the *Polypodiaceae*.

Lower Gondwánas: Raniganj group, Raniganj coalfield.

Type *Phegopteris*, Mett.

With the *Polypodiaceae* has also to be placed *Alethopteris phegopteroides*,* Feistm.

1876. Journ. As. Soc. Beng., Vol. XLV, p. 362, Pl. XVIII.

A very large and interesting fern, of rare occurrence.

Lower Gondwánas: Raniganj group, Raniganj coalfield.

The ferns, hitherto named, are such, as can with some certainty (mostly from the state of the fructification) be correlated with living ferns. There is, however, a by far greater portion of ferns which have to be classed under separate orders whose relation to living forms can only be guessed, while in some other cases it is entirely doubtful.

Order SPHENOPTERIDEAE.

Sphenopteris hislopi,† Oldh. and Morr.

1862. Rájmahál Flora, Pal. ind., Gondwána Flora, Vol. I, Pl. XXXI, figs. 1-5.

Upper Gondwána: Rájmahál group, near Bindrabun, Rájmahál hills.

Sphenopteris? membranosa,‡ Feistm.

1877. Rájmahál Flora, Pal. ind., Gondwána Flora, Vol. I, p. 81, Pl. XXXII, fig. 4.

Upper Gondwánas: Rájmahál group, near Burio, Rájmahál hills.

Order NEUROPTERIDEAE§ and CARDIOPTERIDEAE.‖

Genus *Cyclopteris*,¶ Bgt.

Cyclopteris oldhami,** Feistm.

1877. Rájmahál Flora, Pal. ind. Gondwána Flora, Vol. I, p. 88, Pl. XXXVI, figs. 1, 2, XXXVII, 5, 6.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills.

* Like Phegopteris, a living genus of ferns.
† Proper name.
‡ Thin membranaceous.
§ From Neuropteris (neuron = the vein, and pteris = the fern) = the vein fern.
‖ Kardia (gr) = the heart and pteris; the heart fern.
¶ Kyklos (gr) = circle and pteris.
** Proper name.

Neuropteris valida,* Feistm.

1879. Talchir-Karharbári Flora, Pal. ind., Gondwána Flora, Vol. III, (Ser. XII, 1) pp. 10-11, Pls. II-VI.

A large and exceedingly nice, single pinnate fern, very numerous at one locality.

Lower Gondwánas: Karharbári beds at Buriadi (very frequent), at Passerabhia and Domahni (rare) in the Karharbári coalfield.

Cyclopteris (?) pachyrhachis,† Gopp.

1841. Göppert, Genera plant foss. Nos. 5-6, p. 94, Pl. 4, 5.

Lower Gondwánas: Panchet group, N. W. of Assensole, Raniganj coalfield.

Order ALETHOPTERIDEAE and PECOPTERIDEAE.
(Incertae sedis).

Alethopteris lobifolia,‡ Lindl. and Hutt.

1877. Feistmantel, Jabalpur Flora, Pal. ind., Gondwána Flora, Vol. II, p. 86, Pl. III, fig. 1.

A species of the English Oolite.

Upper Gondwánas: Jabalpur group, from the Sher river, Sátpura basin.

Pecopteris concinna,§ Presl.

1838. Presl. in Sternberg, V. d. Fl. d. Vorw. II, p. 149, Pl. 41, fig. 3.

Lower Gondwánas: Panchet group, N. W. of Assensole, Raniganj coalfield.

Genus *Merianopteris*,‖ Heer.

Established by Prof. Heer in his "Fossil Flora der Schweiz,"¶ upon the former *Pecopteris angusta* from the Trias.

From India I have identified one species of somewhat larger dimensions as:

Merianopteris major,** Feistm.

1880. Damuda Flora, Pal. ind., Gondwána Flora, Vol. III, p. 52.

Lower Gondwánas: Raniganj group, in the Raniganj coalfield.

* Validus (lat) = strong, big.
† Pachys (gr) = thick; rhachis (gr) = stalk.
‡ With lobed leaves.
§ Concinnus (lat.) = pretty, neat.
‖ Merian's fern.
¶ Pflanzen der Trias, pp. 69, 87-88; Pls. XXIV, 7-12; XXXVII, XXXVIII, 7, 8.
** Larger, in comparison with the original species.

*Asplenites** (*Lepidopteris*) *macrocarpus*,† Oldh. and Morr.

1862. Oldham and Morris, Rájmahál Flora, Pal. ind., in Gondwána Flora, Vol. I, p. 51, Pl. XXVIII, 2, 3, XXXVI, 5-7.

1877. Feistmantel, Rájmahál Flora, Gondwána Flora, Vol. I, p. 171, Pl. XXXVII, figs. 3, *a*, *b*, *c*, 4, 4*a*; XLVIII, figs. 2.

Resembles very much the Rhœtic *Lepidopteris ottonis*, Schenk sp.

Upper Gondwánas: Rájmahál group, near Bindrabun, in the Rájmahál hills; in the Atgarh sandstone, near Katák; and near Golapili, on the Southern Godávari.

Pecopteris reversa,‡ Feistm.

1879. Pal. ind. (II-4), Gondwána Flora, Vol. I, p. 205, Pl. I, fig. 5, II. 1, 2, 7.

Upper Gondwánas: Sripermatur group, near Ragavapuram, on the S. Godávari, and in the Sripermatur area.

Order Lomatopterideæ and Pachypteridæ.

Genus *Thinnfeldia*, Braun.

Thinnfeldia§ comp. *odontopteroides*,‖ Feistm. (Morr. sp.)

1845. Morris in Strzelecki, N. S. Wales, etc.

1879. Feistmantel, Flora des östl. Australiens, *Palæontographica*, Suppl. III, Lief. III, pp. 105, 165.

This is a species, occurring in Australia in beds, above the upper coal-measures, *viz.*, Hawkesbury-Wianamatta, and in the upper mesozoic beds of Queensland and Tasmania.

Lower Gondwánas: Panchet group in the Ramkola Tatapáni coal-fields.

Upper Gondwánas; Parsora near Beli, South Rewah basin (lowest upper Gondwána beds).

Thinnfeldia indica,¶ Feistm.

1877. Feistmantel, Rájmahál Flora, Pal. ind., Gondwána Flora, Vol. I, p 87 Pl. XXXIX, 1. 1*a*; a true *Thinnfeldia*.

Upper Gondwánas: Rájmahál group Busko Ghat and Burio, Rájmahál hills.

* Like *Asplenium*, in fossil state.
† Makros (gr) = large; karpos (gr) = fruit.
‡ Reversed.
§ Proper name.
‖ Like *Odontopteris*.
¶ Indian.

Thinnfeldia subtrigona,* Feistm.

1879. Pal. ind., Gondwána Flora, Vol. I, p. 203, Pl. I, fig. 7.

Upper Gondwánas: Sripermatur group near Vemáveram, S. Kistna country.

There are several other fragmentary specimens, which I have also referred to *Thinnfeldia*, but which need not be repeated here.

Genus *Dichopteris*,† Bgt.

Dichopteris ellorensis, Feistm.

1879. Pal. ind., Gondwána Flora, Vol. I, p. 204, Pl. II, figs. 8-10.

Upper Gondwánas: Sripermatur group, at Ragavapuram, Ellore District, S. Godávari.

Genus *Pachypteris*,‡ Bgt.

Pachypteris specifica,§ Feistm.

1876. Feistmantel, Kach Flora, Pal. ind., Gondwána Flora, Vol. II, p. 32, Pl. III, fig. 6.

Upper Gondwánas: Umia group, near Bhujuri in Kach.

Another species was described by me from Kach, which is somewhat doubtful.

Order TAENIOPTERIDEÆ.

Genus *Taeniopteris*,‖ Bgt.

Taeniopteris densinervis,¶ Feistm.

1876. Feistmantel, Kach Flora, Pal. ind., Gondwána Flora, Vol. II, p. 19, Pl. II, fig. 6.

I could not assign this fragmentary specimen to any of the subgenera of *Taeniopteris*.

Upper Gondwánas: Umia group, near Kukurbit, in Kach.

Sub-genus *Macrotaeniopteris*,** Schimp.

This comprises all the large and broad-leaved forms, in Europe it belongs principally to the mesozoic epoch. In India it occurs both in the Lower and Upper Gondwánas.

* Somewhat trigonal.

† Dicha = in two; pteris = fern; the forked fern.

‡ Pachys (gr) = thick, coarse; pteris = fern.

§ Typical.

‖ The ribbon fern.

¶ Densus = close; nervus = the vein.

** Makros (gr) = large and *taeniopteris*.

*Macrotaeniopteris crassinervis,** Feistm.

1877. Feistmantel, Rájmahál Flora, Pal. ind., Gondwána Flora, Vol. I, p. 102, Pl. XXXVIII, figs. 1-3.

Upper Gondwánas: Rájmahál group, near Murero and Busko-ghát, Rájmahál hills.

Macrotaeniopteris lata,† Oldh. and Morr.

1862. Rájmahál Flora; Pal. ind., Gondwána Flora, Vol. I, p. 41, Pls. I, II, fig. 1; III. fig. 2, Pl. V.

1877. Feistmantel, ibidem, p. 99, Pl. XLIII, fig. 1.

Upper Gondwánas: Rájmahál group, near Bindrabun in the Rájmahál hills. Numerous.

Macrotaeniopteris morrisi,‡ Oldh.

1862. Oldham *l. c.*, p. 13, Pl. III, fig. 1.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills.

Macrotaeniopteris ovata,§ Schimper.

1862. Oldham *l. c.*, p. 43, Pl. III, figs. 3-5.

1877. Feistmantel, *l. c.*, p. 103, Pl. XXXVII, fig. 1.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills.

Macrotaeniopteris danaeoides,‖ Royle sp.

1839. Royle, Botany etc., Himalayan Mts. Pl. II.

1876. Feistmantel, J. A. Soc. Bengal, Vol. XLV, p. 365, Pl. XIX, figs. 1, 2, Pl. XX, fig. 1.

Lower Gondwánas: a Barákar group, near Burgo in the Rájmahál hills.

b. Raniganj (Kámthi) group of the Raniganj and Jharia coalfield, Bengal; near Kámthi, Nágpur area.

Macrotaeniopteris feddeni,¶ Feistm.

1876. Feistmantel, R. G. S. I. Vol. IX, Pt. 4, p. 137.

Lower Gondwánas: Kámthi (Raniganj) group, near Kámthi, Nágpur area.

There is another fragment of a *Macrotaeniopteris* from the Jabalpur group, but I do not find it practicable, to distinguish it by a separate name.

* Crassus = thick, nervus = vein.

† Latus = broad.

‡ Proper name.

§ Oval.

‖ Like *Danaea*, a living genus of ferns.

¶ Proper name (Mr. F. Fedden, of the Geolog. Survey of India.)

Sub-genus *Oleandridium*,* Schimp.

Oleandridium vittatum,† Bgt. sp. (Schimp).

1828. *Taeniopteris*, Brongniart hist. d. végét. p. 263, Tab. 82, figs. 1-3.

1876. *Oleandridium*, Feistmantel, Kach Flora, Pal. ind., Gondwána Flora, Vol. II, p. 15, Pl. I, figs. 1-3, II, 1-5, XII. 1.

Upper Gondwánas: Umia group, near Kukurbit in Kach.

Oleandridium comp. *stenoneuron*,‡ Schenk.

1867. Schenk, Flora der Grenzschichten p. 103, tab. XXV, figs. 5, 6.

Lower Gondwánas: Panchet group, in the Raniganj coalfield.

Sub-genus *Angiopteridium*,§ Schimp.

Angiopteridium spathulatum,‖ Schimp. (McClell. sp.).

1862. *Stangerites*, Oldham and Morris, Rájmahál Flora, Pal. ind., Gondwána Flora. Vol I, Pl. VI, figs. 1-7.

1877. Feistmantel, Rájmahál Flora, ib. Vol. I, p. 97.

This is a very common species in the *Upper Gondwánas: a. Rájmahál group*, in the Rájmahál hills and near Golapili, South Godávari district *b. Sripermatúr group* in the S. Godávari district, S. Kistna and Trichinopoli district, as also in the middle Godávari basin.

Angiopteridium mc'Clellandi,¶ Schimp. (Oldh. and Morr. sp.)

1862. *Stangerites*, Oldham and Morris, *l. c.*, p. 33, Pl. XXIII.

1877. Feistmantel, *l. c.*, Pl. XLVI, figs. 5, 6.

This is a species with a pinnate frond.

Upper Gondwánas: a Rájmahál group in the Rájmahál hills; *b. Sripermatúr group* in the S. Godávari and S. Kistna district, and in the Sripermatúr area.

Lower Gondwánas: There are some fragmentary specimens from the "Lower Gondwánas" in the Nágpur area and in the South Rewah basin, which, although not exhibiting the pinnate nature of the frond yet exhibit all the other characters of the species to such a degree, that I cannot distinguish them.

Angiopteridium ensis,** Oldh. sp.

1862. *Stangerites*, Oldham and Morris, *l. c.*, p. 35, Pl. VI, figs. 8-10.

1877. Feistmantel, ibid. p. 97.

* Like *Oleandra*, a living genus.

† Vittatus, from vitta = a headband.

‡ Stenos = close; neuron = the vein.

‖ Like *Angiopteris*, a living genus.

§ Spathulate.

¶ Proper name.

** Ensis (lat) = sword—referring to the form of the leaf.

Upper Gondwánas: Rájmahál group, near Burio, Rájmahál hills.

Angiopteridium comp *ensis*, Oldh. sp.

1877. Feistmantel, Golapili Flora *l. c.*, p. 173, Pl. I, figs. 6*a*, 7*a*.

Upper Gondwánas: Rájmahál group, near Golapili, S. Godávari district.

Angiopteridium infarctum, Feistm.

1880. Feistmantel, Pal. ind., Gondwána Flora, Vol. III, p. 53.

Lower Gondwánas; Barákar group, near Kumerdhubi, Raniganj coalfield.

Type *Vittaria*, Swartz.

Genus *Palaeovittaria*,* Feistm.

Palaeovittaria Kurzi,† Feistm.

1876. Feistmantel, Raniganj plants, J. As. S. B., Vol. XLV, p. 368, Pl. XIX. fig. 3-4.

Lower Gondwánas: Raniganj group, Raniganj coalfield.

Order DICTYOTAENIOPTERIDEÆ.‡

This order might with equal propriety be termed *Glossopterides*, the only genus it at present comprises being the famous *Glossopteris*,§ Bgt.

Genus *Glossopteris*, Bgt.

1828. Brongniart, Histoire, végétaux fossiles, p. 223.

This genus is formed of leaves of generally a more or less oblong or spatulate shape of various sizes, with a *distinct midrib*, and the secondary veins forming a net-venation of a varied character.

It was at first described by Brongniart from Australia (from the upper coalmeasures) and from India, from beds, which are now known as the Raniganj group (see *ante*). Subsequently it was also identified from the lower coalmeasures (carboniferous) in N. S. Wales; it was found in India both in the *Lower* (in all groups) and *Upper* Gondwána system, so that it ranges in these two countries from Carboniferous to Jura.

In India it is very well represented, its greatest development being in the Lower Gondwána system, and in it in the *upper groups*. About 17 or 18 species are described in my Damuda Flora (Pal. ind., Gondwána Flora, Vol. III). For an easier arrangement I have grouped them into five *sections*, according to the net-venation and the shape of the leaf.

Of these species I shall mention here only those originally described by Brongniart and those which have a wide range in India.

* Palaios (gr) = old, ancient; and Vittaria = a living genus of ferns.

† Proper name = the late Curator, Botanical Gardens, Calcutta.

‡ *Taeniopterides* with a net-venation.

§ Glossa (gr) = tongue; pteris = fern.

Glossopteris indica,* Schimp.

1828. Glossopt. browniana, var. indica, Brongniart Hist. vêg. foss. p. 223, tab. 62, fig. 2, β

Lower Gondwánas: Barákar group, Raniganj group and *Panchet group.*

Upper Gondwánas: From the red shales, north face of Latiahar hill, Aurunga coalfield.

Glossopteris communis,† Feistm.

1876. Feistmantel, J. As. Soc. B., Vol. XLV, p. 375, Pl. XX, fig. 5.

Lower Gondwánas: Karharbári beds; Barákar group; Ironstone shales; Raniganj group; Panchet group.

Upper Gondwánas: The red shales, north face, Latiahar hill, Aurunga coalfield; *Jabalpúr group*, Sher river, Sátpura basin.

Glossopteris damudica,‡ Feistm.

1880. Pal ind. Gondwána Flora, Vol. III, p. 53.

Lower Gondwánas: Karharbári beds; Barákar group; Ironstone shales; Raniganj group.

Upper Gondwánas: Red shales, north face Latiahar hill, Aurunga coalfield.

Glossopteris browniana,§ Bgt.

1828. Brongniart, *l. c.*, p. 223, Pl. 62, fig. 1.

Lower Gondwánas: Barákar group; Raniganj group.

Glossopteris angustifolia,‖ Bgt.

1828. Brongniart, *l. c.*, p 227, Pl. 63, fig. 1.

1876. Feistmantel, J. As. Soc. B., *l. c.*, Pl. XXI, fig. 2-4.

Lower Gondwánas: Barákar group; Raniganj group; Panchet group.

The names of the others may just be mentioned:—

Gloss. intermittens, Feistm. (Barákar group); *Gl. stricta*, Bunb. (Kámthi-Raniganj group); *Glossopteris (?) musaefolia*, Bunb. (ditto); *Gl. retifera*, Feistm. (Raniganj group); *Gl. conspicua*, Feistm. (ditto). *Glossopt. divergens*, Feistm. (ditto); *Gl. ingens*, Feistm. (Barákar group); *Gl. leptoneura*, Bunb. (Kámthi-Raniganj group); *Gl. formosa*, Feistm. (Raniganj group); *Gl. orbicularis*, Feistm. (ditto); *Gl. decipiens*, Feistm. (Karharbári beds).

I may also mention that *Glossopteris* is now also known with certainty from the Talchir shales; I have brought several specimens from the Talchirs in the Chano vicinity, North Káranpúra coalfield.

* Indian.

† Common.

‡ Appertaining to the Damuda series.

§ Proper name.

‖ Narrow-leaved.

Order DICTYOPTERIDEÆ.

The most prominent group of fossils in this order belong to a genus equally well represented in India and in Australia (Victoria) in beds of about the same horizon.

Genus *Gangamopteris*,* McCoy.

1875. McCoy Prodr. Pal. Victoria, Dec. II, p. 11.

Like *Glossopteris*, this genus is composed of leaves with a net-venation but *without* a midrib, all the veins radiating from the base into the leaf.

It is of frequent occurrence in the Lower Gondwánas in India but in a reversed proportion to *Glossopteris*, being most frequent in the lowest groups (Talchir-Karharbári) of that portion.

We know the following species:

Gangamopteris cyclopteroides,† Feistm.

1879. Feistmantel, Pal. ind., Gondwána Flora, Vol. III, Pt. 1, p. 12, Pls. VII, IX, XI, etc.

A very abundant species.

Lower Gondwánas: Talchir shales of the Karaun (Deoghur) and Káranpúra coalfields; *Karharbári beds* of the Karharbári and Mohpáni coalfield.

Of this species I have also described many varieties, occurring in one or the other of the above groups or both; but it is not necessary to repeat them here.

Gangamopteris buriadica,‡ Feistm.

1879. Feistmantel, *l. c.*, p. 15, Pl. XVIII, fig. 1-2.

Lower Gondwánas: Karharbári beds, Karharbári coalfield.

Gangamopteris major,§ Feistm.

1879. Feistmantel, *l. c.*, p. 15, Pl. XIV, 3, Pl. XVI, fig. 1-2.

Lower Gondwánas: Karharbári beds, Karharbári coalfield.

Gangamopteris angustifolia,‖ McCoy.

1879. Feistmantel, *l. c.*, p, 16, Pl. IX, fig. 5.

Lower Gondwánas: a. Talchir shales, in the Deoghur and Káranpúra coalfields; *b. Karharbári beds*, in the Karharbári coalfield.

This species also occurs in Australia in the upper coalmeasures (N. Castle-beds) and in the Bacchus-Marsh sandstone, Victoria.

* Gangamon (gr) = a small net; pteris = a fern.
† Like *Cyclopteris*.
‡ From the locality Buriadi, Karharbári coalfield.
§ Larger.
‖ Narrow-leaved

Among the specimens, lately brought by myself from the Karharbári and Káranpúra coalfields, there is also another species which occurs in the Bacchus-Marsh sandstone of Victoria.

Gangamopteris is also represented in the higher groups of the Lower Gondwánas.

*Gangamopteris anthrophyoides,** Feistm.

1880. Feistmantel, Pal. ind. Gondwána Flora, Vol. III, p. 54.

Lower Gondwánas: Raniganj group, Raniganj field.

Gangamopteris hughesi,† Feistm.

1876. Feistmantel, Rec. Geol. Survey of Ind. Vol. IX, Pt. 4, p. 38.

Lower Gondwánas: Kámthi (Raniganj) group, Kámthi, Nágpur area

Gangamopteris whittiana,‡ Feistm.

1876. Feistmantel, J. As. S. Beng., Vol. XLV, p. 371, Pl. XX, figs. 3-4.

Lower Gondwánas: Raniganj group, Raniganj coalfield.

Genus *Belemnopteris,*§ Feistm.

1876. Feistmantel, J. As. Soc. Beng., Vol. XLV, p. 370.

Belemnopteris wood-masoniana,‖ Feistm.

1876. Feistmantel, *l. c.*, p. 371, Pl. XX, figs. 1-2.

This is one of the most interesting fossils, being very close to some living forms, amongst others to *Hemionitis cordata*, Roxburgh, which grows in India.

Lower Gondwánas: Raniganj group, Raniganj field.

INCERTÆ SEDIS.

The systematic positions of some other ferns are not quite certain. Amongst them are several forms with a net-venation and with a compound leaf, as exhibited either by the actual attachment of several leaflets to a common stalk or by the shape of the leaflets.

I have classed them provisionally with *Sagenopteris*, but in case a new generic name should hereafter be required for them, I propose the name *Dactylopteris* (the fingered fern).

They are mostly from the *Raniganj group*. One species was also described by myself from the *Karharbári beds*.

* Like Anthrophyum, a living genus.

† Proper name.

‡ Proper name.

§ Belemnon (gr) = arrow-head; pteris = fern.

‖ Proper name.

One leaflet is very similar to leaflets of *Sagenopteris rhoifolia*, Presl.

In this section (of uncertain ferns) also belongs that fern which I have already quoted elsewhere as *Actinopteris bengalensis*, and the shape of the leaves really resembles very much the form characteristic of this genus as described by Prof. Schenk from the Rhätic formation. Our fossil is from the *Raniganj group*.

Rhizomes and Stalks.

There are several indeterminable fossils which have to be considered as rhizomes and stalks of ferns. I shall refer to two only.

Genus *Rhizomopteris*,* Schimp.
Rhizomopteris balli,† Feistm.

1877. Rec. Geol. Survey, India, Vol. X, p. fig. 2-6.

This form is quite characteristic, exhibiting distinctly the circular scars and in some specimens also the dichotomy of the rhizome.

Upper Gondwánas; Athgarh sandstone (Rájmahál group) near Athgarh, Orissa.

Fern stem or *rhizome*.

1861. Bunbury, Sir. Ch. : Nágpur plants, Q. J. G. S. Vol. XVII, Pl. XII.

Lower Gondwánas: Shales at Mángli C. Prov., Wardha valley coalfield.

One or two specimens of a circinate vernation of a fern were also found in the Rájmahál group of the Rájmahál hills.

Class LYCOPODIACEÆ.‡

Remains of Lycopods are very rare in the Gondwána system. I can only record one species.

Genus *Lycopodites*,§ Sternb.
Lycopodites gracilis,‖ Feistm.

1880. Preface to Vol. II, Gondwána Flora, p. 19.
1881. Records Geol. Survey of India, Vol. XIV, Pt. 1, pp. 150-151, Pl. II, fig. 2.

This fossil was previously classed with the *Coniferae*.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills.

Class CYCADEACEÆ.¶

Remains of cycadeaceous plants are very numerous, especially in the upper portion of the Gondwána system, although they are also sufficiently

* Rhizome of a fern.
† V. Ball, Geolog. Survey, India.
‡ The Club-moss family.
§ Fossil Club moss.
‖ Slender.
¶ Cycad family.

represented in the lower portion, and this by such typical forms, that no doubt can any longer exist as to the occurrence of *Cycadeaceæ* in the Lower Gondwánas.

Order Zamieae.

Genus *Pterophyllum*, Bgt.

This genus is very abundantly represented in the lower groups of the Upper Gondwánas, and so is the subgenus which we shall quote hereafter as *Anomozamites;* both these forms have their representatives also in the Lower Gondwánas.

Pterophyllum carterianum,* Old.

1862. Oldham and Morris, Rájmahál Flora, Pal. ind., Gondwána Flora, Vol. I, p. 22, Pls. XV, fig. 4, XVIII, fig. 1.

Upper Gondwánas: Rájmahál group near Bindrabun Rájmahál hills, and Golapili, South Godávari district.

Pterophyllum crassum,† Morr.

1862. Oldham and Morris, *l. c.*, p. 24, Pl. XVI, 2.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills.

Pterophyllum footeanum,‡ Feistm.

1879. Feistmantal, Pal. ind. Gondwána Flora, Vol. I, p. 209, Pl. VI, figs. 1-6; VIII, XVI, 9.

Upper Gondwánas: Sripermatur group, at Vemávaram, South Kistna district, and in the Sripermatur area.

Pterophyllum kingianam,§ Feistm.

1877. Feistmantal, ib. p. 177, Pl. III; 1, IV, 1.

Upper Gondwánas: Rájmahál group, near Golapili, South Godávari district.

Pterophyllum medlicottianum,‖ Oldh.

1862. Oldham and Morris, *l. c.*, p. 21, Pl. XV, 3 XVII, 1.

1877. Feistmantel, *l. c.*, p. 111, Pl. XLIII, fig. 2; XLIV, fig. 1.

Upper Gondwánas: Rájmahál group, near Bindrabun, Ghutiari and Murero in the Rájmahál hills.

Pterophyllum nerbuddaicum,¶ Feistm.

1877. Gondwána Flora, Vol. II, p. 94, Pl. VI, fig. 9.

* Proper name.
† Thick.
‡ Proper name (Br. Foote of the Geolog. Survey).
§ Proper name (W. King of the Geological Survey of India).
‖ Proper name (H. B. Medlicott, Superintendent, Geol. Survey of India).
¶ Nerbudda river.

Upper Gondwánas: Jabalpur group, on the Sher river, in the Sátpura basin.

This has been hitherto the only representative of *Pterophyllum* found in the upper groups of the Upper Gondwánas.

