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Erratum.—On p. 110 of this volume, instead of *Tinnunculus alaudariu* read *Tinnunculus alaudarius*.

SPOLIA ZEYLANICA.

TOPOGRAPHICAL NOTES ON THE JAFFNA ISLANDS.

By J. P. Lewis, M.A., C.C.S.

With a Map.

Iranaitivu.

November 30, 1904.—A fine morning. Started for Iranaitivu in the "Serendib" with Messrs. Ingles and Hornell. Got off about 11 and arrived about 3 P.M. Went ashore and put up our tents. The huts erected for the accommodation of the Government Agent and other officials are roofless, the natives having helped themselves to the cadjans.

The appearance of the island is pleasing, plants of low meadow-like grass with clumps of suriya trees here and there, under which are the huts of the islanders, who are all fishers and of Pariah caste, but fine, strong-looking men. They all wear the rain cap made of palmyra ola, which is worn by the people of the neighbourhood of Chavakachcheri in the wet season, and which from its shape, not unlike the "canoe cap" of the British private, gives them a sort of smart appearance. It is decidedly effective, cheap, and useful.

December 1.—Weather still fine. Went to see the bêche-de-mer curing places on the east island. There was a Moorman trader at one and a Chinaman at the other. The latter, being an expert as regards bêche-de-mer is employed by traders at Rs. 10 a month to buy the bêche-de-mer from the fishermen and to look after the curing. This young man is the son of a Chinaman, who was well known in Jaffna, and who at one time was very rich, but afterwards managed to lose all his money through the Chetties, it is stated. His son is penniless. The Moorman had a lot of jaggery in little packets made of palmyra leaf. He told us that he gave four in exchange for one bêche-de-mer, but the fishermen did not admit this. The value of each basket is one cent. The truth seemed to be that he gave four for a very good specimen.

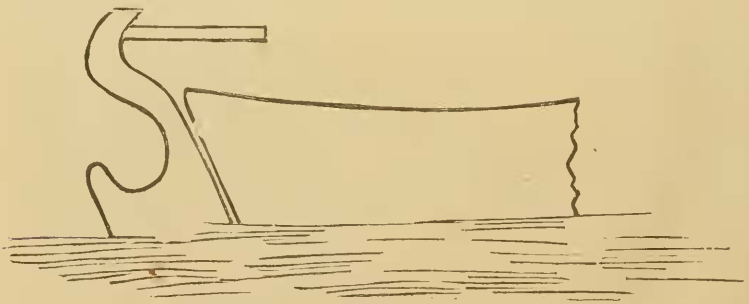
I noticed a coconut shell containing oil hanging up at the hut, and found that it was used by the fishermen for making the water clear when searching for bêche-de-mer. An experiment was tried with it, and it certainly seemed to have some effect, a semi-circle of clearer water gradually began to show itself. The oil is obtained from the liver of the shark.

Every male inhabitant of Iranaitivu, man or boy, wears the cap called "talaivaraipaddai," or "head basket," made of palmyra olas, which, as stated above, the people of Chavakachcheri and other parts of the Jaffna peninsula wear in wet weather, and he makes it also answer the purpose of a pocket. In one examined we found (1) a small looking glass 2 inches by 1, (2) betel-chewing implements, (3) an ola containing arecanuts, &c.

The people are all Pariah caste, and they only live here during the north-east monsoon. In the south-west monsoon they go to the mainland and work as reapers. The men are well made and strong-looking; most of the women I saw were miserable looking.

In the afternoon went round the village. The people live in round low huts, like the Vanni huts, which are secured when they leave the island by locks and keys made of wood.*

The following is an extract from Mr. Wright's report on the botany of Iranaitivu :—"It is interesting to note the occurrence of the lemon citronella oil grass (*Andropogon scheinanthus*), a species cultivated in India, and considered to yield an oil much more valuable than that obtained from the citronella oil grass (*Andropogon nardus*) in the low-country of Ceylon. The apparatus required is very simple and cheap, and the cultivation of this grass should be encouraged. The cultivation of this plant should be carried out in rotation with castor oil plants, fibres, and indigo."



THE RUDDER OF AN IRANAITIVU BALLAM.