Pterophyllum propinquum,* Göpp.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 110, with figure in text.

Upper Gondwánas: Rájmahál group near Bindrabun, Rájmahál hills.

Pterophyllum rajmahalense,† Morr.

1862. Oldham and Morris, *l. c.*, p. 12, Pl. XIII, 3—5 Pl. XIV, Pl. XVIII, fig. 2.

Upper Gondwánas: Rájmahál group, near Bindrabun and Onthea, Rájmahál hills.

Pterophyllum burdwanense,‡ Feistm. (McClell. sp.).

1850. *Zamia burdwanensis*, McClelland, Report, Geol Survey of India, p. 53, Pl. XIX, fig. 4.

1877. *Pterophyllum*, Feistmantel, Rec. Geol. Survey of India, Vol. X, Pt. 2, p. 71, Pl. I, 1.

The cycadeaceous nature of this fossil, by the discovery in the collections of the original specimen, has been established beyond any doubt.

Lower Gondwánas: Raniganj group, Raniganj coalfield.

Subgenus *Anomozamites*,§ Schimp.

This subgenus comprises forms of *Pterophyllum* with unequal (irregular) leaflets (whence the name). Many of the Upper Gondwána *Pterophylla* have to be classed here.

Anomozamites fissus,‖ Feistm.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 61, Pl. XXXIX, figs. 2—4.

Upper Gondwánas: a. Rájmahál group near Burio, Rájmahál hills; *b. Vemáveram group*, at Vemáveram, South Kistna district.

Anomozamites jungens,¶ Feistm.

1879. Feistmantel, Pal. ind., Gondwána Flora, Vol. I, p. 208, Pl. VII, figs. 11—13.

Upper Gondwánas: Vemáveram group, at Vemáveram.

* Close.
† Appertaining to the Rájmahál hills.
‡ From the locality Burdwan.
§ Anomoios (gr.) = unlike, dissimilar.
‖ Fissus (lat.) = slit.
¶ Jungo (lat.) = to connect, to join.

*Anomozamites lindleyanus,** Schimp.

1879. Feistmantel, ib., p. 208, p. Pl. XVI, fig 3.

Upper Gondwánas: Sripermatur (Vemáveram) group, in the Sripermatur area.

Anomozamites morrisianus,† Oldh. sp.

1862. *Pterophyllum*, Oldham and Morris, Rájmahál Flora, *l. c.*, p. 20, Pl. XV, 1, XVII, 2.

1877. Feistmantal, Rájmahál Flora, *l. c.*, p. 59, Pl. XLII, fig. 1.

Upper Gondwánas: Rájmahál group, near Bindrabun, Rájmahál hills and near Golapili, South Godávari district.

Anomozamites princeps,‡ Oldh. and Morr. sp.

1862. Oldham and Morris, ib. p. 23, Pl. X, 1—3; XI, 1; XII, 1; XIII, 1-2.

This is a very frequent species and one which attains very large dimensions.

Upper Gondwánas: Rájmahál group near Bindrabun, Rájmahál hills.

In connection with these species of *Anomozamites* in the "Upper Gondwánas," I have to mention that recently I have collected several specimens of an *Anomozamites* from "*Lower Gondwánas*" in the Aurunga coalfield, *viz.*, in the Barákar group; they will be described and illustrated on the next opportunity.

Genus *Zamites*, Bgt.

Zamites proximus,§ Feistm.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 63, Pl. XLI, fig. 1-2.

Upper Gondwánas: Rájmahál group near Murrero, Rájmahál hills.

Genus *Glossozamites,‖* Schimp.

Glossozamites stoliczkanus,¶ Feistm.

1879. Feistmantel, Talchir-Karharbari Flora, Pal. ind. Gondwána Flora, Vol. III, p. 19, Pl. XX, figs. 4-5.

Lower Gondwánas: Karharbári group, in the Karharbári, coalfield.

* Proper name (Lindley, the botanist).
† Proper name.
‡ Distinguished.
§ Very closely related.
‖ Glossa (gr.) = tongue; and *zamites*.
¶ Proper name.

Genus *Podozamites*, F. Br.

This genus is represented here by detached leaflets only, which however are very numerous.

Podozamites lanceolatus,* Lindl. and Hutt.

1877. Feistmantel, Pal. ind., Gondwána Flora, Vol. II, p. 91, Pl. III, 7-14; IV, 1-10.

Very numerous in the

Upper Gondwánas: Jabalpur group on the Sher river, Sátpura basin, Bansa and Chandia South Rewah basin.

Podozamites lanceolatus, var. *spathulatus*.†

1877. Feistmantel, *l. c.*, p. 92, Pl, IV, 11-12.

Upper Gondwánas: Jabalpur group, Chandia, South Rewah basin.

Podozamites hacketi,‡ Feistm.

1877. Feistmantel, ib. p. 92. Pl. VII, 4-5.

Upper Gondwánas: Jabalpur group, on the Sher river Sátpura basin.

Podozamites comp. *lanceolatus*, Lindl. and Hutt.

1879. Feistmantel, Pal. ind.; Gondwána Flora, Vol. I, p. 210, Pl. IX, figs. 9-10.

Upper Gondwánas: Sripermatur (Vemáveram) group, at Vemáveram, South Kistna district.

With *Podozamites* of the upper Gondwánas a cycadeaceous fossil of the Lower Gondwánas, where it is very numerous, is in close relation.

Genus *Nöggerathiopsis*,§ Feistm.

1879. Feistmantel, Gondwána Flora, Vol. III, p. 23.

1881. Suppl. ib. pp. 55-59.

I have established this genus upon certain leaves, which were at first classed with *Nöggerathia*; but they do not belong to that genus, being more closely related to another (*Rhiptozamites*, Schmalh.) from the Siberian (Altai) Jura. The same genus also occurs in Australia, both in the lower (carboniferous) and upper (permian?) coalmeasures; in India it

* Lanceolate.

† Spatulate.

‡ Proper name.

§ Nöggerathia, the name of a fossil, and *opsis* (GR.) = appearance = a fossil with the appearance of Nöggerathia.

has a distribution through the entire lower Gondwánas, and passes also into the upper Gondwánas.

I think they all belong to one species.

Nöggerathiopsis hislopi,* Feistm.

1879. Feistmantel, *l. c.*, p. 23, Pl. XIX, 1-6; XX, 1; p. 58, Pl. XXVIII, 1-7; XXIX, 1-4; XXX, 5-9.

Spatulate leaves, of varying size, with numerous, straight, slightly radiating and several times forked veins. They are apparently the pinnulae of a pinnate leaf.

Lower Gondwánas: a. Talchir shales in the Deoghur (Karaun) and Káranpúra coalfield.

b. Karharbári beds, in the Karharbári and Mohpáni coalfield.

c. Barákur group in the Ramkola coalfield, at Barkoi in the Umrét coalfield, C. Prov.

d. Raniganj (Kámthi) group in the Raniganj coalfield, South Rewah basin, and in the Nágpur area.

Upper Gondwánas: From Parsora near Beli, South Rewah basin, in red shales, which are placed by Mr. Hughes in the upper Gondwánas.

A variety with a more rhomboidal leaf was distinguished by me as *Nögg. hislopi* var. *rhomboidalis* (*l. c.*, p. 24) from the Karharbári beds of of the Karharbári coalfield.

Genus *Ptilophyllum*,† Morr.

1837. Morris, in Grant's, Geol. of Cutch; Transact. Geol. Soc. Lond. 2nd ser. Vol. V, Pl. XXI.

This is a very common cycadeaceous plant in the upper Gondwánas.

Ptilophyllum acutifolium,‡ Morr.

1837. Morris, *l. c.*, Pl XXI, figs. 1-3.
1862. Oldham and Morris, Rájmahál Flora, *l. c.*, p. 19, Pls. XX—XXI, 2.
1876-79. Feistmantel, Gondwána Flora, Vols. I—II.

The largest form of the genus.

Upper Gondwánas: a. Umia group in Kach., *b. Jabalpur group*, Sátpura and South Rewah basin *c. Sripermatur group*, South Godávari and South Kistna district, Sripermatur area and Trichinopoly district, (Utatúr plant beds) and near Chirakunt middle Godávari; *d. Rájmahál group* in the Rájmahál hills, and South Godávari.

* Proper name.
† Ptilon (gr.) = a feather; phyllum (gr.) = leaf.
‡ Acutus (lat.) = pointed, sharp; folium = leaf.

*Ptilophyllum cutchense,** Morr.

1837. Morris, ibid. *l. c.*, Pl. XXI, 4.
1862. Oldham and Morris, ib. *l. c.*, p. 30, Pl. XXI, 5-6, XXII.
1876. Feistmantel, Kach Flora, Gondwána Flora, Vol. II, Pl. IV, fig. 6, 7; V, 1, 2*a*, 3; VII, 3, and other papers.

Upper Gondwánas: a. Umia group in Kach; *b. Jabalpur group* Sátpura and South Rewah basin; *c. Sripermatur group* South Kistna district and Sripermatur area. *d. Rájmahál group* in the Rájmahál hills and South Godávari district.

Ptilophyllum cutchense var. *minimum*,† Feistm.

1876. Feistmantel, Kach Flora; Gondwána Flora, Vol. II, p. 44, Pl. VII, fig. 1.

Upper Gondwánas: Umia group in Kach (near Kukurbit).

Ptilophyllum brachyphyllum,‡ Feistm.

1867. Feistmantel, Kach Flora, *l. c.*, p. 45, Pl. VII, 3.

Upper Gondwánas: Umia group Kach.

Ptilophyllum tenerrimum,§ Feistm.

1877. Feistmantel, Rájmahál Flora, in Gondwána Flora, Vol. I, p. 118.

Upper Gondwánas: Rájmahál group near Onthea, in the Rájmahál hills.

Genus *Otozamites*,‖ F. Br.

Both basal angles of the leaflets are rounded. Numerous species are known from the Upper Gondwánas.

Otozamites acutifolius,¶ Feistm.

1879. Feistmantel, Pal. ind. Gondwána Flora, Vol. I, p. 212, Pl VIII, fig. 12.

Upper Gondwánas: Sripermatur group in the South Kistna district (Vemáveram).

Otozamites abbreviatus,** Feistm.

1862. *Palæozamia bengalensis*, Oldh. and Morr. *l. c.*, p. 27 Pl. XIX, 1, 2, 6.
1877. *Otozamites*, Feistmantel, Rájmahál Flora, *l. c.*, p. 68.

* Appertaining to Cutch (Kach).
† Very small.
‡ Short-leaved.
§ Very slender.
‖ The cared Zamites.
¶ Sharp-leaved.
** Shortened.

Upper Gondwánas: a. Rájmahál group, at Surujbera, Rájmahál hills; *b. Sripermatur* group in the South Godávari district (Ragavapuram), South Kistna country (Vemáveram) and Sripermatur area.

Otozamites angustatus,* Feistm.

1877. Feistmantel, Jabalpur Flora, Pal., ind. Gondwána Flora, Vol. II, p. 93, Pl. VI, fig. 8, VII, 1.

Upper Gondwánas: Jabalpur group, on the Sher river, Sátpura basin.

Otozamites bengalensis,† Schimp.

1862. *Palæozamia brevifolia*, Oldh. and Morris, Rájmahál Flora, *l. c.*, p. 31, Pl. IX, 4-5.

1869. Schimper, Trait. d. Pal. véget. II, p. 172.

Upper Gondwánas: Rájmahál group, at Bindrabun, Rájmahál hills.

Otozamites (Cyclozamites) bunburyanus,‡ Feistm.

1879. Feistmantel, Gondwána Flora, Vol. I, p. 211; Pl. VII, fig. 5-8; XVI, 2.

Upper Gondwánas: Sripermatur group, at Vemáveram, South Kistna district; and the Sripermatur area.

Otozamites contiguus,§ Feistm.

1876. Feistmantel, Kach Flora, Gondwána Flora, Vol. II, p. 48, Pl. VII, fig. 4.

Upper Gondwánas: Umia group, in Kach, near Kukurbit.

Reminds of *Otozam. abbreviatus* of the Rájmahál group.

Otozamites distans,‖ Feistm.

1877. Feistmantel, Jabalpur Flora, Gondwána Flora, Vol. II, p. 93, Pl. VII, fig. 3.

Upper Gondwánas: Jabalpur group, on the Sher river, Sátpura basin.

Otozamites comp. *goldiaei*,¶ Bgt.

1876. Feistmantel, Kach Flora, p. 49, Pl. XI. 3-4.

Upper Gondwánas: Umia group, Kukurbit in Kach.

Otozamites gracilis,** Schimp.

1877. Feistmantel, Jabalpur Flora, *l. c.*, p. 93, Pl VI, figs. 5-7; VII, 2.

Upper Gondwánas: Jabalpur group on the Sher river, Sátpura basin.

* Narrow.
† Appertaining to Bengal.
‡ Proper name.
§ Contiguus (lat.) = being in contact.
‖ Apart.
¶ Proper name.
** Pretty.

*Otozamites hislopi,** Oldh. (Mss.)

1877. Feistmantel, Jabalpur Flora, *l. c.*, p. 92, Pl. VI, figs. 3-4; XI, 1.

Upper Gondwánas: a. Jabalpur group on the Sher river, Sátpura basin, *b. Sripermatur* group at Vemáveram, South Kistna district.

Otozamites imbricatus,† Feistm.

1876. Feistmantel, Kach Flora, *l. c.*, p. 48, Pl. VIII, fig. 1.

Upper Gondwánas: Umia group near Loharia in Kach.

Otozamites oldhami,‡ Feistm.

1862 *Palæoz. bengalensis* var. *obtusa*, Oldham and Morr. *l. c.*, p. 28, Tab. XIX. figs. 3-5.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 68.

Upper Gondwánas: Rájmahál group at Surujbera, Rájmahál hills.

Otozamites parallelus,§ Feistm.

1879. Feistmantel, Gondwána Flora, Vol. I, p. 212, Pl. VIII, 5.

Upper Gondwánas: Sripermatur group at Vemáveram, South Kistna district.

Otozamites rarinervis,‖ Feistm.

1879. Feistmantel, Gondwána, Vol. I, p. 211, Pl. VIII, figs. 8-11; IX, 6.

A small form with very few (3-4) veins in the leaflets.

Upper Gondwánas: Sripermatur group at Vemáveram, South Kistna district; in the Sripermatur area.

Genus *Dictyozamites,¶* Oldh.

A genus hitherto confined to India. Leaf very much resembling that of *Otozamites*, but the venation is a nice net-venation radiating from the point of insertion at the base. Only one species.

*Dictyozamites indicus,*** Feistm.

1862. *Dictyopteris*, Morris in Oldham and Morris, Rájmahál Flora, *l. c.*, p. 38, Pl. XXIV, 1, 2.

1877. Feistmantel, ib., *l. c.*, p. 70.

1879. Feistmantel, Madras coast Flora, Gondwána Flora, Vol. I, p. 214, Pl. III—V.

* Proper name.
† Imbricate.
‡ Proper name.
§ Parallel.
‖ Rarus = rare, scarce.
¶ Dictyon (gr.) = a small net.
** Indian.

Upper Gondwánas: *a. Rájmahál group* at Amrapara and Murero, Rájmahál hills, and at Golapili South Godávari district; *b. Sripermatur* group at Vemáveram, Annavalawarpalem, Budávada, Deronaḍula, Godlur section, Idupulapadu, Panur and Razpudi, South Kistna country; Alicur hills, Chumbrumbaucum, Nagari river, Sripermatur, Todukadu, Vellakoti section in the Sripermatur area; Marawatúr Trichinopoli district.

Its distribution thus follows a line in a North-East to South-West direction, beginning in the North-East, and running along the South-eastern coast down to Trichinopoli in the South-West.

Order Cycadeæ.

Genus *Cycadites*, Bgt.

Cycadites confertus,* Oldh. and Morr.

1862. Oldham and Morris, *l. c.*, p. 25, Pl. VII, 4; VIII, 2, and *C. blanfordianus*, ib. p. 16, Pl. IX, 2.

1876. Feistmantel, Rájmahál Flora, *l. c.*, p. 127, Pl. XLVIII, 1.

Upper Gondwánas: *Rájmahál group*, at Bindrabun, Rájmahál hills.

Cycadites constrictus,† Feistm.

1879. Feistmantel, Madras coast Flora, Gondwána Flora, Vol. I, p. 215, Pl. VII, fig. 10.

Upper Gondwánas: *Sripermatur* group, shales at Vamáveram, South Kistna district.

Cycadites cutchensis, Feistm.

1876. Feistmantel, Kach Flora, Gondwána Flora, Vol. II, p. 50, Pl. XI, fig. 1.

Upper Gondwánas: *Umia group*, near Kukurbit in Kach.

Cycadites rajmahalensis, Oldh.

1862. Oldham and Morris, *l. c.*, p. 15, Pl. VII, 42, VIII, 1.

Upper Gondwánas: near Bindrabun, Rájmahál hills.

Genus *Williamsonia*, Carr.

1868. Williamson, Transact. Linn. Soc., Vol. XXVI, p. 663, ff. Pl. 52, 53.

1868. Carruthers, ibid., pp. 691, et. f. seq.

Fruits and stems of this plant occurred in the Indian Upper Gondwánas.

* Very close, referring to the leaflets.

† Constrictus (lat.).

Williamsonia gigas,* Carr.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 75, Pl. XLIV, 2-4.

1862. Oldham and Morris, ib. *l. c.*, Pl. XXXII, 12, XXXIV, (stems) figures only, without description.

Upper Gondwánas: a. Rájmahál group near Bindrabun and Amrapará, Rájmahál hills; near Golapili, South Godávari district; *b. Jabalpur group* in the Sátpura basin.

Williamsonia blanfordi,† Feistm.

1876. Feistmantel, Kach Flora, *l. c.*, Pl. XII, figs. 5-7.

Upper Gondwánas: Umia group, near Kukurbit in Kach.

Williamsonia microps,‡ Feistm.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. 129, Pl. XLI, fig. 4, 5.

Upper Gondwánas: Rájmahál group, near Buskoghát, Rájmahal hills.

Only for the sake of reference I may mention that quite recently Nathorst (in Ofvers. af Kongl. Vetenskaps-Akademiens forhandlingar 1880 No. 9), tried to assign to *Williamsonia* a somewhat different systematical position; but as his view is based mostly on the same specimens from which Phillips, Carruthers and Williamson treated it as cycadeaceous, doubts may be entertained whether we should disbelieve these three authors until many more typical specimens have been procured. In India those forms, which I referred to *Williamsonia* occurred solely in association with *Cycadeaceæ*.

Squamæ cycadearum, (? Gymnospermarum).

Both in the Upper and Lower Gondwánas there occur certain scale-like leaflets, which appear to belong to similar forms known from elsewhere, and attributed to cycadeaceous or gymnospermous plants, as scales. Some of those from the Upper Gondwánas could even be classed with a genus from Europe, introduced by Count Saporta, while those of the Lower Gondwánas must be left only with the above general denomination.

Upper Gondwánas: a. Umia group near Bhujuri in Kach; *b. Sripermatur* group at Vemáveram South Kistna district, and at Chirakunt, middle Godávari, (Maleri beds), *c. Lower Mahádevas*, north face of Latiahar hill, Aurunga coalfield.

Lower Gondwánas: a. Barákar group in the Raniganj coalfield. *b. Raniganj group* in the Rájmahál and Raniganj coalfields.

Semina.

In the Rájmahál group (Upper Gondwánas) there occur small oblong ovate, slightly compressed seeds, which agree in form and structure with

* Gigas = gigantic. † Proper name. ‡ Of small appearance.

similar ones, described as belonging to cycadeaceous plants, with which I have thus classed them (*Cycadinocarpus*).

Class CONIFERÆ.*

This large class of plants, so widely represented in present times, was also not uncommon amongst the Gondwána fossils, especially in the upper portion, and the *Gingko*-like forms are of special interest.

Order ABIETACEÆ.

Genus *Voltzia*,† Bgt.

Voltzia heterophylla,‡ Bgt.

1879. Feistmantel, Talchir-Karharbári Flora, Gondwána Flora, Vol. III, p. 25, Pl. XXII—XXIV, fig. 4; XXV.

Lower Gondwánas: *a. Karharbári beds*, Karharbári coalfield; *b. Raniganj group*, (?) South Rewah basin.

These are leaved and branched specimens.

But there is a scale-like impression, from the Raniganj group, of the Raniganj coalfield, which has great resemblance with similar scales, attributed to *Voltzia* as fruit scales.

Genus *Albertia*,§ Schimp.

Albertia sp. (comp speciosa, Schimp.)

1879. Feistmantel, ib., *l. c.*, p. 29, Pls. XXIV, 3; XXVI, 2 and ? XXIV, 1, 2.

Occurring together with *Voltzia* in Europe and India.

Lower Gondwánas: *Karharbári beds*, Karharbári coalfield.

Genus *Palissya*,‖ Endl.

Palissya conferta,¶ (Oldh. sp.) Feistm.

1862. *Cunninghamites*, Oldham in Rájmahál Flora, *l. c.*, (no description), Pl. XXXII, figs. 9-10.

1877. Rájmahál Flora, *l. c.*, p. 183, Pl. XLV, 4-9, XLVIII, fig. 4.

Upper Gondwánas: *a. Rájmahál group* near Bindraban, Murero and Onthea, Rájmahál hills; Golapili South Godávari district and Sironcha sandstones near Anáram on the Pranhita river C. Pr.; *b. Sripermatur* group (and Maleri beds) in the Sripermatur area; at Chirakunt and Jangaon, middle Godávari, basin.

* Conebearing plants.
† Proper name (Voltz.).
‡ With leaves of two kinds.
§ Proper name (Albert).
‖ Proper name (Palissy).
¶ Confertus = dense.

*Palissya indica,** Feistm. (Oldh. sp.).

1862. *Taxodites*, Oldham, *l. c.*, (no description), Pl. XXXIII, fig. 6.
1877. Feistmantel, *l. c.*, p. 84; XLV, 9.
1877. Jabalpur Flora, Gondwána Flora, Vol. II, p. 95, Pl. VIII, 1, 2, 4.

Resembling much *Palissya brauni*, Endl.

Upper Gondwánas: Was hitherto found in all the groups of the Upper Gondwánas, in Kach, in the Sátpura basin, South Kistna district, middle Godávari, Rájmahál hills, Athgarh sandstones near Cuttack and on the South Godávari.

Palissya indica, var. *laxa.*

1876. Feistmantel, Kach Flora, *l. c.*, p. 57, Pl. XII, fig. 8, 9.

Upper Gondwánas: Umia group, near Kukurbit in Kach.

Palissya jabalpurensis,† Feistm.

1877. Feistmantel, Jabalpur Flora, Gondwána Flora, Vol. II, p. 16, Pl. IX, fig. 1.

Upper Gondwánas: a. Umia group near Thann, North Kathiawár; *b. Jabalpur group*, Sátpura basin; *c. Sripermatur* group near Vamávaram South Kistna district, and at Naogaon, middle Godávari.

Genus *Cheirolepis,*‡ Schimp.

Cheirolepis comp. *münsteri,*§ Schimp.

1877. Feistmantel, Golapili Flora, Gondwána Flora, Vol. I, p. 185, Pl. VIII, fig. 8.

Upper Gondwánas: Rájmahál group, at Golapili, South Godávari district.

Genus *Araucarites*, Stbg.

Araucarites cutchensis,‖ Feistm.

1876. Feistmantel, Kach Flora, Gondwána Flora, Vol. II, p. 62, Pl. VII, 7, VIII, figs. 2-6, IX, 1-3; XII, 10.

1877. Jabalpur Flora, ib., p. 16, Pl. XIV.

Upper Gondwánas: a. Umia group in Kach and Kathiawár; *b. Jabalpur group* in the Sátpura and South Rewah basin; *c. Sripermatur* (Maleri) group middle Godávari (Naogaon), South Kistna district, Sripermatur area and Trichinopoli district.

Resembles very much *Arauc. brodiei* from the English Oolite.

* Indian.
† Jabalpur.
‡ Cheir (gr.) = hand; lepis (gr.) = scale, referring to the shape of the fruit scales.
§ Proper name.
‖ The Kach fossil Araucaria.

Araucarites macropterus,* Feistm.

1877. Feistmantel, Golapili Flora, *l. c.*, p. 186, Pl. VIII, figs. 9-11.

Upper Gondwánas: a. Rájmahál group at Golapili, South Godávari; *b. Sripermatur* group in the Sripermatur area.

Genus *Pachyphyllum*,† Sap. in Schimp.

Pachyphyllum (?) *divaricatum*,‡ Bunb. sp.

1876. Feistmantel, Kach Flora, *l. c.*, p. 59, Pl. X, fig. 1, 1a.

Upper Gondwánas: Umia group, Kukurbit in Kach.

Pachyphyllum heterophyllum,§ Feistm.

1879. Feistmantel, Madras-coast Flora, (Pal. ind.), Gondwána Flora, Vol. I, p. 219, Pl. XI, fig. 4, XVI, 16.

Upper Gondwánas: Sripermatur group, at Vemáveram, South Kistna country.

Pachyphyllum peregrinum,‖ Schimp.

1879. Feistmantel, Madras-coast Flora, *l. c.*, p. 218, Pl. XI, fig. 5; XII, 3, 9.

Upper Gondwánas: Sripermatur group, in the South Kistna district and Sripermatur area.

Order Taxodiaceæ.

Genus *Echinostrobus*,¶ Schimp.

Echinostrobus expansus,** Schimp sp.

1876. Feistmantel, Kach Flora, *l. c.*, Pl. IX, 6-9; X, fig. 3, 4.

1877. Jabalpur Flora, *l. c.*, p. 97, Pl. XIX, 4-5.

Upper Gondwánas: a. Sripermatur group, South Kistna district (Vemáveram); *b. Jabalpur group*, Sátpura and South Rewah basin; *c. Umia group*, Kach.

Echinostrobus rajmahalensis,†† Feistm.

1877. Feistmantel, Rájmahál Flora, *l. c.*, p. (90) 142, Pl. XLV, fig. 3.

Upper Gondwánas: a. Rájmahál group, Rájmahál hills, *b. Sripermatur* group, Sripermatur area.

* Makros (gr.) = large; pteron (gr.) = the wing.
† Pachys (gr.) = thick; phyllum (gr.) = the leaf.
‡ Divaricatus (lat.) = spread.
§ With two kinds of leaves.
‖ Peregrinus (lat.) = strange, foreign.
¶ Echinus (lat.) = urchin, strobus (lat.) = the cone.
** Expanded, spread out.
†† Appertaining to the Rájmahál hills.

*Echinostrobus rhombicus,** Feistm.

1877. Feistmantel, Jabalpur Flora, *l. c.*, p. 98, Pl. XI, figs. 6-11.
1879. Madras coast Flora, *l. c.*, p. 220, Pl. XII, fig. 10.

Upper Gondwánas: a. Sripermatur group in the Sripermatur area; *b. Jabalpur group* South Rewah basin.

Genus *Brachyphyllum*,† Bgt.

Brachyphyllum mammillare,‡ Lindl. and Hutt.

1877. Jabalpur Flora, *l. c.*, p. 96, Pl. X, fig. 12, XI, 2-3; XII; XIII.

Upper Gondwánas: Jabalpur group, Sátpura and South Rewah basin.

Order TAXACEAE.

Genus *Taxites*, Bgt.

Taxites planus,§ Feistm.

1879. Feistmantel, Madras coast Flora, *l. c.*, p. 221, Pl. XIII, 1, 2-8; XIV, 1, 2, 4, 5; XV, 2.

Upper Gondwánas: a. Sripermatur group, South Godávari district, South Kistna country and Sripermatur area; *b. Jabalpur group* near Bansa in South Rewah.

Taxites tenerrimus,‖ Feistm.

1877. Feistmantel, Jabalpur Flora, *l. c.*, p. 98, Pl. VIII, 6-8; X, 5, 6-11.

Upper Gondwánas: a. Sripermatur group at Vamáveram, South Kistna district; *b. Jabalpur group*, Sátpura and South Rewah basin; *c. Umia group*, Than in North Kathiawár.

Family *Salisburieae.*

Genus *Gingko*, Thunb.

The discovery of this interesting genus in the Jurassic beds of India, adds greatly to its geographical distribution. We know two fossil species from India.

Gingko crassipes,¶ Feistm.

1877. Feistmantel, Rec. Geol. Survey of India, Vol. X, Pt. 4, p. 197, fig. 6, 7.
1879. Madras coast Flora, *l. c.*, p. 221, Pl. XV, figs. 6-9, XVI, 13.

Upper Gondwánas: Sripermatur group, South Godávari district and Sripermatur area.

* Rhombic.
† Brachys (gr.) = short, phyllum (gr.) = leaf.
‡ Mammillaris (lat.) = elevated.
§ Planus (lat.) = flat.
‖ Very tender.
¶ With a thick stalk.

Gingko lobata,* Feistm.

1877. Feistmantel, Record etc, *l. c.*, p. 187, fig. 4, 5.
1877. Jabalpur Flora, *l. c.*, p. 98, Pl. I, fig. 1.

Upper Gondwánas: Jabalpur group, Sher river, Sátpura basin, together with *Glossopteris*.

Genus *Euryphyllum*,† Feistm.

Euryphyllum whittianum,‡ Feistm.

1879. Feistmantel, Talchir Karharbári Flora, Gondwána Flora, Vol. III, p. 26, Pl. XXI, fig. 1.

Lower Gondwánas: Karharbári beds, Karharbári coalfield.

Genus *Rhipidopsis*,§ Schmalh.

Rhipidopsis densinervis,‖ Feistm.

1880. Feistmantel, Damuda, Panchet Flora, Gondwána Flora, Vol. III, p. 55.

Lower Gondwánas: Kámthi (Raniganj) group South Godávari district.

There is another species, from the Barákar group in the Aurunga coalfield, which closely resembles *Rhipidopsis gingkoides*, Schmalh., from the Petschora country, North Eastern Russia.

INCERTÆ SEDIS.

There are several other fossils, which apparently belong to the *Coniferae*, but the position of which is not quite certain.

Phœnicopsis,¶ Heer sp.

1877. Feistmantel, Jabalpur Flora, *l. c.*, p. 99.

Upper Gondwánas: Jabalpur group, Sher river, Sátpura basin.

Czekanowskia,** Heer sp.

1877. Feistmantel, *l. c.*, p. 99.

Upper Gondwánas: Jabalpur group near Jabalpur, Sátpura basin.

SEEDS AND STEMS.

In the lower Gondwánas there occur certain seeds, most of them being winged, which from their analogy with similar seeds described from else-

* Lobed.
† Eurys (gr.) = broad.
‡ Proper name.
§ Rhipis (gr.) = a fan; opsis (gr.) = appearance.
‖ Densus (latin) close; nervus (lat.) = vein.
¶ Phönix = a palm, opsis appearance.
** Proper name.

where have to be classed as coniferous seeds; they remind mostly of *Samaropsis*, specimens of which were figured by Heer from the Jura of E. Siberia and the Amur countries and by Prof. Schmalhausen from the Altai, Tunguska river, and the Petschora country.

From the shales at Mángli (C. Prov.) and from the iron shales of the Raniganj coalfield, there are known fragments of stems, which appear to be also of coniferous plants, but they are at present of very little importance, being very fragmentary.

I have thought it more practical and more true to nature to treat of the plant remains in a systematical (biological) order from the whole Gondwána system together, not grouping them according to the divisions of "Lower" and "Upper Gondwánas," as it is now known that this system also geologically forms a continuous series, and from this point of view it is then also easier to form an adequate idea, as to the *Homotaxis* of the system, especially if we consider that most of the plants formerly considered characteristic of the lower Gondwánas freely pass into the "upper portion," as can be gathered from the foregoing pages.

ANIMALIA.

Animal remains as a rule are not very numerous in the groups of the Gondwána system, only in those groups where marine animals occur together with the plants or are contained in beds intercalated with the plant bed, the animal remains are more numerous.

I shall proceed in a biological order.

ANNULOIDA.

ECHINODERMATA.*

Very rare.

Ophiura,† sp.

1879. Madras coast Flora, *l. c.*, p. 224.

Upper Gondwánas: Sripermatur group, South Kistna district.

ANNULOSA.

CRUSTACEA.

Candona‡ *kotaensis*,§ Jones.

1862. Monograph of fossil *Estheriæ*, Palæontographical Soc., p. 127.

Upper Gondwánas: Kota beds, near Sironcha, middle Godávari.

Estheria‖ *kotaensis*, Jones.

1862. Ib., *l. c.*, p. 81.

Upper Gondwánas: group and locality the same.

* Echinos (gr.) = a spine; derma (gr.) = skin.

† Ophis (gr.) = snake; ura (gr.) = tail, referring to the thinness of the arms.

‡ Proper name. § Locality Kota. ‖ Proper name.

Estheria mangaliensis,* Jones.

1862. Palæontogr. Society, Monogr. fossil *Estheriæ*, p. 76, Pl. II, 16-23.

Lower Gondwánas: (?) Kámthi group at Mángli, South of Nágpur.

This species was also identified by Prof. Geinitz from rhätic beds of the Argentine Republic.

Besides this larger form, there also occurs another smaller kind, which appears to be identical with a similar form in the Panchet rocks of the Raniganj coalfield, near Assensole.

Eryon† comp. *barrowensis*,‡ McCoy.

1877. Feistmantel, Rec. Geol. Survey of India, Vol. X, p. 193, et fig. 8.

Upper Gondwánas: Sripermatur group at Vemáveram, South Kistna district.

Class MOLLUSCA.§

Representatives of this class have hitherto been found in the upper Gondwánas only.

Order Brachiopoda.‖

Many *Brachiopoda* occur in the Umia group in Kach, in beds intercalated with the plant beds, while there is a form of a *Rhynchonella* in the *Sripermatur* group in the same beds with the plants.

Order Lamellibranchiata.¶

These occur in the *Sripermatur* group at Ragavapuram (South Godávari district), Vemáveram (South Kistna district) and of the Sripermatur area; most of them are of the same genera (and apparently also of the same species) by which and especially by the common occurrence of the same *Ammonites* the groups of these three districts may safely be correlated, even without reference to the fact that the Floras also are of the same character.

In the Umia group of Kach there are many *Lamellibranchiata* (bivalves) of which I shall mention especially two, as they also occur in the Tripetty sandstones on the S. E. Coast (South Godávari), which represent the Umia group.

* Locality Mángli.
† Mytholog. name.
‡ Locality Barrow.
§ Mollis (lat.) = soft, tender.
‖ Brachion (gr.) = an arm; pus (gr.) = a foot.
¶ Lamella (lat.) branchia (gr.) = gill (having lamellar gills).

Trigonia Smeei,†* Sow.

1841. Trans. Geol. Soc. Lond., Vol. V, pp. 715, 716, Pl. LXI, fig. 5.

Upper Gondwánas : Umia group at Bururia and other places in Kach ; and at Innaparazpolliam, about 30 miles North West of Coconada.

Trigonia ventricosa,‡ Kraus.

1850. Kraus N. Act. Acad. Leop. Car., Vol. XXII, Pt. 2, pp. 456-458, Pl. 49, fig. 2.

1879. Manual Geology of India, p. 261, fig.

Upper Gondwánas : Umia group same localities.

There are other bivalves figured and described by Sowerby (*l. c.*), from Kach, but it is not necessary to enumerate them here, as all the bivalves as well as the *Gasteropda* (of which there are however not many) have still to be properly worked out and described.

Cephalopoda.§

The *Cephalopoda* of the Jurassic rocks of Kach have already been figured and described in Ser. IX of the Palæontologia indica, and I shall therefore not quote them here.

I mention this order only on account of one form of *Ammonites*, which is common to the shales at Raguvapuram (South Godávri district) the shales at Vemáveram and other places (South Kistna district) and the Sripermatur area, and helps to correlate the beds of these three areas.

VERTEBRATA.‖

Pisces.

Remains of fishes are not uncommon in the upper Gondwánas, while in the lower Gondwánas they are extremely rare.

Ganoid fishes.

The only remains of fishes in the lower Gondwánas are scales of ganoid fishes. They were first mentioned by the late Rev. Mr. Hislop.¶ One or two specimens are amongst the collections of the Geological Survey of India.

In the upper Gondwánas fishes are more numerous ; they were partly described in the Quart. Journ. Geol. Soc. London, and partly only recently in the Palæontologia Indica.

* Treis (gr.) = three ; gonia (gr.) = angle = the triangled shell.
† Proper name.
‡ Ventricosus (lat.) = blown up.
§ Kephale (gr.) = the head ; pous (gr.) = the foot.
‖ Vertebra = a backbone.
¶ Quar. Jour. Geolog. Soc. Lond., Vol. XVII, p. 347.

They are all from the limestones at Kota, near Sironcha, Central Provinces (Kota Maléri beds). The following have hitherto been described.

Dapedius egertoni,†* Sykes.

Quart. Journ. Geol. Soc. Lond., Vol. IX, p. 352.
Aechmodus ... Egerton, ib., Vol. X, p. 367.
Egerton, Pal. ind. Ser., IV, 2, pp. 6-8, Pl. II, 3-5.

Lepidotus‡ breviceps,§ Egert.

Quart. Journ. Geol. Soc., Vol. X, p. 371, Pl. XII.

L. calcaratus,‖ Egert.

Pal. ind., *l. c.*, p. 3, Pl. III, 2-3.

L. deccanensis,¶ Egert.

Quart. Journ. Geol. Soc., Vol. VII, p. 272, Pl. XV.

*L. longiceps,*** Egert.

Ibid., Vol. X, p. 371, Pl. XII.

L. pachylepis,†† Egert.

Pal. ind., *l. c.*, p. 2, Pl. I.

Tetragonolepis‡‡ analis,§§ Egert.

Ibid., p. 5, Pl. II, fig. 1.

T. oldhami, Egert.

Ibid., p. 3, Pl. II, fig. 1.

T. rugosus,‖‖ Egert.

Ibid., p. 6, Pl. II, fig. 2.

* Dapedon (gr.) = a pavement.
† Proper name.
‡ Lepidotos (gr.) = scaly.
§ Shortheaded.
‖ Calcar (lat.) = a spur.
¶ Deccan.
** Longheaded.
†† With thick scales.
‡‡ With four-angled scales.
§§ Anal.
‖‖ Rugged.

*Dipnoi.**

This order includes the interesting genus *Ceratodus*,† which is not uncommon in the red clays of the (Kota) Maléri group at Maléri, in the middle Godávari basin, South of Chanda.

They were originally described and figured by the late Dr. Oldham in the Memoirs of the Geological Survey of India, Vol. I, pp. 300-307. Four species were then distinguished, *viz.*, *Cerat. hislopianus*, *Cerat. hunterianus*, *Cerat. oblongus* and *Cerat. virapa*. These Ceratodus-teeth were recently re-examined by Prof. Miall and discussed and figured in the Palæontologia Indica, Ser. IV, Pt. 2, pp. 9-17, Pl. IV. He however adopts three species only, classing *C. oblongus* as a synonym of *C. virapa*.

AMPHIBIA.‡

Labyrinthodontia.§

Brachyops‖ *laticeps*,¶ Ow.

1835. Owen, Quart. Journ. Geol. Soc. Lond., Vol. IX, p. 37, Pl. II.
1879. Manual, Geol. India, Vol. I, p. 10, figure.

Lower Gondwánas: Shales at Máugli.

*Gonioglyptus*** *longirostris*,†† Huxley.

1865. Huxley, Pal. ind. Ser. IV, I, pp. 3-6, Pl. VI.
1879. Lydekker, ib. Ser., IV, 3, p. 17, Pl. III, pp. 14-15.

Lower Gondwánas: *Panchet group*, near Deoli South West of Assensole, on the Damuda river, Raniganj coalfield.

Pachygonia‡‡ *incurvata*,§§ Huxl.

1865. Huxley, *l. c*, pp. 6-7, figs. 1-2.
1879. Lydekker, *l. c.*, pp. 18-19, Pl. III, figs. 12-13.

Lower Gondwánas: Locality same as above.

Archegosaurus,‖‖ (?) sp. ?

1864. Journ. As. Soc. Beng., Vol. XXXIII, pp. 336, 442.
1872. Dr. Oldham Rec. Geol. Surv. India, Vol. IV, p. 70.

* Dis (gr.) twice; pnoe (gr.) = breadth.
† Keras (gr.) horn; odous (gr.) = tooth.
‡ Amphi (gr.) = both; bios (gr.) = life.
§ Labyrinthos (gr.) = a labyrinth; odous (gr.) = tooth, referring to the structure of the teeth.
‖ Short-faced.
¶ Broadheaded.
** Gonia (gr.) = angle (of the mandible); glyptos (gr.) = sculpture.
†† With a long snout.
‡‡ Pachys (gr.) = thick; gonia (gr.) = an angle.
§§ Incurved.
‖‖ The ancient Saurian.

1873. H. B. Medlicott, Mem. G. S. Ind., Vol. X, p. 159.
1875. H. F. Blanford, Qu. J. G. Soc. London, Vol. XXXI, p. 522.
1879. Feistmantel, Rec. G. S. India, Vol. XII, pp. 76, 78.
1880. Lydekker, J. A. S. Bengal, Vol. XLIX, p. 12.

A skull of a Labyrinthodont animal is referred to this genus, although it appears that it was never thoroughly examined or figured.

Lower Gondwánas: Bijori horizon (= Raniganj group) of the Sátpura basin, near Bijori in the upper Denwa valley; the name of the horizon is taken from this locality.

Reptilia.*

These are more numerously represented.

Lacertilia.

Hyperodapedon,† sp. Huxley.

1868. Huxley, Qu. J. Geol. Soc. Lond., Vol. XXV, figure, pp. 138-151.
1879. Manual, Geology, India, p. 153, and figure.
1880. Lydekker, J. A. S. B., p. 14.
1880. Feistmantel, Rec. Geol. Soc. India, Vol. XII, Pt. 3, p. 189.

Upper Gondwánas: (Kota) Maléri beds, at Maléri, Middle Godávari basin, C. Prov.; at Tiki in the South Rewah basin.

Crocodilia.‡

Parasuchus,§ (*hislopi* MSS. Huxley).

1870 and 1875. Huxley, Qu. J. G. Soc. London, Vols. XXVI, p. 49, XXXI, p. 423.
1870. Lydekker, Pal. ind. Ser. IV, 3, p. 35
1880. Feistmantel, R. G. S. India, Vol. XIII, p. 189.

Upper Gondwánas: Same as preceding.

Parasuchian crocodile; Scute.

1879. Lydekker, Pal. ind. Ser. IV, 3, p. 30, Pl VI, fig. 8.

Upper Gondwánas: Denwa group, Denwa river near Jhirpa, N. E. of Pachmari.

Parasuchian crocodile, Vertebra.

1877. Lydekker, R. G. S. I., Vol. X, p. 34.
1870. Lydekker, Pal. ind. Ser. IV, 3, p. 31.

Upper Gondwánas: Chari group, near Chari in Kach.

* Repto (lat.) = to crawl.

† Hyperos (gr.) = a pestle, club; dapedon (gr.) = a pavement, referring to the arrangement of the teeth.

‡ Crocodiles.

§ Para (gr.) = prefix, expressing a comparison; suchos = a local name of the crocodile in Egypt.

Sauropterygia.

*Plesiosaurus** *indicus*, †Lyd.

1879. Wynne, Geology of Kach; Mem. Geol. Survey of India, Vol. IX, p. 129, (mentions the jaw.)

1879. Lydekker, Pal. ind. Ser., IV, 3, p. 28. Pl. VI, fig. 1.

Upper Gondwánas: Umia group, near Bururia, Kach.

Anomodontia.

Dicynodon‡ *orientalis*,§ Huxley.

1865. Huxley, Pal. ind. Ser., IV, 1, pp. 8-11, Pls. I—V.

1879. Lydekker, ib. Ser. IV, 3, pp. 1-17, Pl. I, II, III, 1-11.

Lower Gondwánas: Panchet group, near Deoli, Damuda river, S. W. Assensole, Raniganj coalfield.

Deinosauria.

Ankistrodon‖ *indicus*, Huxley.

1865. Huxley, *l. c.*, pp. 11-12, figure on p. 12.

1879. Lydekker, *l. c.*, p. 17.

Lower Gondwánas: Same as preceding.

Concluding remarks.

This sketch being merely written to convey an idea as to the amount and character of the fossils hitherto known from the interesting Gondwána system in India, without the intention of any extensive discussion of its age, the correlation of the groups, or of all the views hitherto proposed and disputed, I shall conclude with a few remarks regarding the chief peculiarities of the fossils of the system.

1. Four of the genera of plants in the lower Gondwánas are also met with in the lower coalmeasures of Australia (*viz.* New South Wales), these are:—*Phyllotheca*, *Vertebraria*, *Glossopteris* and *Nöggerathiopsis*, they are, however, more developed in the upper coalmeasures (New Castle-beds), at the top of the palæozoic epoch, where we also find the first appearance of *Gangamopteris*. By means of these four genera our Damuda Series were formerly correlated with the Australian beds. But while entirely admitting the fact of this common occurrence, we can now state, that *Phyllotheca* on the other hand is very abundant in the Jurassic beds of

* Plesios (gr.) = near; Sauros; (gr.) = a lizard.

† Indian.

‡ Dis (gr.) = twice; Kyon (gr.) = dog; odus (gr.) = a tooth.

§ Oriental.

‖ Ankistron (gr.) = a hook; odus (gr.) = a tooth.

Siberia, the Amur countries and Italy; *Vertebraria*, *Glossopteris* and *Nöggerathiopsis* pass into the upper Gondwánas in India; and *Nöggerathiopsis* has a very close relation in the Jura of the Altai, the Tunguska river and the Petschora country and *Gangamopteris* is in Australia chiefly developed in the Bacchus-marsh beds which are considered to be mesozoic.

2. On the other hand in the Gondwána system, both in the lower and upper portions, there are many forms, which have no representatives in the Australian coalmeasures, though related forms occur in the higher (meszoic) beds elsewhere.

Thus we have very abundantly in the Talchirs the genus *Gangamopteris*, which under similar circumstances occurs in the Bacchus-marsh beds (mesozoic) in Victoria.

In the Karharbári beds there is again abundantly represented *Gangamopteris;* and besides it *Neuropteridium* (single pinnate *Neuropteris* of the Trias) and *Voltzia* (permian, but especially Triassic).

In the Damuda Series there is *Schizoneura* (Trias-Rhätic) a *Cyathea* (jurassic) a *Dicksonia* (related to some jurassic forms) *Asplenium whitbyense* (jurassic) and another form, belonging with a species from the upper beds in Australia probably also to this type; there is a *Merianopteris* (Trias in Europe); there are forms of *Macrotæniopteris* (related with mesozoic forms, one is in the Wianamatta beds in Australia) and there are other *tæniopteroid* plants with mesozoic affinities;

Of *Cycadeaceæ* we have *Pterophyllum*, *Anomozamites* and *Glossozamites* which are predominantly (for the first named) or exclusively (for the two last named) mesozoic.

Of coniferous plants there is *Rhipidopsis* (of the Jura in the Petschora country N. Russia) one of the *Salisbureæ*, and *Cyclopitys*, of the Jura in Siberia, and *Voltzia* (predominantly Triassic).

There are also some seeds with mesozoic affinities.

In the Panchet division there is *Schizoneura*, *Pecopt. concinna* and *Cyclopt. pachyrhachis* which are Triassic and Rhätic.

3. The Upper Gondwána plants do not require any further explanation.

4. But there is, in Kach, the interesting case, that a Flora of middle jurassic type is intercalated with and overlaid by animals of uppermost jurassic age.

5. The animal remains of any importance from the lower Gondwánas, hitherto known, are fresh-water and land vertebrates (*Pisces*, *Batrachia* and *Reptilia*) the relations of which were discussed by Mr. Lydekker, in his above-mentioned paper in this Journal.

The animals of the Upper Gondwánas are somewhat more varied consisting both of land and fresh water animals and of marine animals.

The former are represented by interesting *fishes* and *Reptilia* which show various ranges, when compared with European relations.

The marine animals are on the whole jurassic, representing various groups, up to uppermost Jurassic.

With these few remarks I conclude my sketch of the Gondwána fossils; my object will have been gained if I succeed in drawing general attention to these interesting remains but more especially that of those who are in charge of collieries or quarries and so induce them to be careful in looking out for specimens. I also desire to show to the scientific world, particularly of Europe, how much has already been accomplished, by the small body of officers employed in these areas, who have many a time to carry on their work under most unfavourable circumstances.

XIII.—*Additional note on the identification of the ancient diamond mines visited by Tavernier.*—*By* V. Ball, M. A., F. G. S.

[Received July 2nd; Read July 6th, 1881.]

I return to this subject as since my last paper was published I have obtained some additional information on the subject, part of which is the direct result of the publication of that paper, and the remainder is in further illustration of the views put forward in it.

Raolconda.—By applying what seemed to be a legitimate arithmetical test to the figures given by Tavernier as indices of the position of this place, the conclusion was arrived at that it was to be identified with Rawduconda on the Tungabhadra river. The chief objection to this view was that we had no independent knowledge whatever of there ever having been diamond mines there, but since, as a matter of fact, nothing was known of the Geology, it seemed possible that diamond bearing rocks might occur there. As an alternative the only other place I could suggest was Ramulkota, to which indeed some of Tavernier's stages pointed, but, on the system of calculation adopted, this locality did not seem to fit so well. I did not venture to write on this subject without doing my best to obtain local information, but as it did not come, or rather as that which was received was more of the nature of speculation than actual fact, my paper was printed, and it has had the advantage of leading to the final settlement of the one doubtful point, namely, the position of Raolconda. As will presently be shown by a quotation from Rennell, which was not included in my last paper, this question was discussed and, as we now know, wrongly decided about 100 years ago.

I must here first record my thanks to Mr. Maurice, H. Wilkinson, Secretary to the Nizam in the Public Works Department, for having done

all he could to obtain local information for me in Hyderabad. Mr. King on reading my paper has seen his way to identifying the stages between Golconda and Raolconda, some of which, as being common to the routes to either Rawdaconda or Ramulkota I have already noted. Mr. King's local knowledge is of course invaluable in an enquiry of this kind, and I may say that I agree with his conclusion and adopt the necessary consequence from it that the league of Tavernier was not the equivalent of the modern French league, as it was taken to be in my calculation, but was only about two miles, and therefore the Gos which contained 4 leagues was equal to 8 miles and was of the same value as the *Gow* of Heyne.*

The stages on Tavernier's route and Mr. King's identification of them are as follow:

Golconda = Golconda.
to Canapour = Ghunpoora Lat. 16°·34′ N. Long. 78°·6′·30″.
to Parquel = Boorgul, Lat. 16°·59′ N. Long. 78°·17′·30″ E.
to Cakenol = Kakanoor, Lat. 16° 55′ N. Long. 78°·23′ E.
to Canal-Candanor = Kundanool, Lat. 16° 29′ N. Long. 78° 22′·30″ E.
to Setapour = Satapoor, Lat. 16°·14′·15″ N. Long. 78°·24′30″ E.
to The river = Kistna.
to Alpour = Alumpoor, Lat. 15°·53′ N. Long. 78° 11′·30″ E.
to Canol = Karnul.
to Raolconda = Ramulkota, Lat. 15° 34′ Long. 78° 3′·15″.

The total distance is given by Tavernier as 17 goss which, if the gos equalled 11·12 miles would be 189 miles, but by taking the gos at 8 miles, would be only 136 miles and as Mr. King shows that Tavernier's route was not absolutely direct, the 16 miles, *i. e.*, the excess over the direct distance between Golconda and Ramulkota, namely 120 miles, is at once accounted for. Tavernier gives the distance from his Canol to Raolconda as being 2½ gos this at eight miles to the gos = 20 miles or about the distance from Karnul to Ramulkota. There are the remains of extensive mines at Ramulkota and there is now no room for doubt that it was at this spot that Tavernier saw the diamond bearing stratum, which was very thin, being hooked out by means of iron rods.

Col. Rennells'† remarks on the subject above alluded to were as follow: "Raolconda, a famous diamond mine, is placed in Mr. Montresor's map, about 15 G. miles to the west of Ralicotte, and 12 from the north bank of the Kistnah; but I know not on what authority. Tavernier, who visited Raolconda, gives its distance from Golconda at 17

* It has been already stated in the previous paper, p. 32, that Heyne spoke of a unit of measure called the *Gow* as being equal to 8 miles.

† Memoir on a Map of Hindustan, p. 353.

gos, of four French leagues each. He crossed a river, that formed the common boundary of Golconda and Visiapour, about 4 gos, or more, before he came to Raolconda: and this river can be no other than the Beemah; which, to this day, forms the eastern boundary of Visiapour; and passes 80 or 82 G. miles to the west of Golconda, crossing the road from it to Ralicotte. If we reckon the 82 miles, 13 gos: that is, forming a scale from the distance between Golconda and the river Beemah, each gos will be 6·3 G. miles in horizontal distance (or nearer three than four French leagues); and Raolconda will be placed about 25 G. miles on the west of the Beemah; or 11, east of Ralicotte*.

"If we take the gos at four French leagues, without regarding the proportion arising from the above calculation, it will bring Raolconda very near the situation assigned it by Montresor. But I have nevertheless adopted the former, thinking it, on the whole, the most consistent. Cæsar Frederick says, that the mines (Raolconda) are six days' journey from Bisnagur: but this will apply equally to either of the above positions."