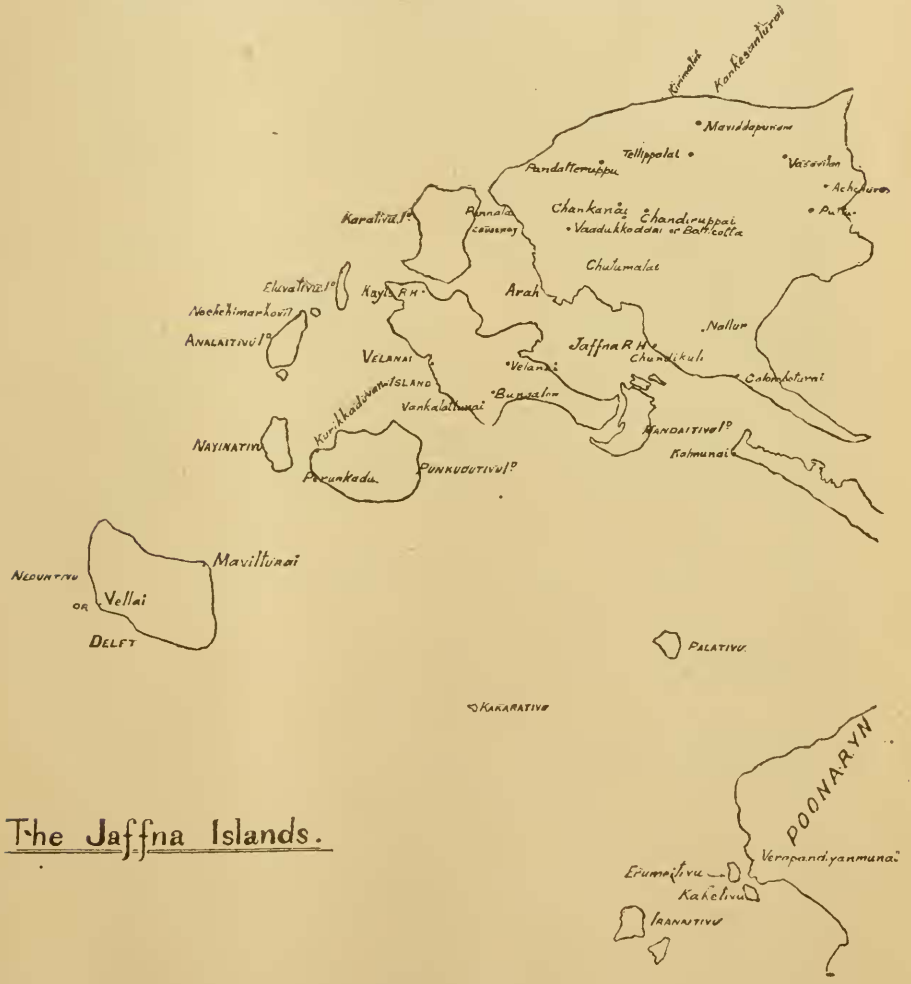
The people use ballams without outriggers, which come from Cochin. They have a quaint-shaped rudder, which I have not seen on the Jaffna ballams.

There are three Roman Catholic churches, two on the east and one on the west island. They are built of coral stone, and two at least are tiled, but the masonry is of a very rough description.

There is a square trigonometrical tower so close to the chief Roman Catholic church that from the sea it looks as if it belonged to it. It is about 40 or 50 feet high, but there is no ladder or stair-

* I have sent one of these wooden locks of Iranaitivu to the Colombo Museum.

case to the top, and if it had to be used again for observations a staging would have to be erected round it. It is substantially built of cut coral stone, and as it is so well built it is a pity that it is not more picturesque. It is, I think, a pity that the Survey Department do not make their permanent towers a little less ugly. This one is exactly like a chimney, but with a little more expenditure it could have been made quite handsome. It is now a permanent feature of the Iranaitivu landscape.



The Jaffna Islands.

I omitted to mention an unfinished grotto of coral, a miniature Lourdes, just above the seashore, some 200 yards from the Roman Catholic church.

Kachchaitivu.

December 2.—Left for Kachchaitivu about 11 o'clock and arrived there about 2.30 P.M. This is an island between Delft and Rameswaram, about 11 miles south-west of Delft, and is uninhabited.

The wind had been rising since the morning, but we were able to find deep water close in on the south side, in which respect the chart was found to be inaccurate, making the depth much less than it was found to be.

We went ashore and had our tents put up, and Mr. Ingles immediately began the survey of the island, getting half-way round it before sunset. The island is covered with vegetation, chiefly kandal (*Rhizophora mucronata*), used for dyeing nets and sails, and stunted suriya trees, also a good many creepers and flowers, including *Gloriosa superba*, which in Jaffna is known as "November flower," as it flowers in that month. Our tent was pitched under a tree which looked like *Callotropis gigantea* grown into a tree, the leaves being very much the same. Some of the servants asserted that it was "erukkalai" (*Callotropis*), but as I had never seen a specimen of this plant larger than a bush, and the flower looked rather different, I have brought away a branch to send to the Director of the Royal Botanic Gardens for identification,* also some specimens of a plant with a flower like clover.

The "vinalai" root, the size of a tiny yam, is found abundantly in Kachchaitivu. Boiled, it is used for food, and flour is prepared from it. Twelve tons of it were imported into Delft from Kachchaitivu in March and April, 1904. It is said to be also known as "karanai."

The eastern corner of the island, opposite which we anchored, terminates in a miniature headland of coral stone, and on this Mr. Ingles found the remains of a trigonometrical station, evidently erected when the Indian Government surveyed the coast line of the Island for the Marine Survey. The island itself has never been surveyed. There is no good water on it, which accounts for the fact that it is uninhabited. Mr. Ingles found a wrecked ballam on the opposite side of the island, and we saw remains of fires indicating that it had been recently visited by fishermen. It is about a mile long by half a mile wide. There is a grass plain on the west side. We were told that there were no snakes on this island nor on Iranaitivu, but both statements were disproved by finding the skin of a snake at one of the Roman Catholic churches on Iranaitivu and here also.