To which may be added that it will also suit the position of Ramulkota which is under 110 miles, but in a different direction altogether, namely, slightly north of east instead of nearly due north. Cæsar Frederick's original statement as translated by Thomas Hickocke† is as follows: "Five days' journey (not six) from Bezeneger (*i. e.* Bijayanagar) is the place where they get diamants. I was not there but it was told me that it was a great place, compassed with a wall, and that they sell the earth within the wall for so much a squadron, and the limits are set how deepe or how low they shall digge. Those diamants that are of a certain size and bigger than that size are all for the king, it is many years agone since they got any there."

Elsewhere he says that the diamonds from this region were called *chiappe* to distinguish them from those from Delly and Iaua (= Java?).

Gani Coulour of Tavernier. With reference to this mine, which is famous for having produced the great Mogul Diamond, Mr. King thinks that I have fully established its identity with the modern Kollur on the Kistna. Indeed had a doubt remained it would have been fully dispelled by a further route to Masulipatam from Golconda given separately by Tavernier, and which passes through Kollur or the so-called Gani.

So far as he has been able, Mr. King has offered the following identifications of the localities mentioned in Tavernier's previously quoted itinerary.

Montecour = ? Moonoogodoo, Lat. 17° 6′ N. Long. 79° 7′ 25″.

Nagelpar = Nagoolpad, Lat. 17° N. Long. 79° 42′.

Savaron = Surrawaram, Lat. 16° 52′ 30″ Long. 79°·51′ 30″.

Mellasercu = Mailacheroo.

* ? = Telicotte in the Kaladgi district.

† Hakluyt's Voyages, p. 221.

I would direct the attention of any one knowing the neighbourhood to the identification of Almaspinde, Kaper and Eligada though indeed it is now of no very great importance to fix them.

Tavernier's route to Masulipatam above alluded to is as follows,* the distances in this case being given in *costes* not in *gos*.

Golconda to Tenara,	4	Costes	
Tenara to Jatenagar,	12	„	
Jatenagar to Patengi,	12	„	
Patengi to Penguel,	14	„	
Penguel to Nagelpar (Nagoolpad),	12	„	17 miles.
Nagelpar, to Lakabaron (Lukkarum),	11	„	15 „
Lakabaron to Coulour (Kollur),	11	„	15½ „
There runs a great river by the town of Coulour, which falls into the gulf of Bengala near Masulipatam.			
Coulour to Kah Kaly,	12		
Kah Kaly to Beyouar (Bezwada),	6		
Near Beyouar you must repass the river of Coulour (*i. e.*, Kistna) Beyouar to Vouchir,	4	„	
Vouchir to Nilimor,	4	„	
Half way between Vouchir and Nilimor you cross a great river on a timber floating bridge.			
Nilimor to Milmol,	6	„	
Milmol to Masulipatam,	4	„	

It would be useless to attempt to fit Tavernier's distances too closely with modern measurements, but it would seem from the equivalent measurements in miles, taken from the map, that the *coste* here was under 1½ miles. Tavernier speaks of the badness of the roads which no doubt necessitated many turnings. He praises the palkis, wherein "you are carried with more speed than in any part of India."

The value of the *rati* in Tavernier's time is a sore puzzle. He gives it as equal to 3½ grains; these in my calculation of the weight of the great Mogul diamond, as it was when he saw it, I treated of as French grains the equivalent of which would be 2·7 English grains, and I stated that instead of this we could put into the equation 1·84 or more properly 1·848 we should get out the exact weight of the Koh-i-Nur. Now according to Mr. E. Thomas, F. R. S.† the old *rati* in the normal Hindu system

* Travels, Part II, Book I. Chapter XI, p. 69.

† Percy's metallurgy, silver and gold, p. 375.

= 1·75 grains and in Akbar's time = 1·935 grains, the mean of these or 1·8137 was so near the required figure that the matter appeared settled; but in Capt. Hamilton's 'East Indies' dated 1727 there is a very full table of weights in which the *rati* is stated to be equal to 3½ grains English, so that one may fairly despair of solving this question.

In reference to the myth regarding the method of obtaining diamonds described by Marco Polo, Nicolo Conti and many others, not omitting Sindbad the Sailor, I have, since my paper was printed, met with numerous accounts of sacrificial rights connected with the opening of mines. The late Mr. M. Fryar when visiting a tin-washing at Maleewoon in Tenasserim was requested to take off his boots as he was told that on a former occasion a European visitor having walked up to the stream without having done so, the guardian spirit took offence, and the supply of tin ceased till the washers had gone to the expense of sacrificing two buffaloes.

Of especial interest as accounting for the wooden structure which Nicolo Conti supposed was for the purpose of flinging the pieces of meat from one mountain to another is a description by Dr. John Anderson of a sacrifice witnessed by himself during his expedition to Yunan. Two buffaloes were offered up by the Khakyens to the Nâts or evil spirits. The animals having been slaughtered over two bamboo altars were cut up and the meat distributed, certain portions with cooked rice being placed on a lofty bamboo scaffolding for the use of the Nâts. The Nâts under such circumstances would infallibly be represented by birds, and among the birds, in most of the hilly regions of India there would probably be included some of the common white scavenger vultures (*Neophron*). Curiously enough one of the early accounts mentions white eagles, among the birds which carried away the meat with diamonds sticking to it. A naturalist, however, would object to the idea of this bird carrying anything in talons or bill, it would devour the offering on the spot. The rest of the story is doubtless due to the fertile imagination of a traveller who supposed the preliminary sacrifice to be part of the actual process of finding diamonds.

In conclusion it may be stated that the forthcoming volume on the Economic Geology of India contains a full *résumé* of information on these subjects and that there is also one though less complete in a small volume recently published on the Diamonds, Gold and Coal of India.

XIV.—*List of Diurnal* Lepidoptera *inhabiting the Nicobar Islands.*—*By* J. Wood-Mason, *Deputy Superintendent, Indian Museum, Calcutta, and* Lionel de Nicéville.

[Received January 1st;—Read March 2nd, 1881.]

(With a Woodcut.)

In Mr. F. Moore's paper on 'The Lepidopterous Fauna of the Andaman and Nicobar Islands'* only 33 species of Rhopalocera are recorded from all the numerous islands of the latter group. The Museum has, during the past and present years, received from Mr. F. A. de Roepstorff several small collections of Nicobar butterflies numbering some 42 distinct species, of which 25 have not been previously recorded; and, since this paper was read, we have been indebted to the kindness and courtesy of Lieut.-Colonel T. Cadell, V. C., Chief Commissioner of the Andaman and Nicobar Islands, for a collection consisting of very numerous individuals of about 23 species, eight of which we had not before obtained and five of which prove to be new to the Islands; so that in all there have passed through our hands, 47 species of which 30 are now for the first time recorded; this number, of which 4 are new to science and 3 are described as varieties of known forms, added to the 34 previously recorded brings up the total of species known from these islands to 64.

In the absence of *Danais chrysippus* one cannot help speculating as to what Nicobar females of *Hypolimnas misippus* may be like: are they dark-coloured like the males or do they mimic some other red *Danais?*

LEPIDOPTERA RHOPALOCERA.

Family NYMPHALIDÆ.

Subfamily Danainæ.

1. Danais limniace.

Pap. limniace, Cramer, Pap. Exot., 1775, vol. i, pl. 59, figs. D, E.

Nankowri Island *(Moore)*. One male and two females from Kamorta *(Colonel Cadell)*.

2. Danais agleoides.

D. agleoides, Felder, Wien. Entom. Monatschr., 1860, vol. iv, p. 398, ♂; Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 486; *non* Boisd.

D. grammica, Moore, Proc. Zool. Soc. Lond., 1877, p. 581.

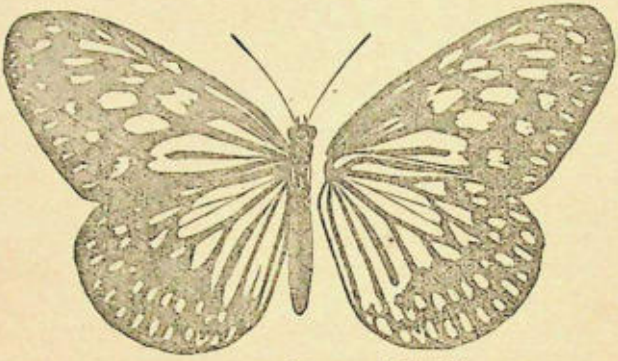
Four males and six females from Nankowri, one male from Great Nicobar (Sambelong), and two males and one female from Kar Nicobar, all absolutely identical in structure, markings, and colour with one another

* Proc. Zool. Soc. Lond., 1877, p. 580.

and with specimens from Rangoon (*J. W.-M.*); and Felder states that his specimens from the Great Nicobar agree with the typical ones from Malacca in the Malay peninsula.

The specimens obtained by Mr. Meldola on Kamorta Island doubtless belong to this species and not to *D. grammica* (Boisduval), which is apparently restricted to South India and Ceylon (*D. ceylanica*): it is, to say the least, improbable that two such closely allied varieties should inhabit the same limited area (Kamorta, Nankowri, Great Nicobar, and Kar Nicobar Islands). Nankowri, Kamorta, and Trinkut Islands (*Colonel Cadell*).

3. Danais similis, var. nicobarica, nov.



Upperside. ♀. *Underside.*

♂. ♀. Nearest to *D. expromptа*, Butler, from Ceylon, from the figure* of which species (probably that of a female, though the sex is not stated) it differs, *in the anterior wing*, in having the streak in the base of the interno-median area broader, occupying all but the entire breadth of the space, shorter, and marked along the middle by a linear streak (instead of being divided into two long and narrow streaks connected at the base only); and, *in the posterior wing*, in having the cell entirely subdiaphanous greenish or bluish white except for two excessively fine and faint longitudinal and apically-divergent dusky lines much as in *D. juventa* (instead of being divided by two very broad and black ones into two streaks, the posterior of which is strongly recurved at its free end), the discal series of bluish streaks immediately beyond the cell much narrower and shorter, and the ground-colour around them consequently of greater extent and giving to this portion of the wing a much darker appearance, again much as in *D. juventa*.

The male differs from the female in the bluish markings of both wings being of a much deeper shade and, with the exceptions to be stated, larger;

* Moore, 'Lep. Ceylon,' pl. 2, fig. 2, ♀.

in the anterior wing being narrower and externally slightly emarginate (instead of well-rounded), with its outer submarginal series of spots reduced to small specks, and the three posterior ones of its inner series externally distinctly tridentate; and in the posterior wing being also apparently somewhat narrower and less rounded externally, with both series of submarginal spots much smaller,—with its two posterior veins margined on both sides with fuscous of a far lighter and duller tint than the rest of the ground,—and with the submedian one of them more prominent with the wing-membrane on each side of it raised into a slight fold and the two light streaks that bound it dirty whitey-brown: the male of this species is, in fact, provided with a distinct, though little-specialized, sexual mark or scent-gland.

Length of anterior wing, ♂ 1·5, ♀ 1·55; whence expanse = ♂ 3·1, ♀ 3·2 inches.

One male and three females, the latter agreeing exactly with one another, from Great Nicobar.

D. vulgaris, Butler, from Upper Tenasserim, Malacca, and Borneo, *D. exprompta* from Ceylon, *D. juventa* from Java, and *D. nicobarica* from the Nicobars appear to us to be only constant geographical varieties of *D. similis* from Formosa and China. Mr. Butler in describing the first-named species (Ent. Month. Mag., 1874, vol. xi, p. 164) gives 'Nepal, Bengal' as localities for it in addition to Singapur and Borneo. This is probably a mistake; we have seen no specimen of it from any region further to the west than Upper Tenasserim.

4. Danais plexippus.

One male and two females from Nankowri Island; five males from Kar Nicobar; also Kamorta *(Moore)*. Numerous specimens of both sexes from Kamorta and Nankowri (*Colonel Cadell*).

5. Danais hegesippus, var. nesippus.

D. nesippus, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 486, ♂; Reise Novara, Lep., p. 347, ♂ ♀.

Four males and five females from Nankowri Island; and Great Nicobar *(Felder)*.

6. Euploea (Macroploea) phœbus.

Euploea phœbus, Butler, Proc. Zool. Soc. Lond., 1866, p. 270, ♂ ♀.
Macroploea phœbus, Butler, Journ. Linn. Soc. Lond., Zoology, 1878, vol. xiv, p. 292.

One very fine male from Kar Nicobar Island agreeing (except in its rather larger size, its expanse being 5·3 inches) exactly with continental specimens from Cherra Punji.

7. Euplœa (Salpinx) novaræ.

Euplœa novaræ, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 482, ♂; id., Reise Novara, Lep., p. 317, pl. 39, fig. 7, ♂.

Kar Nicobar *(Felder)*.

8. Euplœa esperi.

Euplœa esperi, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 482, ♀, from Kar Nicobar.

Euplœa frauenfeldii, Id., ibid., p. 479, ♂, from Ceylon; Reise Novara, Lep., p. 342, ♂ ♀, pl. 41, fig. 4, ♂, from Ceylon!

Euplœa felderi, Butler, Proc. Zool. Soc. Lond., 1866, p. 275, ♀, from Sumatra.

Euplœa lorquinii, Felder, Reise Novara, Lep., p. 340, ♂ ♀, from Southern China.

Two males and two females from Pulo Kondul; three males and a female from Kamorta; and six males and three females from Trinkut Islands.

Of the males from Pulo Kondul, one differs from the specimen described and figured by Felder in the 'Novara Reise' solely in presenting no trace of a cellular spot in either wing, in having a minute whitish dot intercalated between the first and second and another larger added at the posterior end of the submarginal series of spots on the upperside, and a short linear cellular mark in the right wing only (instead of a geminated one in both wings) with a still shorter streak (obsolete in the left) beyond it on the underside, of the anterior pair of wings; and in there being only a very indistinct cellular point present in the right wing, and in the minute geminated spot (= the foremost of the submarginal series) between the third median veinlet and the discoidal vein being absent from both wings, of the posterior pair on the underside. The other male differs from the preceding in having, on the upperside of both anterior wings, distinct shadows of the rounded white cellular spots of the underside, the second dot in the submarginal series absent, the two discal spots larger, and, on the underside, a discal oval violet-white spot just behind the subcostal followed from before backwards by two linear marks beyond the end of the cell, all three faintly marked on the upperside and larger in the left than in the right wing; on the underside of the posterior wings it presents a distinct rounded cellular spot smaller than those of the anterior wings and a submarginal series of minute dots commencing in one wing with the geminated one, in the other between the two discoidal veinlets and both ending between the submedian and first median veinlet; and on the upperside, no trace of cellular spots, but the submarginal series much as below. The two females differ from one another chiefly in the size of the markings, and from Felder's description in having, on the upperside, three discal white spots (one cellular) with a streak in front of the two extracellular ones, eight submarginal ones with, in one specimen, two linear dashes between the first of the series and the subcostal spot, and, on

the underside, a small spot and, in the next cell but one, a linear streak behind the second subcostal spot.

The three males from Kamorta differ from the second of those described above in having the second submarginal dot in the anterior wings more often present than not, a double series of marginal spots in the posterior wing, and all the spots larger and more prominent; the female has no second subcostal spot and the cellular spot in the anterior wings is rounded.

Of the six males and three females from Trinkut, the former also agree with the second of the two from Pulo Kondul in the anterior wings, differing in the great development and prominence of the two marginal series of spots in the posterior ones; the females differ from those of Kondul Island in no respect of any moment.

All the specimens differ from the continental variety *E. lonquinii* in the wings being merely glossed with dark purple-violet, and not "*vivide violaceo-cyaneo suffusæ*."

9. Euploea camorta.

E. camorta, Moore, Proc. Zool. Soc. Lond., 1877, p. 582, ♂.

Two males and two females from Nankowri Island; two males and one female from Katschall Island; three males and one female from Kar Nicobar; one female from Kamorta Island; and two females from the Great Nicobar.

The males from all the islands shew no variation whatever, all have the basal dark portion of both wings glossed with very dark blue-violet. The females, however, present considerable variation. Those from Nankowri differ from their males only in the subcostal spot on the anterior wing below showing through on the upperside. The one from Katschall is exactly like its male, except in the absence of the usual sexual characters. The Kar Nicobar specimen shows the subcostal spot and another just outside the cell between the second and third median veinlets on the upperside, and a spot between the two branches of the subcostal on the posterior wing; there are also two small indistinct specks near the apex of the anterior wing, the posterior of which only is visible below. That from Kamorta is altogether much paler, the borders to both wings being pale fawn-colour; it has the subcostal and cell-spots on the upperside of the anterior wing. The Great Nicobar females are the most aberrant of all: the anterior wing has on the upperside an increasing series of three subapical spots, a spot at the end of the cell and another just outside it between the second and third median veinlets, and the subcostal spot; and the posterior, a prominent spot between the two branches of the subcostal; all these spots (which are coincident with spots on the underside) are violet-white; on the underside of the anterior wing the spot in the cell, the subcostal one above it, the three subapical ones, an increasing series of spots outside

the cell, one in each median interspace, and a large patch below the median vein are all very prominent and (except the three subapical ones, which are whitish above) violet-white; in all the other specimens seen (except the Kar Nicobar one, which has five) and described, there are only four spots; in these there are eight.

10. Euploea (Crastia) simulatrix, n. sp.

♂. Wings above spotless black-fuscous suffused with the deepest violet-blue, externally tolerably broadly bordered with paler unglossed fuscous.

Posterior wing with an oval patch of iridescent lighter modified scales occupying about the second and third fifths of the length of the organ, extending from the middle of the discoidal cell to the middle of the interspace between the costal and subcostal veins at its widest part, and bounded in front by an indistinct streak of cretaceous white; and with the wing-membrane in front of this oval patch and of the apical portion of the first subcostal branch cinereous.

Wings below lighter and less sombrely coloured, their dark basal portions being distinctly glossed with purple-violet, more broadly bordered with paler fuscous, and marked with prominent spots and streaks.

Anterior wing with eight spots, *viz.*, a subapical series of three dots, the posterior of which is equal to the other two taken together, a somewhat elongated large spot between the first and second median veinlets, nearly pure white; a reversed comma-shaped spot near the end of the cell, a rounded one and a short linear streak beyond it, the former between the second and third median veinlets and the latter between the second median veinlet and the discoidal vein, and a subcostal spot on a level with the end of the cell, bluish or violet white; with a streak pointed at both ends in the middle of the interno-median area, and, posterior to this, a similarly shaped and placed patch divided by the submedian vein, cretaceous-white; and with the sutural cell behind the whitey-brown patch cinereous and satiny.

Posterior wing with a submarginal series of minute violet-white dots, a cellular spot and a curvilinear series of six just outside it, bluish white, in addition to the usual basal dots.

Length of anterior wing, 1·8; whence expanse = 3·7 inches.

A single specimen from Great Nicobar. On the upperside, it very closely resembles *E. camorta*, of which it is in all probability a mimic, differing from that species, however, in its rather darker and more sombre hue and in being devoid of a silky sexual streak, and on the underside in the presence of a submarginal series of dots in the posterior wing.

Subfamily SATYRINÆ.

11. MYCALESIS (ORSOTRIENA) MEDUS.

Papilio medus, Fabricius, Syst. Ent., 1775, p. 488.
„ *hesione*, Cramer, Pap. Exot., 1775, vol. i, pl. 11, figs. C, D.
Orsotriena medus, Moore, Trans. Ent. Soc. Lond., 1880, p. 160.

One male from Katschall Island; a male and a female from Great Nicobar; a female from Nankowri Island; and Kamorta Island (*Moore*). Numerous specimens from Nankowri and Kamorta Islands (*Col. Cadell*).

12. MYCALESIS (CALYSISME) DRUSIA.

Pap. drusia, Cramer, Pap. Exot., 1775, vol. i, pl. 84, figs. C, D, ♀.
Mycalesis drusia, Butler, Cat. *Satyridæ*, B. M., 1868, p. 133; id., Cat. Fabrician Lep. B. M., 1869, p. 33.
Calysisme drusia, Moore, Trans. Ent. Soc. Lond., 1880, p. 161.

Five males and three females from Nancowry Island; one male each from Katschall and Kar Nicobar Islands; one female from Great Nicobar; and Kamorta Island (*Moore*). Numerous specimens ♂ ♀ Kamorta and Nankowri (*Col. Cadell*).

13. ELYMNIAS MIMUS, n. sp.

♂. Wings above black fuscous of a fuliginous tint somewhat paler on the costal margin of the anterior wing, still paler at the apex of the same wing, and on the outer margins of all the wings, the extreme edges and the points of the lobes of which margins are again darker; with the incisural cilia whitish.

Wings beneath brownish, coarsely and confluently striated with rich dark chestnut for their basal two-thirds, whence both wings become suddenly lighter owing to the striation being more rare as well as lighter coloured.

Anterior wing with the outer margin of the closely striated portion sharply defined, and angulated outwards between the first and second discoidal veinlets; and with the ground colour immediately beyond the anterior and shorter of the two lines forming the angulated outline of the basal portion whitish.

Posterior wing with the ground beyond the chestnut base pale sepia passing to whitish around the outer-marginal ocelli, obscurely and rarely striated before, but more richly and closely at the outer margin beyond the ocelli with vandyke-brown; and with seven suboval black ocelli occupying the same positions as those of *E. dusara*, of which the second is the largest of all but only slightly larger than the fifth, the first is subequal to the sixth, and the third, fourth, and seventh (which touches the sixth in the same cell) are subequal and much smaller than the rest, the first and

second have a white pupil (which in the latter is eccentric) irrorated at the edges with light metallic greenish-blue scales, and the rest have the pupil almond-shaped with some mauve-coloured irrorations on and around its inner end.

♀. Wings above much lighter, with a submarginal whitey-brown common band which passes straight across both wings from near the anal angle of the posterior one to the second branch of the discoided vein of the anterior, at which point it turns sharply off at a right angle to the costal margin; with the light intervals between the striations of the underside visible as light bars on the anterior margin, and the apical dark portion lighter than the basal, of the anterior wing; and with two infuscations (less perceptible in the darker male) on the posterior wing corresponding to the fifth and sixth ocelli of the underside.

Wings below lighter, with the anastomozing chestnut striæ less confluent permitting more of the ground-colour to be seen; and with the anterior ocellus larger and much diffused circumferentially, the second with the pupil rudimentary, and the third larger than the fourth.

Length of anterior wing ♂ 1·3, ♀ 1·4; whence expanse = ♂ 2·7, ♀ 2·9 inches.

One male from Kar Nicobar and one female from Pulo Kondul.

Closely allied to *E. dusara* (*panthera*, Fabr.), Horsfield, Cat. Lep. E. I. Co., 1829, pl. v, figs. 7, 7*a*, ♀ (no description), from which it would appear to differ in having the light band of the anterior wing distinctly angulated and the costal margin of the same barred with lighter, in its more highly developed and unequal ocelli, in the more abrupt definition of the basal chestnut from the rest of the underside, and apparently also in its more strongly lobed wing-margins and finer tails.

It in all probability mimics *Euploea camorta*, a species which abounds on all the islands of the Nicobar group.

Subfamily Nymphalinæ.

14. Cethosia nikobarica.

C. nikobarica, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 484, ♂; id., Reise Novara, Lep., pl. 48, figs. 7, 8, ♂; Moore, Proc. Zool. Soc. Lond., 1877, p. 583, ♀.

Five males and five females from Nankowri Island; one female from Great Nicobar; and two females from Pulo Kondul Island.

This species is equally common at Port Blair, specimens from which place are absolutely identical with those before us from the Nicobars.

15. Cirrhochroa nicobarica, n. sp.

♂. Wings above bright fulvous powdered with fuscous scales at the bases, and along each side of the discocellular veinlets.

Anterior wings with the costal margin narrowly, the apex broadly, and the external margin decreasingly fuscous, and with a small obscure patch of fuscous scales near the inner angle.

Posterior wings with a thin discal striga somewhat discontinuous and nearly straight anteriorly but zigzaged posteriorly, seven rather large rounded spots, and a short streak between the median and discoidal veins in the same line as the spots, black, and beyond the spots three regularly engrailed fuscous strigæ, one of which is marginal and the innermost of which is the darkest and is connected with the discal thin striga by the dark brown margins of the veins, with the usual white blotch between the anterior black spot and the discal striga, with the dusky fulvous interval between the two outermost marginal fuscous strigæ continued for a short distance on to the fuscous margin of the anterior wing at the inner angle.

Wings beneath much paler, all faintly suffused with lilac, with a common opalescent discal band inwardly bounded with dusky, scarcely perceptible in the anterior ones but prominent in the posterior, in which it is nearly straight externally but dentate internally.

Posterior wings with five of the black spots of the upperside (two interspaces being devoid of a spot) smaller than above, seated, the foremost one wholly, the second and last (which is twinned) partially, upon a dusky ground, the remaining ones upon fulvous of a brighter shade than the rest of the wing; beyond the spots with two opalescent lunular bands, the first the broader and internally margined with diffused dusky and the second the narrower and sharply defined, both of which bands are continued faintly and diffusedly on to the anterior wings; and with the usual basal and discocellular pale fuscous marks.

Length of anterior wing 1·2; whence expanse = 2·5 inches.

A single specimen from Great Nicobar.

Apparently most nearly allied to *C. malaya*, Felder, from the Malay Peninsula.

16. Messaras erymanthis, var. nikobarica.

M. erymanthis, var. *nikobarica*, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 486.

Great Nicobar (*Felder*), one male from Kamorta (*Col. Cadell*).

17. Atella alcippe.

One very small male from Katschall Island.

18. Pyrameis cardui.

Papilio cardui, Linnæus, Syst. Nat., 1767, I, 2, p. 774.

One male from Kamorta (*Col. Cadell*).

19. JUNONIA ASTERIE, var. NIKOBARIENSIS.

J. asterie, var. *nikobariensis*, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 482.

Kar Nicobar (*Felder*).

20. JUNONIA LAOMEDIA.

Four males and five females from Nankowri (*A. de R.*) and Kamorta (*Col. Cadell*).

21. HYPOLIMNAS MISIPPUS.

Two males, but no females as yet, from Nankowri or any other island.

22. HYPOLIMNAS BOLINA.

One male from the Great Nicobar; and Tillangschong Island (*Felder*).

23. NEPTIS NICOBARICA.

N. nicobarica, Moore, Proc. Zool. Soc. Lond., 1877, p. 586, ♂ ♀.

Numerous males and females from Nankowri Island, one female each from Nankowri (*Col. Cadell*), Kamorta, and Kar Nicobar Islands, and Takoin.

24. NEPTIS MATUTA.

N. matuta, Hübner, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 483.

Nankowri Island (*Felder*).

25. NEPTIS MANANDA, Moore.

N. mananda, Moore, Proc. Zool. Soc. Lond., 1877, p. 586, ♂ ♀; pl. lviii, fig. 4, ♀.

One female from Kar Nicobar Island. It agrees with Port Blair (Andaman) specimens, except that the markings are pure instead of ochreous white, and the subbasal band of posterior wing is wider.

26. TANAECIA CIBARITIS.

One female from Nankowri Island identical with Port Blair specimens.

Family ERYCINIDÆ.

27. ABISARA BIFASCIATA.

A. bifasciata, Moore, Proc. Zool. Soc. Lond., 1877, p. 587; pl. lviii, fig. 1, ♀.

One male from Kar Nicobar Island. It differs from female specimens (the Museum has as yet received no males) from Port Blair in the markings on both upper and underside being dusky greenish instead of pure white; the upperside is also brilliantly suffused with purple, especially on the posterior wing; the female shows no trace of this colour.

Subfamily LYCÆNIDÆ.

28. CURETIS THETYS.

A single female of this variable and widely distributed species from Nankowri Island, and another from Trinkut (*Col. Cadell*).

29. CASTALIUS MANLUENA.

Lycæna manluena, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 484, ♀.

Kondul Island (*Felder*).

30. LAMPIDES ÆLIANUS.

Two males and a female from Kamorta, Trinkut (*Col. Cadell*), and Nankowri Islands all extremely pale, especially below.

31. LAMPIDES PANDAVA.

Numerous specimens from Nankowri (*Col. Cadell* and *A. de R.*) and Katschall Islands (*A. de R.*); Nankowri and Kamorta (*Moore*); Trinkut and Kamorta Islands and Takoin (*Col. Cadell*).

32. LAMPIDES STRABO.

Three males from Nankowri (*Col. Cadell* and *A. de R.*); two males Trinkut, one male Kamorta, and one female Takoin (*Col. Cadell*).

33. LAMPIDES PARRHASIUS.

Lycæna parrhasius, (Fabr.), Horsfield, Cat. Lep. E. I. Co., 1829, p. 86, ♂ ♀.

A male from Nankowri.

34. LAMPIDES PLATO, var. NICOBARICUS.

Numerous males and females from Nankowri (*A. de R.*): Kamorta, Nankowri, and Trinkut, (*Col. Cadell*).

The males differ from specimens of the same sex from Calcutta, Sikkim, S. India, Ceylon, and Bombay in the greater extent of the blue on the anterior wing, the broad black outer border of which does not stretch back towards the middle of the costa in the manner described by Horsfield.

35. LAMPIDES PLUMBEOMICANS, var. NICOBARICUS.

L. plumbeomicans, Wood-Mason and de Nicéville, Journ. Asiat. Soc. Beng., vol. xlix, pt. 2, 1880, p. 231, ♂ ♀.

One male from Katschall Island differing from Andaman (Port Blair) specimens in having the underside purplish slate-colour, the marginal and submarginal macular fasciæ more distinct, iron-grey, narrower, and separated by a wider space of the ground-colour from the discal fascia; in

having a very much larger subanal black spot, which is more broadly encircled with brighter orange; and in having all the fasciæ more sharply defined.

36. Lampides cnejus.

Kamorta (*Moore*).

37. Lampides kinkurka.

Lycæna kinkurka, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 481; id., Novara Reise, Lep., p. 273, pl. 34, figs. 24, 25, ♀.

Kar Nicobar (*Felder*); and Nankowri (*Moore*).

38. Lampides kankena.

Lycæna kankena, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 481, ♂; id., Reise Novara, Lep., p. 270, pl. 34, fig. 37, ♂.

Kar Nicobar (*Felder*).

39. Lampides kondulana.

Lycæna kondulana, Felder, Verh. zool.-bot. Gesellsch. Wein, 1862, vol. xii, p. 484, ♂; id., Reise Novara, Lep., p. 271, pl. 34, fig. 6, ♂.

Kondul Island (*Felder*).

40. Lampides macrophthalma.

Lycæna macrophthalma, Felder, Verh. zool-bot. Gesellsch. Wien, 1862, vol. xii, p. 483, ♂; id., Reise Novara, Lep., p. 275, pl. 34, fig. 35, ♂.

Pulo Milo (*Felder*).

41. Lampides rosimon.

Pap. rosimon, Fabr., Syst. Entom., 1775, p. 523.

A single bad specimen from Nankowri (*Col. Cadell*).

42. Polyommatus karsandra.

P. karsandra, Moore, Proc. Zool. Soc. Lond., 1865, p. 505, n. 106; pl. 31, fig. 7.

One female from Kamorta (*Col. Cadell*).

43. Polyommatus sangra.

P. sangra, Moore, Proc. Zool. Soc. Lond., 1865, p. 772; pl. 41, fig. 8, ♂.

Kamorta Island (*Moore*).

44. Hypolycæna thecloides.

Myrina thecloides, Felder, Wien. Entom. Monatschr., 1860, vol. iv, p. 395, ♂; *Hypolycæna thecloides*, Hewitson, Ill. D. Lep., *Lyc.*, pl. 22, figs. 9, 10, ♂.

One male from Katschall and two from Nankowri Islands; Malay Peninsula (*Felder*); and Singapore (*Hewitson*).

45. Sithon sugriva, var. areca.

S. sugriva, var. *areca*, Wood-Mason and de Nicéville, Journ. As. Soc. Bengal, 1880, vol. xlix., pt. 2, p. 232, ♂ ♀.

Kar Nicobar (*Felder*).

46. Sithon kamorta.

Myrina kamorta, Felder, Verh. zool.-bot Gesellsch. Wien, 1862, vol. xii, p. 485, ♀.—Wood-Mason and de Nicéville, Journ. As. Soc. Bengal, 1880, vol. xlix, pt. 2, p. 233, ♂.

One male each from Nankowri and Kar Nicobar Islands; and Great Nicobar (*Felder*).

47. Deudorix orseis.

Kamorta (*Moore*).

48. Myrina atymnus.

Three males from Nankowri Island (*Col. Cadell* and *A. de R.*).

Family PAPILIONIDÆ.

Subfamily Pierinæ.

49. Terias hecabe.

Katschall, Trinkut, and Nankowri Islands; and Takoin, probably a small village near the settlement. Very common.

50. Terias nikobariensis.

T. nikobariensis, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 480.

We have at last received from Kamorta, through the kindness and courtesy of Col. Cadell, V. C., Chief Commr. of the Andamans and Nicobars, 10 specimens all males, which are no doubt referrible to this species; in one specimen only, however, is the external margin of the posterior wings narrowly and obsoletely bordered with fuscous, the border being reduced to dots sometimes so small as to be barely visible and connected or not with one another by a few fuscous scales; the colour of the specimens is bright lemon-yellow. Kar Nicobar (*Felder*).

51. Terias drona.

T. drona, Horsfield, Cat. Lep. E. I. Co., 1829, p. 137, pl. 1, fig. 13.

Two males and three females from Kamorta and one female from Nankowri (*Colonel Cadell*).

52. Tachyris paulina, var. galathea.

Pieris galathea, Felder, Verh. zool.-bot. Gesellsch. Wien., 1862, vol. xii, p. 485, ♂.

Two males from Nankowri and Katschall Islands, both having a round spot of black scales between the 2nd and 3rd median veinlets on both sides of the anterior wing, the remains of the intense black spot occupying the same position in the females of typical *T. paulina*; and Great Nicobar (*Felder*).

53. Tachyris panda.

Pieris panda, Godt., Snellen v. Vollenhoven, Faune Entom. Arch. Indo-Néerland., 2 me. Monogr., Fam. des *Piérides*, p. 44, ♂ ♀.

A male from Great Nicobar agreeing perfectly with Vollenhoven's description; Java (*Horsfield, Vollenhoven*).

54. Catopsilia crocale.

Kamorta Island (*Moore*).

55. Pieris coronis, var. lichenosa.

P. lichenosa, Moore, Proc. Zool. Soc. Lond., 1877, p. 591.

One male from Kar Nicobar Island.

Subfamily Papilioninæ.

56. Papilio aristolochiæ, var. camorta.

P. aristolochiæ, var. *camorta*, Moore, Proc. Zool. Soc. Lond., 1877, p. 592, ♀.

Three males and two females from Nankowri Island; three males and one female from Kar Nicobar Island; two males from Great Nicobar Island; and Kamorta (*Moore*).

57. Papilio polytes, var. nikobarus.

P. pammon, var. *nikobarus*, Felder, Verh. zool.-bot. Gesellsch. Wien, 1862, vol. xii, p. 483, ♀.

One male and two females from Nankowri Island; seven males from Pulu Kondul; two males and one female from Kamorta Island; two females from Kar Nicobar; and two males Takoin (*Col. Cadell*).

All the females from all the islands are of the First Form, *i. e.*, like the males. The male specimens from Pulu Kondul all have on the underside of the posterior wing external to the discal white macular band a series of irregular patches of beautiful blue scales, which forms a very distinct blue macular band across the wing.

58. Papilio agamemnon.

Kamorta Island (*Moore*).

Family HESPERIDÆ.

59. Tagiades helferi.

Pterygospidea helferi, Felder, Verh. zool.-bot. Gesellsch. Wien, 1860, vol. xii, p. 483, ♂.

Pulo Milo (*Felder*).

60. Tagiades ravi.

One male from Nankowri Island.

61. Hesperia mathias.

Hesperia mathias, (Fabr.), Butler, Cat. Fabr. Lep. Brit. Mus., 1869, p. 275, pl. 3, fig. 8, ♂.

Kamorta Island (*Moore*).

62. Hesperia colaca.

Two females, one from Kamorta (*Col. Cadell*) and one from Nankowri Island (*A. de R.*).

63. Pamphila palmarum.

Moore, Proc. Zool. Soc. Lond., 1878, p. 690, pl. 45, figs. 6, 7, ♂ ♀, from Calcutta.

Two males from Katschall and Nankowri Islands, agreeing perfectly with Calcutta specimens.

64. Telegonus thyrsis.

Pap. thyrsis, Fab.. Syst. Ent. 1775, p. 532; *Hesperia pandia*, Moore, Proc. Zool. Soc. Lond., 1865, p. 790.

One male *(Col. Cadell)*.

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XV.—*Notes on an apparently undescribed* Varanus *from Tenasserim and on other* Reptilia *and* Amphibia.—*By* W. T. Blanford, F. R. S.

[Received November 3rd;—Read December 7th, 1881.]

(With Plate XVI.)

The notes appended are on a few reptiles from very different parts of the dependencies of British India, and on a species of Pseudophidian from the Himalayas. The *Varanus* described has been in my possession for at least three years, and I hoped to identify it with some known species, but I have not succeeded in doing so.

Varanus macrolepis, sp. nov.

V. *digitis longiusculis; naribus oblongis, obliquis, ab oculis parum distantibus, subtus spectantibus; squamis nuchalibus magnis, planulatis, rotundatis; dorsalibus paullo minoribus, sed multo majoribus quam in cæteris speciebus Indicis vel Burmanis, ovatis, obtuse carinatis; corpore caudâque exempli juvenis fasciis latis nigris transversis ornatis.*

Description.—The toes are as long as in *V. dracæna* and *V. nebulosus*, the middle fore toe being considerably longer than half the distance between the eye and the end of the snout. The nostril is peculiar: it is in the anterior portion of a single large shield, and the opening is oblique, directed backwards and downwards. The nasal shield is much nearer to the eye than to the end of the snout, the distance from the latter being about twice that of the former. Tympanum rather smaller and rounder

than in the allied forms, the breadth being but little inferior to the height and the diameter less than the length of the eye.

All the scales of the upper part of the body are larger than in any other Indian or Burmese form. The scales of the nape above the neck are flat, about as broad as long and much larger than those on the head. The dorsal scales are oval and bluntly keeled, nearly as long as those of the nape, but narrower, and rather larger than those of the sides. A few smaller scales are interspersed, both on the back and nape. The ventral scales are nearly or quite as broad as long, not more than half as long as the larger dorsal scales; there are about eighty scales between the gular fold and the thighs. Scales above the limbs bluntly keeled.

The scales on the top of the head are flat and do not vary much in size; those in the middle of the superciliary region are slightly enlarged, but less so than in *V. nebulosus*.

Tail very much compressed with the upper lateral scales minute, only half the length of those on the lower portion of the tail, where several longitudinal rows are larger and sharply keeled.

In the young individual examined, the colour of the body and tail consists of broad transverse alternating black and yellow bands, the black bands on the body being more than twice as broad as the intervening yellow rings, but, on the tail, the difference between the breadth of the two decreases. The black bands disappear upon the lower parts, except towards the end of the tail. There is a broad black band across the hinder parts of the neck, extending to the side in front of the shoulder, and giving out, on each side, a narrower black stripe that extends above the ear to the eye. There are three broad black bands between the shoulders and the thighs, one between the thighs, eight on the tail. None of the bands are broken up by spots or mottling on the upper parts. The limbs are blackish above with small yellow spots, yellow below with a tendency to dark transverse marks. The head and nape are uniform yellowish above; there are a few short vertical dark marks on the upper and lower labials.

The total length of the only specimen procured is 8·5 inches, of which the tail from the anus measures 4·5, head from hinder edge of tympanum to end of nose 1 inch, fore limb to end of middle toe 1·2, middle toe without claw 0·33, hind limb to end of fourth toe 1·45, fourth toe without claw, from division between third and fourth, 0·45, third from the same 0·37.

This well-marked species may be immediately distinguished from all other Indian forms by its peculiar nostril, situated in a single scale, by the larger scales on the upper part of the body, and especially by *the scales of the nape being larger than those above the head, or those on the back.* These structural differences will of course be found in adults. The colouration also is quite peculiar, but young *Varani* are very differently coloured

from adults, and it is probable that the bands of colour are not persistent in older individuals.

For the only specimen of this remarkable monitor that I have seen I am indebted to Mr. W. Davison, who obtained it in Tenasserim, and, I believe, in the neighbourhood of Tavoy. The specimen was carefully labelled, but the label, being of paper, has unfortunately become detached.

There is a Philippine species of *Hydrosaurus* (*H. nuchalis*, Gthr. P. Z. S. 1872, p. 145) that has somewhat similar, though much smaller, scales on the nape and back, but it is of course distinguished by the form and position of the nostrils.

Draco taeniopterus.

In J. A. S. B., 1878, Vol. XLVII, Part 2, p. 126, I noticed some specimens from near Tavoy, collected by Mr. Davison, and expressed a slight doubt as to whether they were identical with the typical *D. taeniopterus* described by Günther from Siam (Reptiles Brit. Ind., p. 126). On comparing the Tenasserim specimens with the type in the British Museum, I find they agree very fairly. In the latter the markings on the 'wings' are more distinct and darker; to see them in the Tenasserim form the wings should be held up against the light and looked through. There is a very small tubercle behind the orbit, and the nuchal crest is too rudimentary to be of any importance.

Naja tripudians.

A few snakes collected by Major Biddulph in Gilgit have been presented by him to the British Museum. Amongst them are three specimens of a cobra differing in colour and to some slight extent in structure from any Indian form known to me.

Of the three specimens two measure 4 feet 5 inches each, both being of precisely the same length, and one specimen is young, being only 1 foot 9 inches long. In the two larger specimens, the colour above is uniform dark brown, below white throughout with the exception of a few irregular dusky marks on the ventral scutes chiefly anteriorly and near the tail, the subcaudals being pretty dusky. The smaller specimen is light grey above with rather faint darker cross bands, angularly bent forward in the middle of the back, and rather broader than the interspaces. The lower parts are white with the exception of two dusky bands across the throat as frequently found in Indian cobras. Neither in the adults nor in the young is there any spectacle-mark or ocellus on the back of the neck, but in the young there is a blackish spot with indistinct edges on each side of the neck where the anterior dusky band crosses the ventral shields.

In the larger specimens there are 23 to 27 longitudinal series of scales on the neck, in the smaller 25 to 27, in all 23 round the middle of the body.

The number of ventrals in the three specimens is 203, 205, and 207, there are 72 pairs of subcaudals in two and 74 in the third, the smallest individual, in which the number of ventral shields is 207. It is manifest that this variety is more elongate than the forms usually found in India and the countries to the eastward. All of the varieties of cobra described in Günther's 'Reptiles of British India' have less than 200 ventrals. The colouration too is peculiar, especially in the young specimen, and remarkably similar to that in the Central Asiatic type described by Eichwald under the name of *Tomyris oxiana*.* This snake has since been shewn by Strauch,† who re-examined the original specimen, to be a true *Naja* closely allied to *N. tripudians*, but distinguished by the form of the head and the characters of the temporal shields. *N. oxiana* is founded on a young specimen, the only one hitherto recorded, 40 centimetres (15¾ inches) long, and having 202 ventrals and 66 pairs of subcaudals, so that it resembles the Gilgit snake in the great number of the former. The essential differences, however, are considered by Strauch to consist in the facts that in *N. oxiana* the length of the head is thrice the height and nearly twice the breadth in the temporal region (whereas in *N. tripudians* the length is only twice the height and one and a half times the breadth), and that there are two larger temporals in front in contact with the postoculars, the posterior temporals being numerous and scarcely larger than the back scales, whilst in the Indian cobra the temporals consist of 4 or 5 subequal shields.

Now in the Gilgit snakes the temporals vary in form. The two anterior are generally the largest, but the lower posterior temporal is nearly, sometimes quite, as large. The anterior lower temporal is in contact with 3 others. In each of the larger specimens 3 temporals are in contact with each occipital, in the smaller 4. I find precisely similar temporal shields in many Indian cobras in the British Museum. The head too in the Gilgit snakes is precisely similar in form to that of *N. tripudians*.

If, therefore, Strauch is correct in considering the distinctions he has pointed out in the type of *N. oxiana* of specific value, it is clear that the Gilgit snakes cannot be referred to that species. The temporals are so variable in form and number in cobras that, were there no other distinction, I should doubt whether the Central Asiatic form really deserved separation, but the shape of the head is a more important character. At the same time it is very interesting to find in Gilgit, where several birds and mammals belonging to Central Asiatic types occur, a cobra presenting so remarkable a similarity in colour and structure to the form described from Central Asia.

* Zool. Spec., III, p. 171: Fauna Casp. Cauc. p. 130, pl. xx.

† Bull. Acad. Sci. St. Pet. 1868, xiii, p. 81.

ICHTHYOPHIS GLUTINOSUS.

Peters, in his recent monograph* of the Cæcilians, gives as localities for this species (the *Epicrium glutinosum* of Günther's 'Reptiles of British India,' p. 441.) Ceylon, Siam, and Java, and, on Günther's authority, South India, Khasi hills, and Tenasserim. So far as I am aware, no Pseudophidian has hitherto been recorded from the Himalayas.

I received four or five years since, from the late Mr. Mandelli, two specimens of this species, obtained near Darjiling, and I find, in the British Museum, two more from the same locality, procured by Dr. Jerdon. In both my specimens, and in one of Dr. Jerdon's, the lateral band is wanting, but there is no structural difference from other specimens.

XVI.—*Second List of Rhopalocerous* Lepidoptera *from Port Blair, Andaman Islands, with Descriptions of, and Notes on, new and little-known Species and Varieties.—By* J. WOOD-MASON, *Deputy Superintendent, Indian Museum, Calcutta, and* LIONEL DE NICÉVILLE.

[Received July 26th;—Read August 3rd, 1881.]

(With Plate XIV.)

At the end of 1880, we contributed to this Journal an account of the Rhopalocerous portion of the collection of Lepidopterous insects formed during that year for the Indian Museum by Mr. F. A. de Roepstorff, an Assistant Superintendent on the Port Blair Establishment, to whose energetic labours zoologists are almost entirely indebted for such knowledge as they possess of the interesting Lepidopterous fauna of the Andaman Islands, for by far the greater number of the specimens belonging to both divisions of the order reported upon in 1877 by Mr. F. Moore was also collected by this officer. The collection sent to us in 1880 by Mr. de Roepstorff comprised no less than 90 distinct species, of which 25 had not been previously recorded. The present list is based upon a very fine collection (numbering more than 1000 specimens in the finest condition, and especially valuable as furnishing us with the opposite sexes of most of the species) sent to the Museum in instalments during the current year by the same assiduous collector, and it adds 22 fresh species to the fauna. In order to render it a record complete to the end of the year 1881 of the species of butterflies inhabiting the Andaman Islands, several corrections have been made in the paper since it was read, and a few additional species, together with the names of the few forms which have been recorded by Mr. Moore but not

* Monatsbericht Ak. Wiss. Berlin, 1879, p. 931.

seen by ourselves, inserted with an asterisk prefixed to each of the latter to distinguish them from those of which we have received examples.

LEPIDOPTERA RHOPALOCERA.

Family NYMPHALIDÆ.

Subfamily DANAINÆ.

1. HESTIA CADELLI.

H. cadelli, Wood-Mason and de Nicéville, Journ. As. Soc. Bengal, 1880, vol. xlix, pt. ii, p. 225, pl., xiii, fig. 1 ♂.

Since our first paper was published, we have received numerous specimens of both sexes of this species from South Andaman from Mr. de Roepstorff.

♀. All the wings broader, with the markings of the same shape, situation, size, and shade as in the male, from which, in fact, the female differs in the proportions of the organs of flight just in the same manner as does *H. hadeni* ♀ from *H. cadelli* ♂ (*vide* J. A. S. B., 1880, Pl. XIII).

*2. HESTIA AGAMARSCHANA,† Felder.

Andaman Islands (*Felder*).

3. DANAIS MELANOLEUCA, Moore.

4. EUPLŒA CORE, Cramer.

We have received no specimens of this common species since 1872, when the native collector Moti Ram forwarded a single example from Port Blair.

5. EUPLŒA ANDAMANENSIS, Atk.

Subfamily SATYRINÆ.

6. LETHE EUROPA, Fabr.

7. MELANITIS LEDA, Linn.

8. MELANITIS ISMENE, Cramer.

9. MELANITIS ZITENIUS.

Pap. zitenius, Herbst, Natur. Syst. Ins. Schmett. viii Theil, p. 5, pl. 182, figs. 1, 2.

The single male received from Mr. de Roepstorff has the round black spot on the yellow-red band of the anterior wings divided longitudinally into two parts by the yellow of the band, and the white pupil obsolete. In other respects, especially in its less falcate anterior wings, it agrees best with specimens in the Museum from Upper Tenasserim.

10. MYCALESIS (CALYSISME) PERSEUS, Fabr.

11. MYCALESIS (CALYSISME) DRUSIA, Cramer.

12. MYCALESIS (VIRAPA) RADZA, Moore.

† ? 'agamarsena' from ἄγαμος, 'unmarried,' and ἄρσην-ἄρσενος, 'male,' in allusion to the fact that the describer was ignorant of the opposite (female) sex.

13. Elymnias cottonis, Hewitson.

Hewitson states that the sexes are alike in this species, but the three females before us have the outer margins of all the wings lighter with a more or less distinct submarginal rounded-angulate macular band in the anterior ones corresponding to the band of blue spots in the males of *E. undularis*, and in two specimens two, and in the other four, distinct whitey-brown spots, the blurred pupils of the obsolete ocelli of the underside showing through, on the upperside of the posterior wings; below, they are much lighter than the males, the subapical triangular patch of lilacine ground-colour in the anterior wings and the submarginal lilacine ground of both wings, but especially in the posterior pair, being whiter and consequently more distinct than in the male; there are also six pupils of ocelli instead of one distinctly traceable, and the anastamozing chestnut striation besides being lighter is less confluent. The females, in fact, much resemble the males of *E. undularis*. Hewitson makes no mention of the beautiful rich deep plum-colour which suffuses the dark parts of the upperside in both sexes almost equally, nor of the faint red-violet reflections emitted by the light borders.

Danais plexippus, the model of the females of the allied continental form, has not yet been detected at Port Blair.

Subfamily Morphinæ.

14. Amathusia phidippus, Linn.

Two males and one female.

15. Discophora celinde, Stoll.

Two males.

Subfamily Nymphalinæ.

16. Cethosia nikobarica, Felder.

17. Atella alcippe, Cramer.

*18. Cirrhochroa anjira, Moore.

19. Cirrhochroa thais, Fabr.

20. Cynthia erota, Fabr.

21. Messaras erymanthis, var. nikobarica, Felder.

22. Pyrameis cardui, Linn.

23. Junonia œnone, Linn.

24. Junonia asterie, Linn.

25. Junonia almana, Linn.

26. Doleschallia bisaltide, Cr.

27. Kallima albofasciata, Moore.

The underside is, as might have been expected, excessively variable.

28. Eurytela horsfieldii, Boisduval.

A single specimen of the very differently coloured female.

29. CYRESTIS COCLES, var. ANDAMANICA, nov.

Our single male differs from a continental (Sylhet) one in the Museum collection only in its larger size, whiter ground-colour throwing up the slightly darker markings, in the finer and rather indistinct submarginal black lines of all its wings on the upperside, and in the more distinct ochraceous-fuscous markings of the underside.

Mr. Hewitson, we find, referred a series of specimens of a *Cyrestis* from the Andamans to this species, and he justly said of them that for delicacy of colouring they were some of the most beautiful things he had ever seen.

30. CYRESTIS FORMOSA, Felder.

Cyrestis formosa, Felder, Reise Novara, Lep. vol. iii, p. 412, ♂.

——— *horatius*, W.-M. & de N., Proc. As. Soc. Bengal 1881, August, p. 142.

♂. Allied to *C. cocles*, with which it agrees almost exactly in the character of the markings of the upperside, but from which it differs in its pure white ground-colour painted with different shades of sepia-brown instead of pale ochraceous and ochraceous-fuscous and black, the black marks of *C. cocles* being represented by the darkest of the sepia colouring, in its larger and more distinct ocelli, and in having a distinct but pale fulvous patch at the anal angle of the posterior wing; and, on the underside, in having only the lightest portions of the sepia markings absent and replaced by white or whitish.

Length of anterior wing 1·16; whence expanse = 2·4 inches.

Nine specimens exactly alike from S. Andaman.

We have since received a tattered male specimen from Khurda, a place 25 miles S. S. W. of Cuttack, the chief town of Orissa, in Continental India.

31. CYRESTIS THYODAMAS, var. ANDAMANICA, nov.

We entered the name of this species in our previous list without remark because we had at the time but a single specimen before us and the characters which distinguish it from the typical continental form might have proved to be inconstant. We have since received a very large series of specimens of the male all agreeing perfectly with one another and differing from all continental (from Kulu to Upper Tenasserim) ones in the blacker apex and outer margin, in the prominent somewhat diffused black spot on the third median veinlet between the third and fourth common black strigæ at the point where these bend towards each other in the anterior wing; and in having the fulvous marks of the anal half of the abdominal margin, of the anal angle, and of the outer margin as far as the discoidal vein, of the posterior wing, much diffused and darker;—in having, in fact, all the markings and colouring darker and coarser both above and below.

32. HYPOLIMNAS BOLINA, Linn.

33. HERONA ANDAMANA, Moore.

34. PARTHENOS GAMBRISIUS, Fabr.

35. Limenitis procris, var. anarta.

36. Neptis cnacalis, Hewitson.

One male and two females.

37. Neptis jumba.

N. jumba, Moore, Cat. Lep. E. I. Co. 1857, vol. i, p. 167, pl. 4*a*, fig. 5; Proc. Zool. Soc. Lond. 1858, p. 7.

A male and a female from S. Andaman.

38. Neptis mananda, Moore.

39. Neptis andamana, Moore.

40. Athyma reta.

Athyma reta, Moore, Proc. Zool. Soc. Lond. 1858, p. 12, pl. 50, fig. 3 ♂, from Sumatra.

Athyma selenophora, Kollar, Wood-Mason and de Nicéville, Journ. As. Soc. Bengal, 1880, vol. xlix, pt. ii, p. 229, ♀.

♀. Anterior wings above with the divided cellular mark, the triangular spot beyond this, a subapical largish spot, and a much smaller one just in front of the second median veinlet in the discal series, orange, and with the curved series of six discal spots white, diffusedly bordered, from the costal margin increasingly and afterwards decreasingly to the inner margin, with orange.

Posterior wings with the discal band white decreasingly from the anterior margin narrowly edged externally with orange, and with the submarginal sinuous band narrower, broken up into lunules, and orange-coloured.

Length of anterior wing 1·44; whence expanse = 3·04 inches.

41. Tanaecia cibaritis, Hewitson.

42. Adolias acontius.

Adolias acontius, Hewitson, Ann. and Mag. Nat. Hist. 1874, ser. 4, vol. xiv, p. 358; Exot. Butt. vol. v, *Adolias*, pl. iv, fig. 11, ♀.

Tanaecia acontius, Moore, Proc. Zool. Soc. Lond. 1877, p. 586.—Wood-Mason and de Nicéville, Journ. As. Soc. Bengal, 1880, p. 229, ♀.

♂. Wings above almost black, the ground-colour being very dark brown of a bronzy tint, and the prominent cellular and basal marks, the outer margins, and the common discal and submarginal submacular bands velvety black, the former of the two last-named bounded externally at its anterior end by a series of four indistinct U-shaped white marks, and the latter provided at its inner and anterior extremity with two small elongated subcostal white spots (the posterior of which is the larger), and, in the posterior wings, composed of distinct subelongate spots each with an inconspicuous dash paler than the surrounding ground-colour at either end. The posterior wings strongly glossed with dark greenish-purple anteriorly.

Wings below much as in A. *garuda*, but all more strongly glossed with amethyst-purple submarginally and having their basal half coloured greyish-green and conspicuously marked with black as in the female.

Length of anterior wing 1·28; whence expanse = 2·72 inches.

The characters of the venation and the structure of the palpi remove this species from the genus *Tanaëcia*, in which it has been placed by Moore, to *Adolias*, whilst the form and colouration of the wings in the male assign it a position in the system next to, or in the immediate neighbourhood of, *A. garuda*, of which, indeed, the above described insect might, on a cursory view of the upperside, be mistaken for a black local race.

43. Symphædra teuta, var. teutoides.

44. Nymphalis athamas, Drury.

Family ERYCINIDÆ.

*45. Abisara kausambi, Felder.

46. Abisara bifasciata, Moore.

Our specimens of the female all agree with Moore's figure of the upperside, but they all have three anterior ocelli on the underside of the posterior wing; the front one, however, reduced to an almost rudimentary condition.

Our numerous males all have the discal light bands of the anterior wing less bent than in the females, but all except two (which have a rudiment of the foremost one) present only two ocelli in the anterior series; and our unique Nicobarese specimen agrees with them except in having the discal band if anything a little more angled.

It is probable that the two foregoing species will prove to be identical.

Family LYCÆNIDÆ.

47. Curetis thetys, var. saronis.

48. Pithecops hylax, Fabr.

49. Castalius ethion, Hewitson.

Four males and a female from S. Andaman.

50. Castalius elna, Hewitson.

Three males and a female from S. Andaman, variable in the size and connections of the black spots and bands of the underside and wanting the minute black spot at the anterior end of the common white band of the upperside.

51. Castalius roxus, Horsfield.

Three males and two females.

52. Lampides ælianus, Fabr.

53. Lampides strabo (Fabr.), Butler.

A single male from S. Andaman.

*54. LAMPIDES KONDULANA, Felder.

55. LAMPIDES MALAYA.

Lycæna malaya, Horsfield, Cat. Lep. E. I. Co. 1829, p. 70.

One specimen from S. Andaman.

56. LAMPIDES ARDATES, Moore.

57. LAMPIDES ELPIS, Godart.

58. LAMPIDES PANDAVA, Horsfield.

59. LAMPIDES confer PACTOLUS.

60. LAMPIDES PLUMBEOMICANS, W.-M. & de N.

61. POLYOMMATUS SANGRA, Moore.

62. APHNÆUS LOHITA, var. ZOILUS.

63. HYPOLYCÆNA ERYLUS, Godart.

*64. HYPOLYCÆNA ELTOLA, Hewitson.

65. SITHON SUGRIVA, var. ARECA, W.-M. & de N.

Six more males and two females.

66. 'SITHON' WESTERMANNII, var. ANDAMANICA, nov.

Another male.

67. 'SITHON' TARPINA, Hewitson.

Three more males and two females.

68. 'SITHON' ALBIMACULA, n. sp.

♂. Anterior wings above brown-black of a vinous tint with a large conspicuous oval white discal spot equal in length to half the breadth of the part of the organ on which it lies, equally distant from the opposite margins, and so placed that its major axis and more pointed anterior end are directed towards the middle of the costa.

Posterior wings above dark violet-blue bordered increasingly from the base of the anterior margin to the apical angle and thence decreasingly to the anal angle with fuscous-black and from the submedian vein to the abdominal margin with greyish-black; with a fine black anteciliary line and, immediately internal to this, a very faint and fine silver-grey line decreasing from the anal angle and dwindling to nothing before reaching the apical angle; with the cilia dark brown evenly tipped with silvery white; and with the tails black-brown, the unequal submedian and second median shorter ones edged internally with silvery white cilia, and the longer intermediate first median one white-tufted at its inner extremity.

Wings below much lighter.

Anterior pair with a broad and prominent white band bordered both sides with fuscous of a darker shade than the rest of the ground-colour, passing off from the greyish-white basal portion of the sutural area across the organ to within a short distance of the costa, increasing in its course to a little beyond the first branch of the median vein and thence decreasing to its anterior extremity (which is washed with fuscous), so that its outline,

while almost straight internally, is bluntly obtuse-angled externally; and with the outer margin at the inner angle obsoletely trilineated with white as in the posterior pair.

Posterior pair with a narrower and less conspicuous discal whitish band of uniform width throughout, not sharply defined, but on the contrary diffused externally, and bordered internally with a line of fuscous which is darker than the ground, sharply bent inwards at right angles to itself to the abdominal margin, and externally margined with brassy, at its posterior end; with the deep black spot of the small anal lobe, a large patch of grey scales between the ends of the submedian vein and the first median veinlet, an intense black spot next to and about half the size of this between the ends of the first and second median veinlets, and a very short and transversely elongated or narrow similar but inconspicuous black spot between the ends of the first and second median veinlets, all internally margined with a discontinuous line of brassy scales which extends from the point where the dark discal striga with its brassy edging reaches the abdominal margin all along the outer margin of the organs, following the inner contours of the above-described spots, up to the second subcostal veinlet; and with the external margin finely lineated with three regularly concentric silvery white lines separated from one another by the black anteciliary line and the brown bases of the cilia.

Length of the anterior wing ·52; whence expanse = 1·09 inches.

A single male of this beautiful little species, the nearest ally of which is *M. ciniata*, Hewitson, Ill. Diurn. Lep. p. 35, pl. XIV, figs. 30, 31 ♀.

69. Deudorix epijarbas, Moore.

70. Deudorix dieneces, Hewitson.

71. Deudorix varuna, Horsfield.

72. Deudorix orseis, Hewitson.

73. Myrina atymnus, var. prabha.

74. Amblypodia narada, var. erichsonii.

A single male with the upperside coloured the deepest and richest metallic violet bordered with fuscous-black exactly to the same extent and in just the same manner as, but more darkly than, in Calcutta specimens of *A. narada*. One of the females in the tint and extent of the blue of the upperside closely resembles Calcutta specimens of *A. narada*, but it is otherwise darkly and richly coloured as in the rest of the Andaman specimens.

75. Arhopala centaurus, var. coruscans, W.-M. & de N.

Numerous additional males and females.

76. Arhopala amantes.

Amblypodia amantes, Hewitson, Cat. Lyc. Brit. Mus. 1862, p. 4, pl. 2, figs. 1-3.

One small female.

*77. Arrhopala nakula, Felder.

78. Narathura fulla, var. andamanica, nov.

Amblypodia fulla, Hewitson, Cat. Lyc. Brit. Mus. 1862, p. 10, pl. vi, figs. 67, 68 ♂, from Boirou.

Narathura fulla, var. *andamanica*, Wood-Mason and de Nicéville, Proc. As. Soc. Bengal, August, 1881, p. 143.

Narathura subfasciata, Moore, Trans. Entom. Soc. Lond. 1881, September, part iii, p. 312, ♂ ♀, from the Andamans.

♂. Wings above brilliant violet-cyaneous, all slightly more broadly bordered with black-fuscous than in Hewitson's figure of the typical form.

Wings below pale ocraceous-fuscous, with faint traces of a discocellular mark in both wings and of three or four basal spots in the posterior wings, besides the markings beyond the middle of the wings, darker than the ground-colour.

The end of the first submedian branch of the posterior wing forms a minute tooth on the outer margin.

This very slight variety seems intermediate between *N. fulla*, Hewitson, from Boirou, and *N. arsenius*, Felder, from Luzon.

Mr. Moore compares his species to *Amblypodia canuta*, Hewitson, a name which we have failed to trace.

79. Surendra quercetorum, var. latimargo.

*80. Amblypodia zeta, Moore.

Family PAPILIONIDÆ.

Subfamily Pierinæ.

81. Terias hecabe, Linn.

82. Terias harina, Horsfield.

*83. Terias nikobariensis, Felder.

We have received specimens from the Nicobars (*vide supra* p. 236), but none as yet from the Andamans.

*84. Hebomoia glaucippe, Linn.

85. Hebomoia roepstorffii, W.-M. Pl. XIV, Figs. 3 & 4 ♂, 5 ♀.

Since this species was described, we have received a very large series of both sexes.

86. Ixias andamana, Moore.

87. Catopsilia catilla (Cramer), Butler.

One male only.

88. Catopsilia crocale, Cramer.

Two males with the apex of the anterior wings slightly more broadly bordered with black than in Butler's fig. 1, pl. ix, Lep. Exot., and two others approaching very closely his fig. 4, representing *C. flava*, but with the apex of the anterior wings equally broadly black-bordered with

the two former, and the outer portion of all the wings, especially of the posterior ones, paler than the basal. Also two females.

*89. Catopsilia chryseis, Drury.

90. Pieris nadina, var. nama.

91. Pieris coronis, var. lichenosa.

92. Eronia valeria, var. naraka.

93. Tachyris paulina, Cramer.

Subfamily Papilioninæ.

94. Ornithoptera pompeus (? *rectius* heliacon).

Mr. Moore does not inform us, and we have not succeeded in discovering, in what points his *Orn. heli[a]conoides* differs from the *Orn. pompeus* of Sikkim and Assam.

In one of our four males from Port Blair all the submarginal black spots of the posterior wings are wanting except the first or anal, which is fused with the marginal conical spot as it all but invariably is in Continental specimens; in another the second spot is present on the upperside only; in a third, the second and third, and in a fourth, the second, third, and sixth, while in the feminine male upon which Mr. Moore founded his *Orn. heliaconoides* the second, third, fifth, and sixth are present on both sides: all of which variations are to be met with in a sufficiently large series of Continental specimens, particularly in our own fine one from the Sikkim and Khasi Hills.

Of our five females two have the anterior wings conspicuously rayed with white like some Assam specimens, and three (two from the Little Brother Island and one from S. Andaman) have the veins of these wings either simply bordered both sides with paler black than the general ground-colour or only exhibit here and there faint traces of white scales like others from the southern slopes of the Khasi Hills (Sylhet).

The males which are least differentiated from the females in point of markings, also resemble them in the fuller and more broadly rounded inner angle of their anterior wings.

95. Papilio mayo.

P. mayo, Atkinson, Proc. Zool. Soc. Lond. 1873, p. 736, pl. 63, fig. 1, ♂

P. charicles, Hewitson, Ann. and Mag. Nat. Hist. 1874, ser. 4, vol. xiv, p. 356, ♀; Exot. Butt. 1875, vol. v, pl. xiv, Pap. fig. 45, ♀.

The shape of the wings and the presence of red markings on the underside of the hinder pair prove that *P. mayo* is more closely allied to *P. androgeus* than to *P. polymnestor*; not a single red scale being to be detected in the hind wing of the latter except at the base of the organ, and the conspicuous blue-grey band on the upperside of the former being nothing more than an excessive development and concentration of the radiating

lines of grey scales with which *P. androgeus* is more or less conspicuously ornamented between the veins and folds of all its wings, but especially of the posterior pair, on the upperside. *P. mayo* is also adorned in the anterior wings with radiating shorter lines of luteous grey scales, a point not mentioned by Atkinson nor represented by him in his figure.

It is a well-known fact that the Continental *P. androgeus* is provided with three different forms of female, two tailless like the male and one tailed, which mimicks the red-spotted *P. doubledayi* just as the corresponding female of the closely allied *P. memnon* does the yellow-spotted *P. coon*. The two rare tailless females of its Andaman representative have not yet been detected; but there is no doubt whatever that in the *P. charicles* of Hewitson we have the commoner tailed form, which mimicks the red-tailed *P. rhodifer*. Our first specimens of the supposed two species were captured by the native collector Moti Ram in 1872 all together in the same spot; and all the numerous specimens (upwards of fifty in number) of *P. mayo* which have passed through our hands during the past two years are males, and all the (some 6 to 8) *P. charicles* females.

From these facts we can come to no other conclusion than that the two are the opposite sexes of one and the same species, and we accordingly unite them under the former as being the prior of these two names.

96. Papilio polytes, var. nikobarus, Felder.

97. Papilio agamemnon, Linn.

98. Papilio eurypylus, Linn.

99. Papilio rhodifer, Butler.

♀. Differs from the male in having all its wings broader, and the crimson of the posterior ones not quite so bright.

100. Papilio clytia, var. flavolimbatus. Pl. XIV, Fig. 1, 2, ♂.

We have since received many males and a female, the former all quite constant, and the latter differing from them only in its broader wings and in the paler fulvous markings of both sides of the posterior ones.

*101. Papilio antiphates, Cramer.

102. Papilio lestrygonum, W.-M.

♀. Wings all lighter above in consequence partly of their greater breadth, partly of the bands and other black markings being narrower or less developed, and partly of the smaller extent of grey present on the posterior pair: the fifth forked black band not reaching the inner angle on either side and none of the bands of the anterior pair being connected by a black edging at the inner margin, and the two marginal and sub-marginal lunular bands of the posterior pair being smaller and less diffused and more distinctly divided from one another by light scales anteriorly on the upperside.

Length of anterior wing 1·8; whence expanse = 3·75 inches.

A single specimen.

103. Papilio prexaspes.

P. prexaspes, Felder, Reise Novara, Lep. vol. i, p. 107, pl xv, fig. *d*, ♂, from Malacca.—Oberthür, Études D'Entom. ivme livr. p. 46, ♂ ♀, from the Andaman Isles.

♀. Wings above lighter and dingier, much in fact, as in *P. chaon*, Westw., with the fascia of the underside of the anterior ones faintly indicated.

Anterior wings below with an incurved ashy-white fascia beyond the end of the cell, commencing near the costal margin, interrupted by the veins and folds, and rapidly decreasing to the third median veinlet, where it ends to recommence at the first, whence it increases to the submedian vein.

Tails of the posterior wings broader at the expanded extremity and narrower at the constricted portion, just as in *P. chaon* ♀ as compared with its males.

Length of anterior wing 2·35; whence expanse = 4·86 inches.

Seven males and two females.

Family HESPERIDÆ.

104. Ismene chromus, Cramer.

Andaman females all have only a single small semitransparent subapical speck between the last two branches of the subcostal of the anterior wing; but those from Continental India have sometimes one and sometimes two besides this on the disk of the same wing, which in one from Bangalore in South India are enlarged into two conspicuous reversed comma-shaped spots.

105. Ismene malayana, Felder.

The females have a small semitransparent yellowish discal speck between the two posterior branches of the median vein and of course lack the oblique band of short lines of modified scales seen in the males of this as well as of the preceding closely-allied species.

106. Ismene aria, Moore.

107. Ismene lebadea, var. andamanica, nov.

♂. Wings above dark brown of a slightly greenish tinge, all without spots.

Anterior wings bearing a huge and dense pear-shaped sericeous patch of setæ glossed with greyish-greenish and extending nearly from the bottom of the angle formed at the base of the organ by the subcostal and submedian veins about to the level of the end of the fourth fifth of the length of the latter vein, with all the setæ directed backwards and slightly outwards; with the costal margin purplish; the outer portion beyond the setuloso patch bronzy; and the cilia pale luteous.

Posterior wings purple-glossed, with two subparallel raised discal longitudinal lines of modified scales attached to the apparently thickened bases of the first and second median veinlets, and with the cilia pale orange.

Anterior wings below bronzy-brown with a patch of brilliant amethyst-purple sparsely irrorated with white scales and extending from the end of the cell nearly to the apex of each organ, and with the basal portion of the wing-membrane behind the median vein and its first branch whitey-brown passing to ashy posteriorly, and with a tuft of brown-tipped yellow setæ arranged longitudinally upon and on each side of the basal half of the submedian vein.

Posterior wings below purple-glossed, darkest over the scent-glands, with an interrupted transverse discal band of white scales from near the abdominal margin to the middle of the organs, where it diffuses itself widely over a diffused patch of amethyst-purple.

♀. All the wings above and below paler and duller and glossed with purple, the anterior ones spotted.

Anterior wings suffused with purple on the disk, which bears three semitransparent yellow lustrous spots of the same size, relative proportions, and shape as in *C. attina*, Hew., with a fourth smaller and elongate yellow opaque spot placed just in front of the submedian vein rather beyond the middle of the organs.

♂. ♀. Eyes blood-red.

Antennæ purplish brown with the club bright luteous below.

Length of anterior wing ♂ 1·25, ♀ 1·25; whence expanse = ♂ 2·65, ♀ 2·65 inches.

The patch of setæ on the upperside of the anterior wings, the yellow tuft (which probably serves as a scent-fan) on the underside of the same wings, and the lines of modified scales (which probably cover the scent-glands as they seem soiled as if by some exuding fluid) on the upper-side of the posterior wings are structures peculiar to the male sex.

108. Ismene druna, Moore.

♀. Differs from the male only in the absence of the sexual streak in the anterior wings.

In both sexes of this species the anterior wings are tipped with paler on both sides.

109. Ismene exclamationis.

Hesp. exclamationis (Fabr.), Butler, Cat. Diurn. Lep. Fabr. 1870, p. 269, pl. iii, fig. 2.

Numerous males and females.

110. Ismene harisa.

I. harisa, Moore, Proc. Zool. Soc. Lond. 1865, p. 782, ♂ ♀.

A single female.

111. Ismene badra.

Goniloba badra, Moore, Proc. Zool. Soc. Lond. p. 778, ♂ ♀.

A single female in very fine condition.

112. Tagiades alica, Moore.

Numerous specimens of both sexes.

113. Tagiades ravi, Moore.

114. Tagiades menaka.

Pterygospidea menaka, Moore, Proc. Zool. Lond. 1865, p. 778, ♂ ♀, from 'N. E. Bengal.'

Male and female.

115. Tagiades bhagava, var. andamanica, nov. Pl. IV, Fig. 5, ♂.

Satarupa bhagava, Moore, Proc. Zool. Soc. Lond. 1865, p. 781, ♂, from 'N. E. Bengal.'

Numerous males and a female from S. Andaman.

♂. With the cream-coloured subbasal band of the posterior wings in one specimen narrower and not continued on to the anterior wings, in another as broad as in an Upper Tenasserim example, and continued faintly on to the anterior wings; with the spot at the end of the cell larger than in the female and not isolated from the fuscous outer margin; and with the transverse abdominal band concolorous with the subbasal.

♀. Wings above paler, with the spots of the anterior wings whiter and larger, and the band of the posterior ones pure white, much broader, and extending on to the anterior ones broadly up to the submedian vein and thence narrowly up to the first median veinlet between the two pairs of black spots.

Posterior wings with a black speck at the end of the cell on a white ground on both sides, and the two anterior of the semicircular series of black spots on the upperside nearly, but on the underside wholly, placed on the white subbasal band.

A specimen from the Sikkim Hills, 3000 feet, differs in having the band broader both on the posterior wings and between the two pairs of spots in the anterior ones.

116. Plesioneura alysos, Moore.

Our specimens from S. Andaman, the Sikkim Hills, and the N. E. Frontier districts (Sibsagar, etc.,) all agree with one another in always having three conjugated obliquely placed subapical semitransparent spots and usually three in the reversed oblique series, the innermost of which is separated from the next to it by a greater interval than this is from the outermost, which latter is the absent one in those specimens with only two in the series.

Males and females.

117. PLESIONEURA PARALYSOS, n. sp.

Proc. As. Soc. Bengal, August 1881, p. 143.

♂. ♀. Closely allied to *P. alysos*, but differing therefrom, on the upper-side of the anterior wings, in the discal oblique semitransparent white lustrous band being broader with less irregular margins, and in only one small spot, placed between the third median and the discoidal veinlet, midway between the discal band and the outer margin, being present; and, on the underside of the posterior pair, in having one or two small white opaque lustrous spots, one near the end of the cell, the larger and the more constantly present, and the other just beyond it between the first and second median veinlets.

Three males and one female.

Length of anterior wing ♂ ·78, ♀ ·82; whence expanse = ♂ 1·66, ♀ 1·74 inches.

Specimens from the Sikkim Hills; Sibsagar (*S. E. Peal*), Dhunsiri valley and Dafla Hills, Assam (*H. H. Godwin-Austen*); Trevandrum, S. India (*F. W. Bourdillon*), and Ceylon (*F. R. Mackwood*) are devoid of all traces of the spots on the lower surface of the posterior wings.

118. PLESIONEURA DAN, var. ANDAMANICA, nov.

Pap. dan, Fabr., Mant. Ins, ii, p. 88; *Hesperia fatih*, Kollar in Hügel's Kaschmir, vol. iv, pl. 18, figs. 5, 6.—*Plesioneura dan*, Moore, Proc. Zool. Soc. Lond. 1865, p. 789.

Our specimens from Port Blair differ from Continental ones in having the discal series of spots all run together so as to form an unbroken band, and the three subapical spots conjugated and in the same straight line, with their conjoined inner margin nearly straight and their outer festooned; and two examples exhibit in addition two smaller dots placed nearly parallel to the outer margin just below and external to the three subapical ones.

Numerous specimens.

119. PLESIONEURA LEUCOCERA.

Hesperia leucocera, Kollar in Hügel's Kaschmir, 1848, vol. iv, p. 454, pl. xviii, figs. 3, 4.

Plesioneura sumitra, Moore, Proc. Zool. Soc. Lond. 1865, p. 787, from N. E. Bengal.

——— *pulomaya*, Id., loc. cit. p. 787, from 'Darjeeling'.

——— *ambareesa*, Id., loc. cit. p. 788, from Maungbhoom, Bengal.

——— *chamunda*, Id., loc. cit. p 788, from Bengal.

——— *putra*, Id., loc. cit. p 788, from Bengal.

Our large series of specimens from the Sikkim Hills, Cherrapunji in the Khasi Hills, the N. W. Himalayas, Travancore, Ceylon, and S. Andaman furnishes us with an almost complete series of gradations between those with the smallest number and the greatest amount of coalescence and those presenting the largest number and the least coalescence of the spots on the disk of the anterior wings; moreover, the orange spots in the posterior wings are to the last degree capricious in their development, being

exceedingly prominent in some and totally wanting in others; not a single character, in fact, which we have chosen in our attempts to divide our series into local races has proved to be constant.

120. Plesioneura praba.

P. praba, Moore, Proc. Zool. Soc. Lond. 1865, p. 790, ♂ ♀.

Three males from S. Andaman.

121. Hesperia cahira, Moore.

The three females have, in addition to the eight spots present in males, a more or less well-developed triangular bright yellow opaque one touching the submedian rather beyond the middle of this, and appearing on the undersides as an imperfect band between that vein and the first median veinlet; and, moreover, have the whole underside thickly and evenly clothed with rufous brown scales.

122. Hesperia ocela, Hewitson.

♂. Wings above rich dark purple-brown with bronzy reflections.

Anterior wings typically with eight semitransparent pale yellow lustrous spots, namely, two, dot-like, at the end of the cell, of which the posterior is the larger, a third subquadrate, the largest of all, between the first and second median veinlets, a fourth, about half the size, between the second and third median veinlets, with a dot, the fifth, beyond and in front of it, and a series of three dots, the sixth, seventh, and eighth, in a series, in front of this again.

Posterior wings each with a conspicuous tuft of long dark brown pale-based setæ inserted into the wing membrane immediately behind the base of the subcostal trunk.

Wings below lighter and duller.

Anterior wings with a huge oval ashy patch of a most brilliant satiny lustre, occupying the middle four fifths of the portion of the organs between the median vein and the posterior margin, and in the middle of which is so placed as to be divided by the submedian vein a very much smaller oval patch of brown modified scales.

♀. Wings above paler and scarcely at all suffused with purple, with the setæ olive-green and the cilia pale luteous.

Anterior pair all but invariably with nine spots, an additional opaque one being present just in front of the submedian vein a little beyond the middle of the organs.

Wings below pure dead uniform olive-brown.

Length of anterior wing ♂ ·74, ♀ ·86; whence expanse = ♂ 1·63, ♀ 1·88 inches.

In the male of this species the basal tuft on the upperside of the posterior wings probably serves as the scent-fan, while the patch of modified scales on the underside of the anterior ones covers, and collects sponge-like the odorous fluid secreted by, subjacent glands.

Obs. The female has been described by Mr. Moore as that of his *H. cahira* (*vide supra*).

The male varies considerably in the number of spots in the anterior wings, while the female is almost constant. These variations may most conveniently be exhibited in such a formula as the following, in which the numerals 1, 2, 3, 4, 5, 6, 7, and 8 stand for the semicircular series of eight discal spots seen in typical examples numbered in the order of their succession from before backwards *inwards* and forwards, the cypher (0) wherever it occurs indicating that that particular spot the place of whose number it occupies is absent, and *x* representing the submedian additional spot all but invariably present in females only :—

♂.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8	Typical.
♂.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8	
♂.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8	
♂.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8	
♂.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 0	
♂.	0 + 2 + 3 + 4 + 5 + 6 + 7 + 8	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 0	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 8	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 8	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 8	
♂.	0 + 2 + 3 + 0 + 5 + 6 + 7 + 8	
♂.	0 + 0 + 3 + 0 + 5 + 6 + 7 + 0	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	Typical.
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + *x*	
♀.	1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 0	

123. HESPERIA COLACA, Moore.

Two males and four females.

124. HESPERIA SALA.

Hesperia sala, Hewitson, Trans. Entom. Soc. Lond., ser. 3, vol. ii, 1866, p. 500, from Singapore.

♀. Wings above vandyke-brown with a very faint vinaceous tinge.

Anterior wings with four semitransparent white lustrous spots all close together in the middle of the disk, two in the cell, the posterior of which is double the size of the anterior, which is the smallest of all, another immediately behind and in the same straight line with these, quadrate, the largest of all, being fully double the size of the posterior of the two cellular ones,

and the fourth placed quincuncially between the second and third and rather smaller than the former of these.

Posterior wings immaculate.

Wings below paler, darkest around the spots in the anterior ones, all also suffused with vinaceous.

Anterior ones with the sutural area ashy and a large patch in the internomedian area whiter and showing through on the upperside as a somewhat diffused whitish speck.

Posterior wings clothed with ashy scales and bearing a cellular roundish spot darker than the ground-colour, around which spot are semicircularly arranged three or four similar ones, as in *H. divodasa*.

Cilia dusky-ashy.

Length of anterior wing ·56; whence expanse = 1·23 inches.

Closely allied to *H. divodasa*, Moore.

The "three minute brown spots before the apex" of the anterior wings mentioned by Hewitson are not discernible in our two specimens; they correspond to the dark brown marks which bound the apical dots on both sides in some specimens of *H. divodasa*, and, consequently, represent the apical semitransparent dots of that species.

125. HESPERIA NAROOA.

H. narooa, Moore, Proc. Zool. Soc. Lond. 1878, p. 687, pl. 45, fig. 4, ♂ ♀, from Bombay and Ceylon.

A male agreeing exactly with Moore's figure, but not quite so perfectly with his description, five discal spots being described but only four figured.

Obs. This species is said by Mr. Moore to differ only in its larger size from the *H. contigua* of Mabille, a species which we have failed to trace in the literature.

126. HESPERIA ACROLEUCA, n. sp.

Telegonus acroleucus, Proc. As. Soc. Bengal, August, 1881, p. 143.

Hesperia hiraca, Moore, Trans. Ent. Soc. Lond. September 1881, p. 313, ♀.

♂. Wings above dark brown slightly suffused with vinous.

Anterior wings tipped with ashy-white and with three large semitransparent pale yellow quadrangular lustrous spots arranged as in *T. thrax*, namely, one in the cell with its outer margin bifestooned and its inner biscalloped, another larger and elongated below and partly under this between the first and second median veinlets, and a third, the smallest of the three, rhomboidal, between the second and third median veinlets, and with the cilia dusky at the apex, but gradually becoming pale yellow towards the inner angle.

Posterior wings darker towards the outer margin with all the cilia pale yellow.

Wings below paler and duller, suffused with purple on the disk, and ornamented, especially on the medial area of the posterior pair, with scattered ochreous setiform scales.

Antennæ black with the straight portion of the club broadly and conspicuously incompletely ringed with cretaceous white and the much shorter terminal hooked portion red internally.

♀. Differs from the male only in its larger size; and in not having the anterior wings tipped with ashy, nor the antennæ nearly so conspicuously ringed with white.

♂ ♀. Eyes blood-red.

Palpi with the terminal joint rudimentary.

Length of anterior wing ♂ 1·05, ♀ 1·09; whence expanse = ♂ 2·26, ♀ 2·32 inches.

127. Telegonus thyrsis, Fabr.

The male of this species presents, on the upperside of each anterior wing, three lines of modified scales, namely, one along the posterior side of the median vein between the origins of its first and second branches, another on each side of the first median veinlet from the origin of this up to the second discal spot, and a third, also double, along an equal portion of the submedian vein, and a thick clothing of setæ paler than the ground-colour at the base of the internomedian area and a similar clothing of paler setæ on the middle three-fourths of the sutural area; and, on the underside, a conspicuous and equally long furry patch of pale-fulvous coarse setæ divided by the submedian vein.

Five males and a female.

128. Halpe beturia, Hewitson.

129. Pamphila mathias.

Hesperia mathias (Fabr.), Butler, Cat. Fabr. Lep. Brit. Mus. 1869, p. 275, pl. 3, fig. 8, ♂.

The specimens referred to *H. chaya* in our previous list are now placed under this species.

130. Pamphila purreea.

P. purreea, Moore, Proc. Zool. Soc. Lond. 1877, p. 594, pl. lviii, fig. 10.

♀. Larger than the male, with the yellow discal band throughout in the posterior wings, but only in the internomedian area in the anterior ones, and the yellow portions of the cilia, especially towards the inner and anal angles, darker, inclining to orange.

Length of anterior wing ·55; whence expanse = 1·18 inches.

A male and a female.

131. Pamphila gola, Moore.

132. Pamphila mæsoides, Butler.

133. Pamphila augias, Linn.

Two males.

Explanation of Plate XIV.

Fig. 1. *Papilio clytia*, var. *flavolimbatus*, Oberthür. ♂. Upperside.
„ 2. ——— ——— ——— ♂. Underside.
„ 3. *Hebomoia roepstorffii*, W.-M., ♂. Upperside.
„ 4. ——— ——— ——— ♂. Underside.
„ 5. ——— ——— ——— ♀. Upperside.

XVII.—*Description of a new Species of* Rostellaria, *from the Bay of Bengal.*—*By* Geoffrey Nevill, C. M. Z. S.

[Received November 3rd;—Read December 7th, 1881.]

Rostellaria delicatula, n. sp.

Distinguished at once from all the other living species of the genus by its thin, delicate, and translucent substance, in these respects showing a highly important approach to some fossil forms. Colour a pale ochraceous brown lineated on the last whorl with four narrow white bands, each of which terminates in one of the four projecting digitate processes of the outer lip, one only of these bands appearing in the middle of the preceding four whorls; spire not quite half the entire length, apex moderately acute; whorls 10½, moderately convex, the last conspicuously convexly tumid and like the preceding one, marked with a slight sutural depression, produced at the base into a short canaliculation, relatively less developed than in any of the other known species, this "canal" is slightly tortuously deflected, more conspicuously so than in *R. magnus* (Chemnitz); the first three or four whorls are sculptureless, the next three or four inconspicuously but regularly spirally striated, striae about ten in number, filiform and slightly punctured, becoming obsolete on the last two whorls, except at the base of the last of all, where they reappear more coarsely developed than before; there are also five varices, somewhat inconspicuous, at intervals on the last four whorls, which also show, under a lens, minute longitudinal striation, the striae close set, fine, and flexuous; aperture oval, rather large, with the peristome thickened and denticulated with four equidistant, relatively somewhat small, digitate processes.

Long. 76, diam. 28; from the apex to suture of the last whorl 29½, from base of the aperture to end of the "canal" 6½ mill.

This highly interesting and very characteristic form, quite unlike any of the other seven known living species of the genus [as restricted] was dredged in deep water off Cheduba, Arrakan Coast, by Surgeon J. Armstrong, late Naturalist to the Indian Marine Survey.

XVIII.—*A numerical Estimate of the Species of Animals chiefly Land and Freshwater hitherto recorded from British India and its Dependencies.*—*By* WILLIAM T. BLANFORD, F. R. S.

[Received November 10th;—Read December 7th, 1881.]

A few months ago I endeavoured to obtain an estimate of the number of species belonging to the animal kingdom that are found in British India and its Dependencies. I learned, somewhat to my surprise, that not only did no such census of the nominal species exist, but that, with the exception of the Vertebrata, the classes and orders had but rarely been catalogued in such a manner as to render an estimate of the number of species found in different countries practicable. I learned, moreover that, owing doubtless to the difficulty of ascertaining the number of species described, it was impossible to obtain a general enumeration of the fauna of any large area of the earth's surface.

The marine fauna inhabiting the seas around India is necessarily of vast extent and very imperfectly known. Confining myself, in the sub-kingdoms except the Vertebrata, to the land and freshwater fauna alone, I found anything like a correct estimate of the known species, except amongst the Vertebrata and the Mollusca, very difficult to procure. With the assistance of some friends, to whom I am greatly indebted for their aid, I have, however, obtained a rough idea of the number of species hitherto recorded in several orders, and this estimate leads to some very curious results, so much so that I think it may be useful to publish the data I have obtained, imperfect as they are.

In the first place, I should state precisely what is the area that I understand as comprised in the title of British India and its Dependencies. Of course the whole Peninsula of India proper is included, together with Ceylon. On the westward, Baluchistan is classed as a dependency, but not Afghanistan, so that the western frontier extends to Persia. Kashmir carries the boundary northward beyond the Karakoram pass to the confines of Eastern Turkestan, but this is the only Trans-Himalayan region comprised in the limits adopted; further east the small Himalayan states between Kashmir and Kamaon, with Kamaon itself, Nepal, Sikkim, and Bhutan, are all included as Dependencies, although in the case of Nepal and Bhutan the position politically is open to some question. But the fauna of these countries has always been included in that of India, and but few forms are known from them that do not occur in Sikkim or some other truly dependent state. All Great Tibet is excluded and so are the Himalayan tracts east of Bhutan. Assam with the hills to the south of the valley, Manipur, Cachar, Sylhet, Tipperah, Chutiaganj, and British Burmah

(Arakan, Pegu, Tenasserim) are comprised within our limits, but not Independent Burmah. On the mainland the frontier chosen does not run south beyond the end of Tenasserim, the Straits Settlements being excluded; but the fauna of the Andaman and Nicobar Islands is added to that of British Burma, of which they form dependencies.

It would be easy to find reasons for modifying various portions of the boundaries chosen, but they are believed to coincide as nearly as possible with the "red line" that marks the limit of British power. The most questionable addition of the whole is perhaps Ceylon, for this island, though entirely British, is in no sense a dependency of British India. But Ceylon is included for zoological reasons: its fauna differs very little indeed from that of Southern India, and the most important and typically Indian portion of the fauna would be imperfect were the animals of the island omitted.

The area thus circumscribed includes portions of two great zoological regions, the Oriental and the Palæarctic. To the latter belong northern Kashmir and part of Baluchistan together with all the Himalayas above an elevation varying from about 7000 to about 10,000 feet in different parts of the range; the former comprises the remainder of the area. The comparatively small tract of the Palæarctic region includes parts of at least two separable subregions of the higher Himalayas and portions of the Central Asiatic plateau, whilst in the Oriental part of the area the whole of two of Mr. Wallace's subregions* and portions of the other two are included.

The following are the numbers of species known, so far as I have been able to determine them. I repeat that whilst the number of Vertebrate species is, I believe, a fair approximation to the real number inhabiting the country, the Invertebrates are, as a rule, much less accurately known, and that whilst in the Vertebrata both land and marine forms are included, amongst the Invertebrata, the land and freshwater species alone are enumerated.

The data for the Mammals are various. I have collated the various works by Jerdon, Blyth, Dobson, Anderson, and others, and as nearly as I can estimate the following species are known:—

Quadrumana,	23
Lemures,	3
Chiroptera,	80
Insectivora,	55
Carnivora,	75

* It must be understood that Mr. Wallace's subdivisions are open to a considerable revision, and, as I shewed some years since, the boundaries of his Indian and Ceylonese subregions at all events are not correct.

Cetacea,	23
Rodentia,	95
Ungulata,	47
Sirenia,	1
Edentata,	3
	405

For Birds, I take Mr. Hume's lists* in 'Stray Feathers,' Vol. VIII, pp. 81—116. It is scarcely necessary to say that the birds of India are better known than any other class. For the convenience of Indian ornithologists too, to whom the new classification is, as yet, not sufficiently familiar, I adopt the old as employed by Jerdon, although I must apologize for having recourse to an artificial and unscientific arrangement. I give the numbers of some of the more important orders and families. As Mr. Hume has shewn, about 70 species here included are doubtful.

Raptores:		
Accipitres,	97	
Striges,	52	
		149
Insessores:		
Psittaci,	18	
Picariæ,	212	
Passeres,	952	
		1182
Columbi,		46
Rasores:		
Pteroclidæ,	8	
Gralla,	64	
		72
		1449
Grallatores:		
Otididæ,	6	
Limicolæ,	67	
Gruidæ,	4	
Rallidæ,	22	
Ciconidæ,	6	

* Mr. Hume's limits differ from mine by excluding Baluchistan and the Mergui Archipelago, which I include. There are not, however, I believe, half a dozen birds known from the two together that are not found within Indian limits elsewhere.

Ardeidæ,	23	
Tantalidæ,	1	
Plataleidæ,	1	
Ibididæ,	5	
		135

NATATORES :

Phœnicopteridæ,	2	
Anseres,	36	
Podicipidæ,	3	
Procellaridæ,	6	
Laridæ,	34	
Phaëtonidæ,	3	
Sulidæ,	3	
Attagenidæ,	2	
Pelecanidæ,	4	
Graculidæ,	4	
		97
		1681

The data for the Reptiles are again various. Gunther's and Theobald's works form the basis for the enumeration.

CHELONIA,		54
CROCODILIA,		4

LACERTILIA :

Varanidæ,	5	
Lacertidæ,	14	
Zonuridæ,	1	
Scincidæ,	48	
Geckotidæ,	59	
Agamidæ,	54	
Chamæleontidæ,	1	
		182

OPHIDIA :

Typhlopidæ,	10
Tortricidæ,	2
Xenopeltidæ,	1
Uropeltidæ,	41
Calamaridæ,	11
Oligodontidæ,	27
Colubridæ,	57
Homalopsidæ,	10

OPHIDIA:

Acontiophidæ,	1	
Psammophidæ,	3	
Dendrophidæ,	5	
Dryiophidæ,	8	
Dipsadidæ,	12	
Lycodontidæ,	10	
Amblycephalidæ,	5	
Pythonidæ,	2	
Erycidæ,	2	
Acrochordidæ,	1	
Elapidæ,	15	
Hydridæ,	30	
Crotalidæ,	17	
Viperidæ,	4	
		274
		514

The number of Amphibia is less easily determined as the species of BATRACHIA require careful revision. The number known is about 100, of which 1 only belongs to the URODELA and 5 to the PSEUDOPHIDIA.

The numbers of the Fishes are taken from Dr. Day's work, and are consequently trustworthy.

Acanthopterygii,	705
Acanthini,	43
Physostomi,	485
Lophobranchii,	15
Plectognathi,	44
Chondropterygii,	65
	1357

My principal authority for the Mollusca (land and freshwater) is Mr. Theobald's list printed as a supplement to the Conchologia Indica. I have omitted the estuarine species therein enumerated. Unfortunately I have not the numbers of the different families, and, as I am writing away from books, I can only give the approximate numbers of the classes here. They are—

GASTEROPODA (land and freshwater),	900
LAMELLIBRANCHIATA (all freshwater),	100
	1000

The next subkingdom Arthropoda includes the most formidable numerically of all orders, those of insects. Of some of these fairly approximate estimates may be formed, the principal difficulty in groups like Coleoptera and Lepidoptera being the labour of enumeration, but of many orders very little is known.

The numbers of the COLEOPTERA are taken from Gemminger and Harold's Catalogue, with additions up to 1878 from the Zoological Record. The following is the result :

Cicindelidæ,	112
Carabidæ,	617
Dytiscidæ,	44
Gyrinidæ,	13
Hydrophilidæ,	30
Paussidæ,	33
Staphylinidæ,	476
Pselaphidæ,	76
Scydmænidæ,	40
Silphidæ,	11
Trichopterygidæ,	12
Scaphidiidæ,	7
Histeridæ,	79
Phalacridæ,	18
Nitidulidæ,	63
Trogositidæ,	9
Colydiidæ,	19
Rhysodidæ,	3
Cucujidæ,	27
Cryptophagidæ,	9
Lathridiidæ,	19
Mycetophagidæ,	3
Dermestidæ,	8
Byrrhidae,	12
Parnidae,	5
Heteroceridae,	6
Lucanidae,	96
Scarabæidae,	558
Buprestidae,	107
Throscidae,	4
Eucnemidae,	19
Elateridae,	285
Rhipidoceridae,	7
Dascillidae,	17
Telephoridae,	96

Cleridae,	48
Lymexylidae,	2
Ptinidae,	4
Bostrychidae,	2
Cioidae,	6
Trictenotomidae,	2
Tenebrionidae,	118
Melandryidae,	2
Lagriidae,	5
Pedilidae,	12
Anthicidae,	65
Mordellidae,	5
Rhipidophoridae,	6
Cantharidae,	37
Œdemeridae,	2
Curculionidae,	248
Scolytidae,	59
Brenthidae,	18
Anthribidae,	35
Bruchidae,	28
Cerambycidae,	341
Chrysomelidae,	526
Languridae,	18
Erotylidae,	39
Endomychidae,	29
Coccinellidae,	145
Corylophidae,	8
	4780

Of the HYMENOPTERA I find 393 in the British Museum Catalogues, in which, however, some of the largest families such as *Ichneumonidae* are wanting. In the Zoological Record 277 additional species are noticed. Probably about 150 to 200 other forms are known and the number of described species may be estimated at 850.

I am indebted to Mr. F. Moore, who has probably a more extensive knowledge of Indian Lepidoptera, and especially of the moths, than any other naturalist, for an estimate of the number of described species of HETEROCERA. The following is the result:

Sphinges,	225
Bombyces,	1150
Noctues,	1150

Pyrales,	330
Geometres,	600
Crambices,	130
Tortrices and *Tineines*,	160
	3745

The RHOPALOCERA, or butterflies, have been enumerated for me by Mr. W. L. Distant, to whom I am indebted for assistance in several matters connected with this enquiry. He considers the number of species known to be about 875. The whole number of LEPIDOPTERA is consequently 4,620.

I am also indebted to Mr. Distant for having taken the trouble of approximately estimating the known RHYNCHOTA. He finds the number to be about

HEMIPTERA HETEROPTERA,	450
HEMIPTERA HOMOPTERA,	200
	650

Mr. R. McLachlan, to whom I applied for assistance in the order of NEUROPTERA of which he has made a special study, considers that 350 is a fair estimate.

I have been unable to obtain any trustworthy enumeration of the DIPTERA and ORTHOPTERA.

Amongst the other classes of the Arthropoda the only trustworthy information I have been able to procure is from Mr. Cambridge who informs me that although a large number of Indian Spiders have been collected very few have been determined or described. He knows of only 108 species distributed amongst the following families:

Theraphosidae,	3
Tetrablemmidae,	1
Drassidae,	12
Palpimanidae,	1
Agelenidae,	2
Hersiliidae,	2
Scytodidae,	2
Pholcidae,	4
Theridiidae,	10
Phoroncidiidae,	5
Epeiridae,	16
Gasteracanthidae,	11

Uloboridae,	1
Magrammopidae,	2
Polbidae,	1
Stephanopidae,	1
Thomisidae,	12
Lycosidae,	5
Oxyopidae,	5
Salticidae,	12
	108

To these may be added about a dozen scorpions making 120 ARACHNIDA.

The MYRIOPODA may be estimated roughly at 50.

The CRUSTACEA land and freshwater can scarcely exceed 100.

Of Vermes I can only find some 14 described species, 7 Planarians, 5 earthworms, and 2 leeches. I am indebted to Professor Jeffrey Bell for these numbers.

The following is a summary of the enumeration given above.

	Number of species.	
VERTEBRATA.		
Mammals,	405	
Birds,	1681	
Reptiles,	514	
Amphibia,	100	
Fishes,	1357	
	4058	
MOLLUSCA (LAND AND FRESHWATER ONLY).		
Gasteropoda,	900	
Lamellibranchiata,	100	
	1000	
ARTHROPODA.		
INSECTA.		
Coleoptera,	4780	
Hymenoptera,	850	
Lepidoptera,	4620	
Diptera,	500 ?	
Rhynchota,	650	
Neuroptera,	350	
Orthoptera,	350 ?	
		12,100

Myriopoda, ...	50 ?	
Arachnida, ...	120	
Crustacea, ...	100 ?	
	——	270
		12,370

VERMES.

Only about 14 species appear to be recorded.

I repeat that the numbers given for the *Arthropoda* are in some cases little more than guesses. I have not had time to go through some lists, an examination of which would have enabled me to give more accurate estimates. But except in the case of the four numbers to which a note of interrogation is appended the figures given are I believe a fair approximation to the truth, and the result is one that I think should make Anglo-Indian naturalists endeavour to improve our knowledge of the fauna. It is scarcely creditable that in a perfectly accessible country, with facilities for travelling and for living in different parts of the area unrivalled within the tropics, we should remain so ignorant of the zoology. It is ridiculous to suppose that the Indian *Coleoptera* are scarcely more numerous than the *Lepidoptera*, that the *Hymenoptera* (which very probably rival and may excel, each of the other orders) are only between $\frac{1}{3}$ and $\frac{1}{6}$ as numerous, or that the *Neuroptera*, of which, Mr. McLachlan tells me, about 1000 are known from Europe are only represented by 350 species. As to the spiders, it is no exaggeration to say that in most parts of India 108 species might be collected in a few days' search. It is to be hoped that the next five years will witness a very considerable increase in our knowledge of the fauna of India.

XIX.—*Description of a new Species of the Lepidopterous Genus* Euripus *from North-Eastern India.*—*By* J. Wood-Mason, *Deputy Superintendent, Indian Museum, Calcutta.*

Euripus cinnamomeus, n. sp., Pl. IV, Fig. 4.

♀. Anterior wings above purplish black-brown darkest at the base and along the edges and glossed with steel-blue on the disk, with a conspicuous suboval or subtriangular patch of changeable lilac-blue divided by the dark veins, commencing broadly just in front of the ultimate subcostal fork and rapidly narrowing to the inner angle, and with an indistinct submarginal series of small roundish white spots placed upon the inner edge of the narrow black-brown outer border and extending from the inner angle up to the third median veinlet.

Posterior wings above black-brown of a richer tint, broadly and interdigitatingly bordered externally with clear cinnamon-brown, which is traversed by the dark brown veins and bears, midway between the black base and the wavy purplish-black narrow outer border of the organs, a series of four impressed white specks all encircled internally with black-brown, one in each interspace from the first median to the second subcostal veinlet, and, at its junction with the wavy black outer border, a similar but more complete series of white specks, two to each interspace (except the second, in which there are four, the middle one of the three being divided) from the internal vein to the first subcostal veinlet, and all roundish, except the first two, which present the form of linear marks parallel to the outer margin.

Wings below cinnamon-brown all narrowly bordered externally with purplish black-brown, with the veins rich dark brown and the submarginal spots more numerous and distinct than above.

Anterior pair slightly darker for their basal two-thirds, with a short streak of pale lilac between the first and second median veinlets near the base of the cell and an ill-defined roundish clump of scales of the same colour beyond it, an externally forked streak of dark violet-blue occupying the basal two-thirds of the internomedian area and followed by a indistinct clump of violet-grey scales, a grey streak in the apical half of the sutural area, and a submarginal series of violet-white spots situated upon the inner edge of the black outer border, and extending from the sutural area to the apical angle, with all the spots round except the first six (which have the form of linear streaks) and the last (which is elongate), and arranged two in each interspace except the eighth from the apex (in which there are three) and the last, in which there is only one.

Posterior pair uniformly coloured, with a discal series of seven violet-white spots and dots, arranged in two series, an anterior curved one of three, and a posterior straight one of four, the three foremost of which latter, with the last of the anterior series, coincide with the four impressed spots of the upperside; and with a submarginal series of spots of the same colour, situation, and extent as in the anterior wings, but differing somewhat in shape, the last three being linear streaks parallel to the outer margin and the rest more or less elongate and those of each pair divergent externally as if they were the remaining outer ends or horns of lost lunules.

Length of anterior wing 1·6; whence expanse = 3·34 inches.

Hab. Shillong, Khasi Hills, N. E. India. A single specimen of this beautiful and distinct species has been communicated to by Mr. L. De Nicéville. It was captured in November last by the late Mr. J. P. Cock.

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☞ Names of new Genera and Species have an asterisk (*) prefixed.

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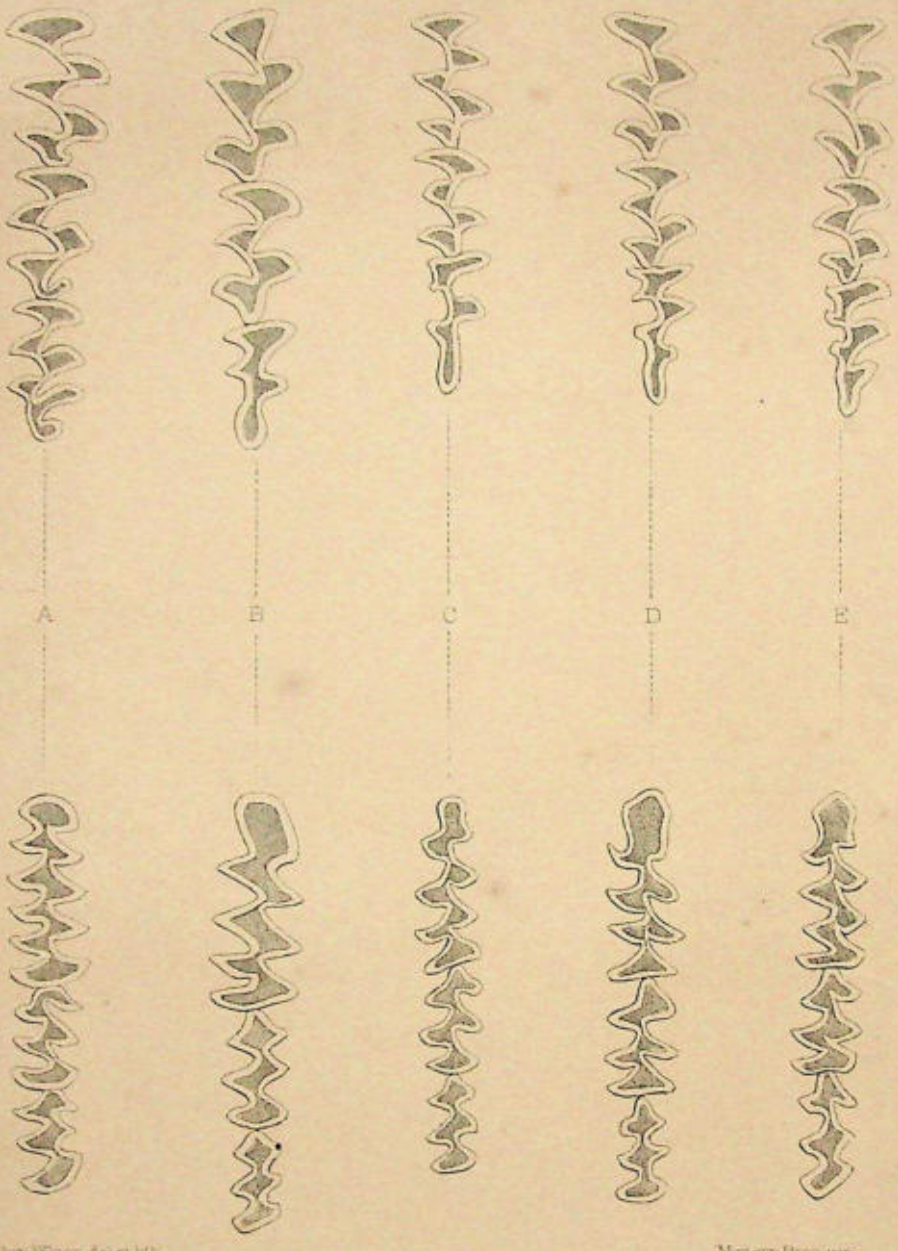

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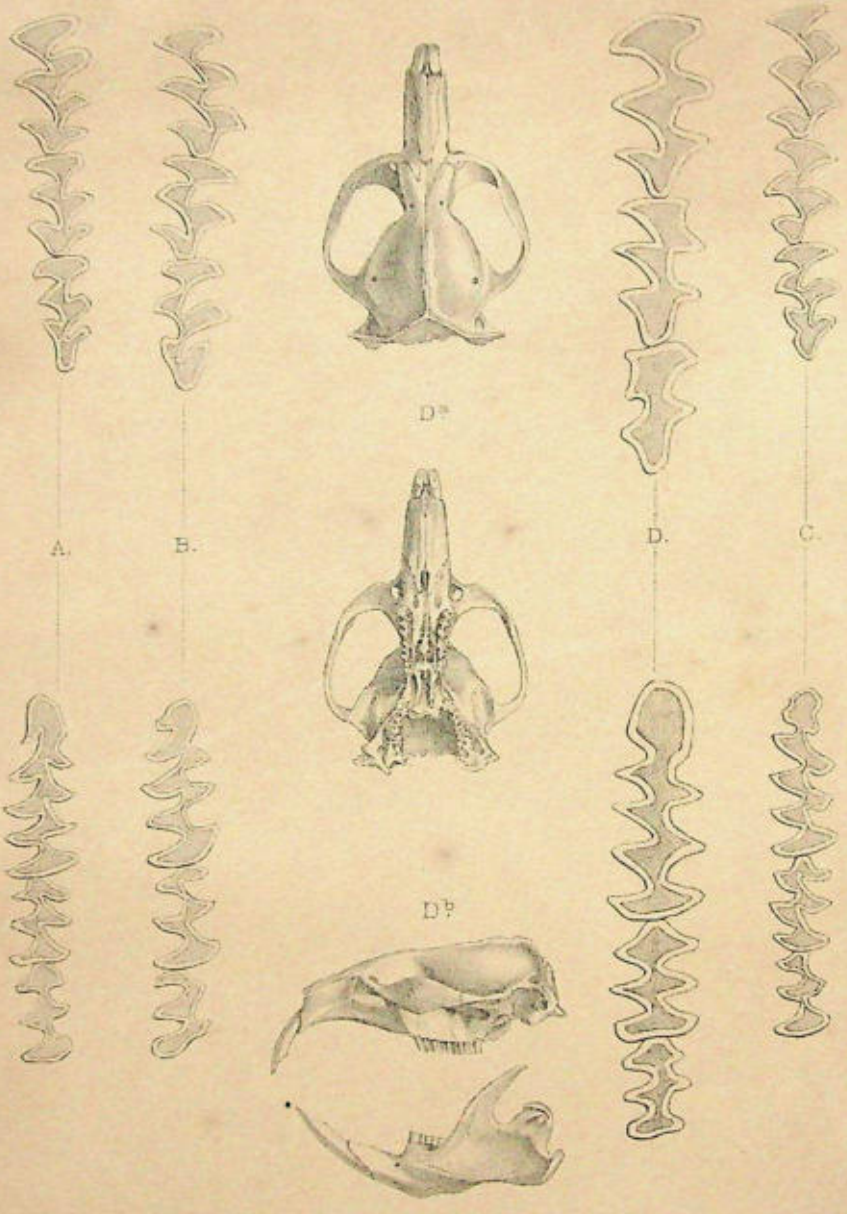
Masters, Bros. imp.

A. Arvicola sikkimensis.
B. A. wynnei.
C. A. strachey.
D. A. royle.
E. A. blanfordi.



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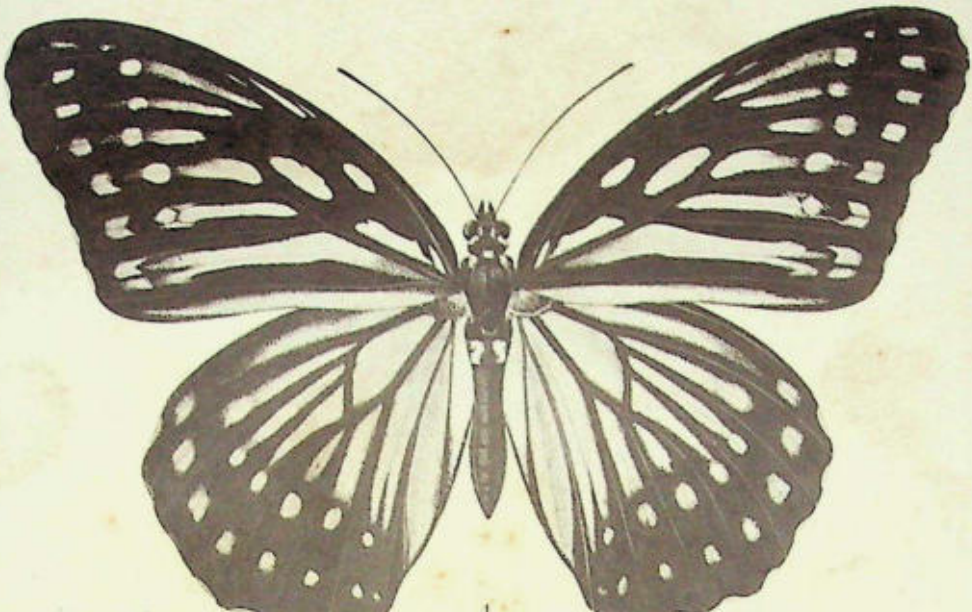
Western Press, Agra

A. Arvicola melanogaster.
B. A. blythi.
C. A. mandarinus.
D. Ellobius fuscicapillus.



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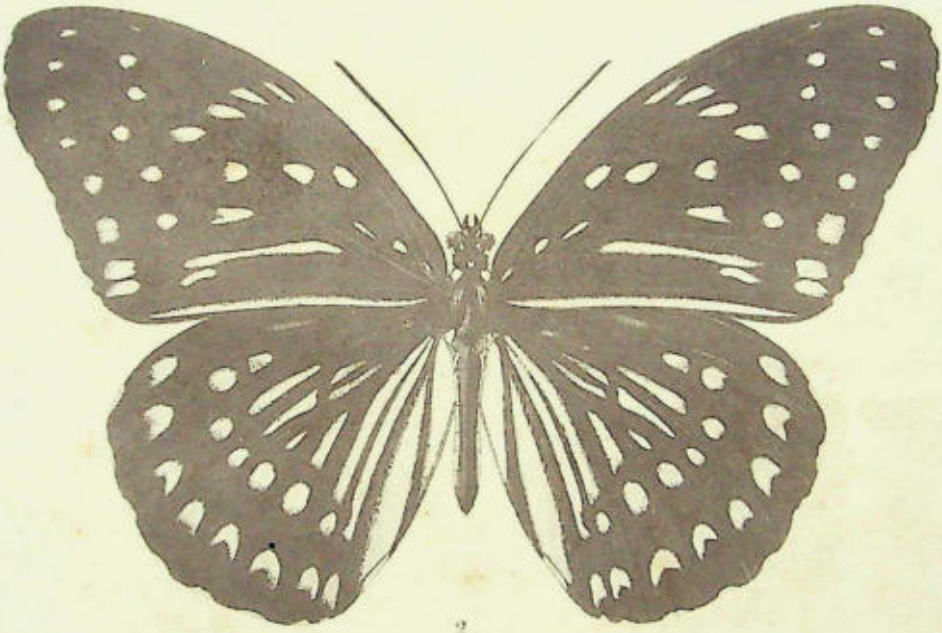


2.

Fig. 1. Penthema lisarda, ♂.

Fig. 2. Penthema darlisa, ♂.

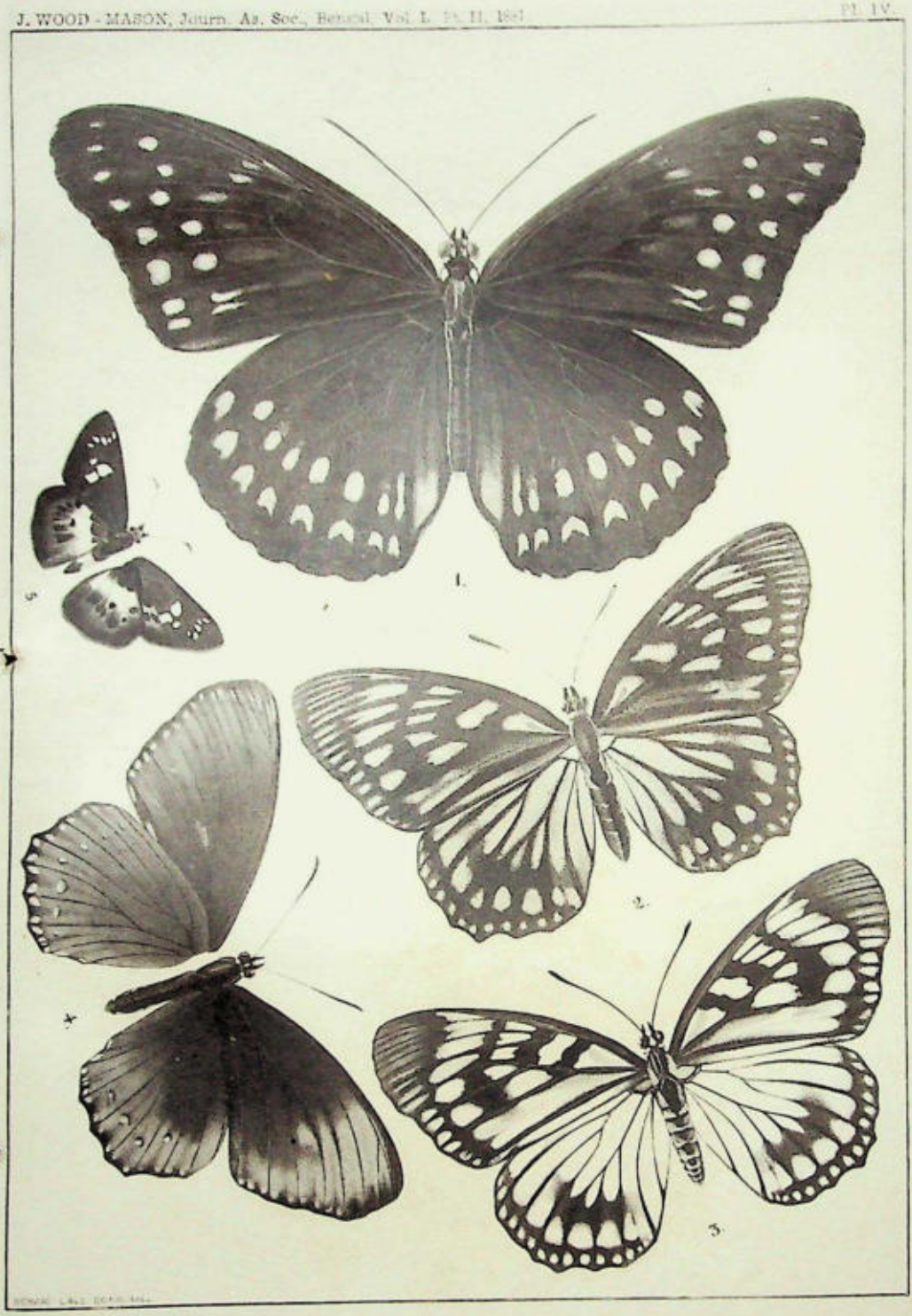


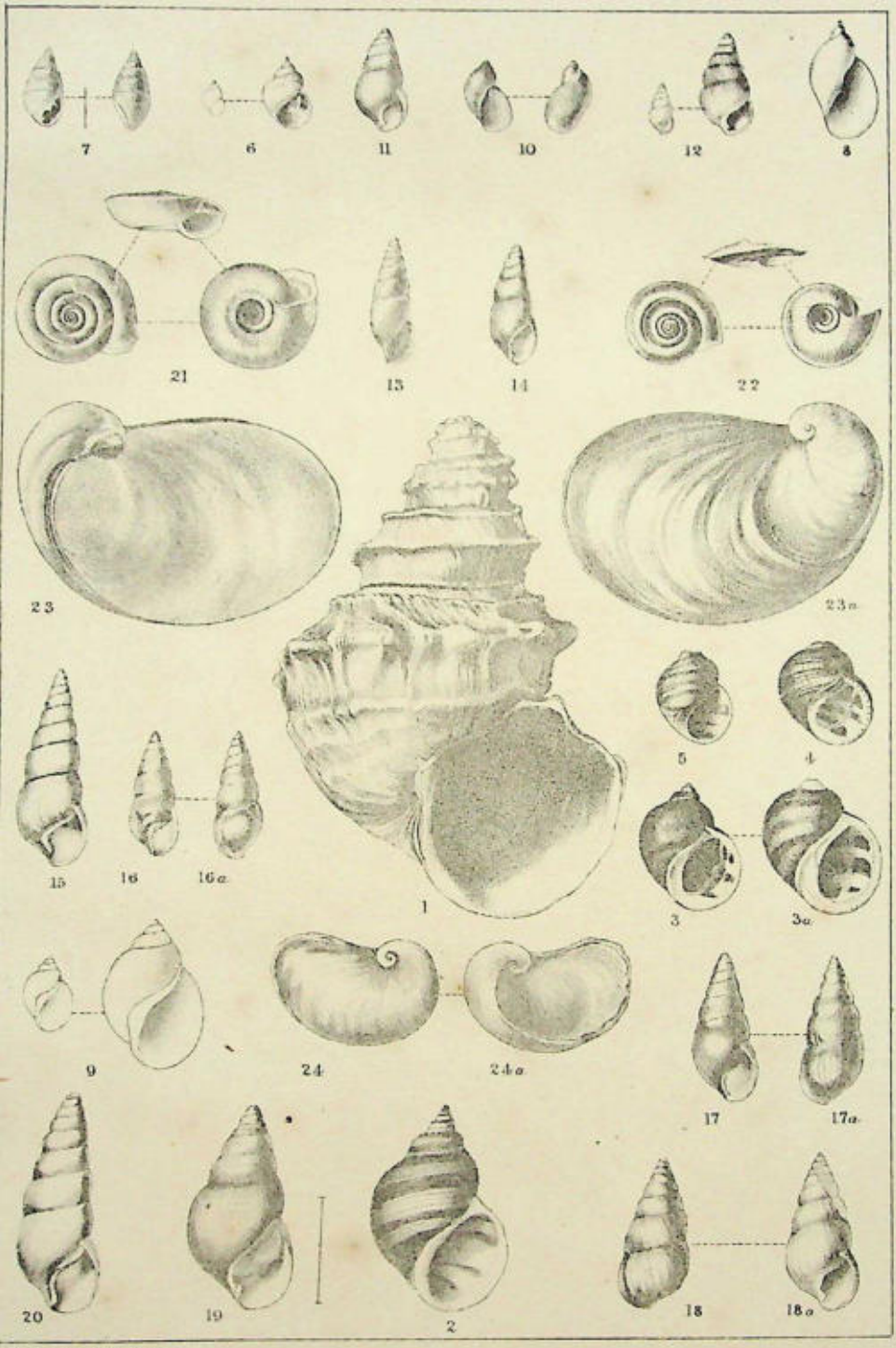
Fig. 1. Penthema binghami, ♂.

Fig. 2. Euripus consimilis, var. meridionalis, ♀.

Fig. 3. Euripus consimilis, ♀.

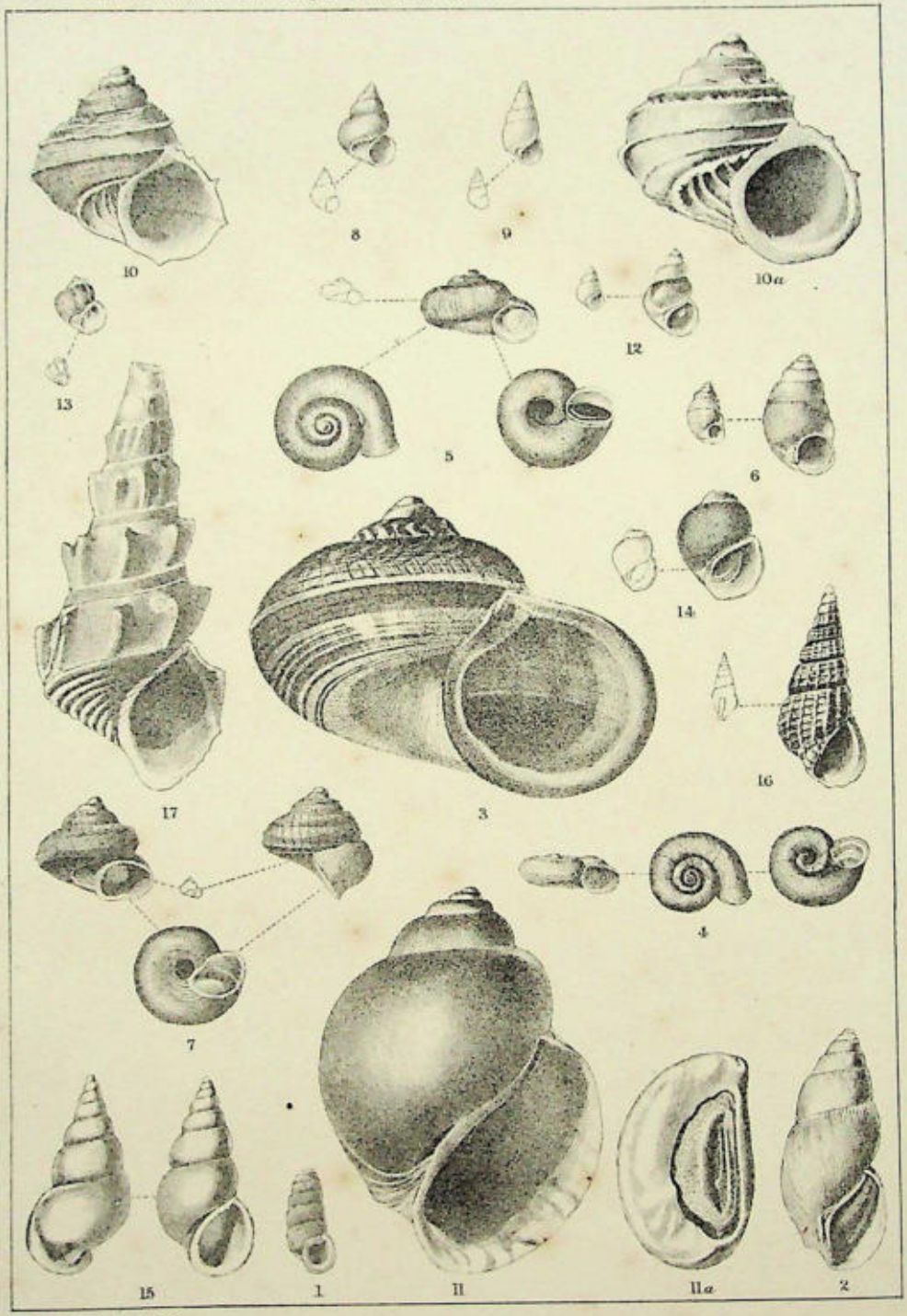
Fig. 4. Euripus cinnamomeus, ♀.

Fig. 5. Tagiades bhagava, var. andamanica, ♂.



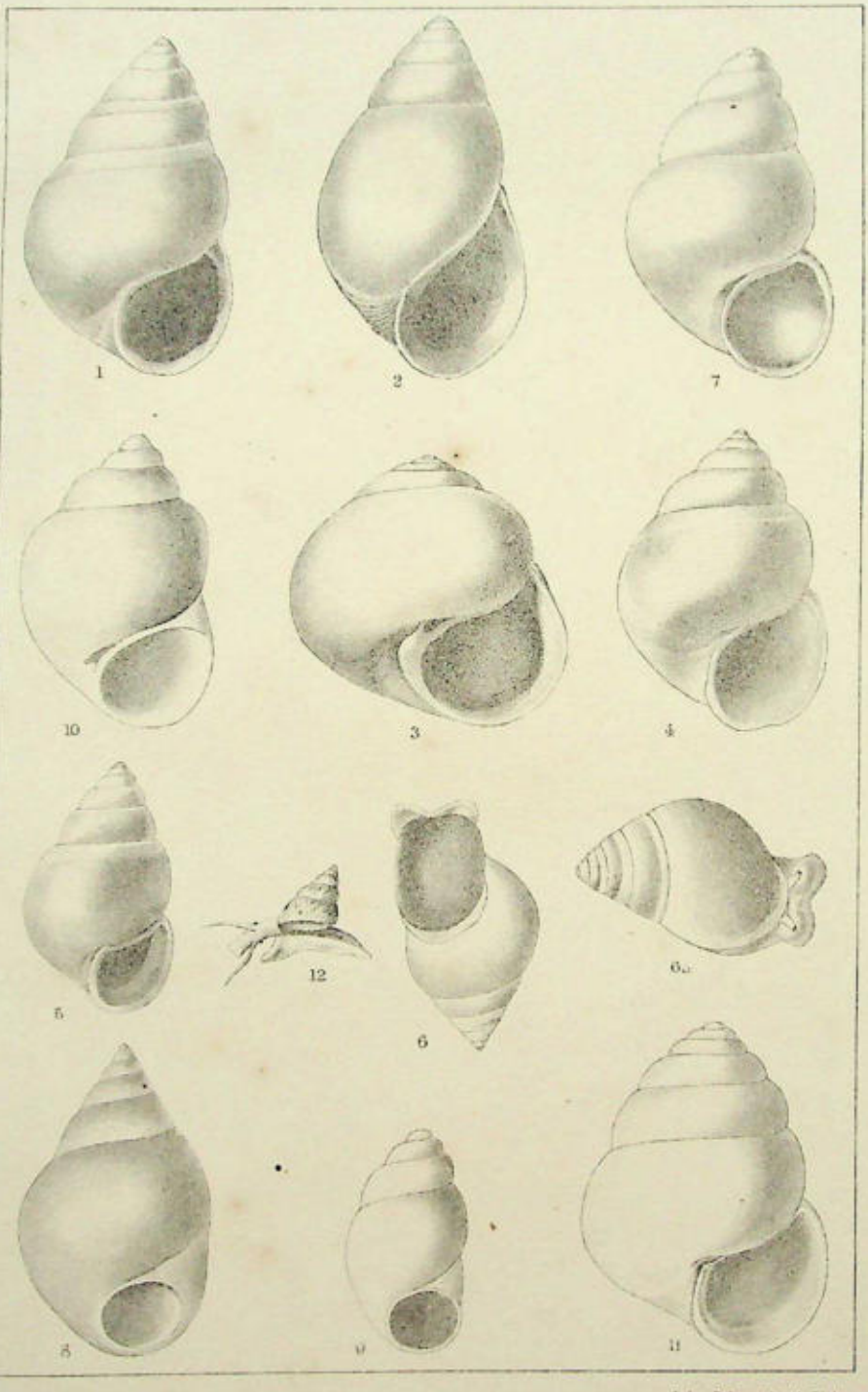
Jules Schaumburg, Lith.

Lithographed at the Surveyor General's Office, Calcutta, July 1881.

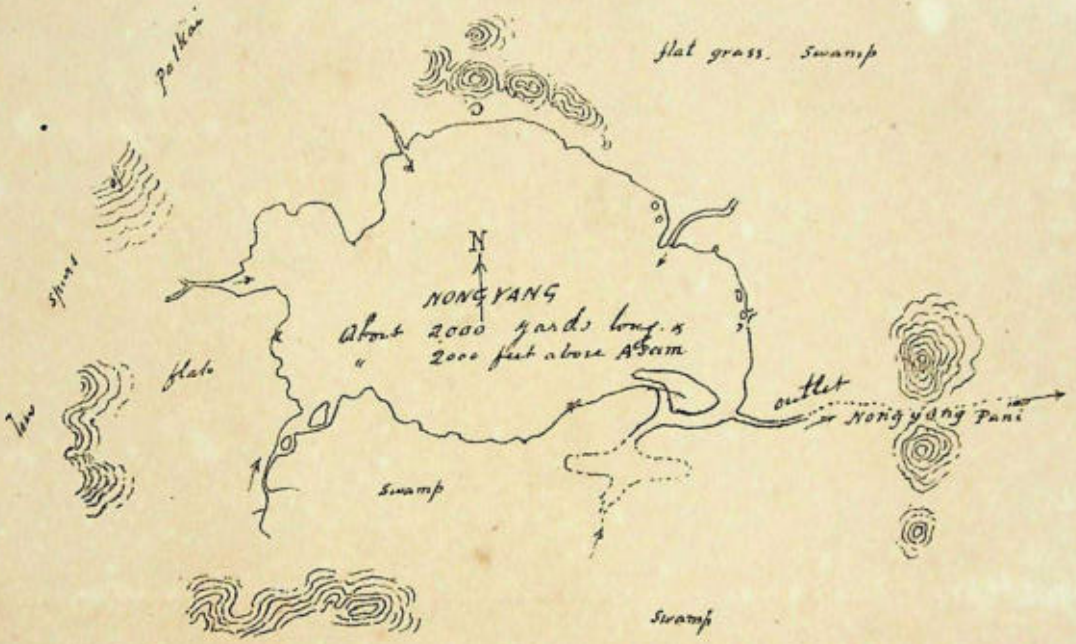


Jules Schaumburg, Lith.

Lithographed at the Surveyor General's Office, Calcutta, July 1881.



J. Wood Mason, del. Jules Schaumburg, Litho



PHOTOZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE, CALCUTTA.

PLAN OF NONGYANG LAKE.