December 3.—There were several squalls during the night, and the wind seemed to be gradually rising, so that it seemed expedient that we should get away as soon as possible, especially as we only had a limited supply of water (we had to wash in salt water this morning), but we had to wait till Mr. Ingles had finished his survey, which took another 3½ hours. We got away about 11.30 A.M. with a very high head wind blowing and a very heavy sea, so much so that the captain of the "Serendib" was rather anxious for the safety of the vessel, which was built for use as a harbour boat only,

* It was identified as *Tournefortia argentea* "a characteristic shore tree of the Eastern Equatorial Zone, but not hitherto recorded north of Trincomalee." The leaves certainly have a silvery shimmer, hence the name I suppose.

is long, narrow, and top heavy, and quite unsuited to the sort of sea we experienced to-day. I decided that we had better make for Delft and get under the lee of the southern coast of the island, which we accordingly did, arriving there about 2.15 P.M. If we had had a beam sea to deal with, I do not know what the consequences might not have been. Yet when we left Jaffna it was quite calm ; but at this time of the year these sudden changes are to be expected.

We had our tent put up at Vellai, close to the horse enclosure, and found the cadjan shed there most useful, as for the rest of the day there were incessant squalls of heavy rain, which went on all night also. In fact it seemed to me a regular cyclone such as we had in Jaffna in 1884. We congratulated ourselves, however, that we had got away from Kachchaitivu just in time, otherwise we should have been marooned on that desert island for two or three days probably.

Delft.

December 4.—The captain of the " Serendib " sent a note ashore about 8 A.M. requesting us to come on board at once, leaving all our impedimenta behind, as the wind had shifted from north-east to east during the night, and he was unwilling to risk another night on the coast, as he had carried away one of his anchors (it turned out that it was only the cross-piece), and was afraid it might go round to the south and perhaps blow him ashore. We had to decide the question on the spur of the moment, and decided that it was not good enough going to Jaffna in a cyclone of wind and rain without even a change of clothes.

The " Serendib " accordingly started, and we at the same time started to cross the island to the Government bungalow (3½ miles). The last glimpse we had of the steamer she seemed to be at a stand-still and making no progress whatever in her eastward course.

I had told the captain to return for us as soon as the weather moderated, and by evening it had improved a little, though still squally. However, we had now a dry roof over our heads, and for once I felt grateful to the Mangalore tiles, which are so unpleasant in the hot weather and so effective in wet.

We were, however, pestered by sand flies called " vellundu," which abound in the bungalow, and are far worse than any mosquitoes, their bites causing more intense irritation, while at the same time they give no other indication of their presence, so that it is impossible to get at them until the mischief is done. We had very little sleep this night, and I had none the night before in the cadjan shed at Vellai from a constant apprehension that the roof would blow off and leave me entirely exposed to the rain.

December 5.—The wind had completely gone down by the evening, but there was no sign of the " Serendib " returning for us. Mr. Ingles made a survey of the Portuguese fort in the morning, and he and Mr. Hornell went to see the wells at Sarappiddi in the afternoon.

Mr. Hornell was of opinion that the wells (there are said to be 92) were neither Portuguese nor Dutch, but prehistoric.

There are no sponges to be found in Delft, but Mr. Hornell found some good specimens at Iranaitivu.

The varaku (*Pasepalum scrobiculatum*), mondi (*Andropogon sorghum*), and sami (*Panicum miliaceum*) fields are thriving.

The Maniagar of Punaryn, who returned from Iranaitivu with us, informs me that the sand flies, which are chronic here, are due to the quantity of dry cowdung lying about the seashore in the neighbourhood of the bungalow. There is an extraordinary quantity of it, and no use of it for manure is made by the Delft cultivator, though everywhere else in the Jaffna District it is carefully collected for the purpose. The Delft man has an idea that Delft cowdung is not good for manure, but this is a mere excuse for laziness. Were it not for the cost of transport it would be shipped to Jaffna, as the *kavoti* plant (*Psoralea corylifolia*, Sin. *bodi*) is now shipped to Analaitivu for the same purpose, and would be shipped to Jaffna were it not for this reason.

The Udaiyar informed me that snake bite at Kachchaitivu has no ill-results, on account of the existence of the herb called pochchintil. This is a super-excellent kind of chintil (a medicinal plant found in Delft; *Tinospora cordifolia*), but no one but a yogi can find it.

Sea snakes are common at Iranaitivu, but, as everywhere else, they are said to be so sluggish that they seldom bite any one, and "it does not matter if they do, as you have only to drink salt water three times and no harm will ensue," so an Iranaitivu fisherman told me; yet Sir Emerson Tennent says they are all deadly.

Some catamarans were out yesterday in a very rough sea, and as one started for Kayts I sent a letter by it. There are about twenty catamarans on the island.

The Delft man has a cap of his own different from those worn by the Iranaitivu men, but made, like them, of palmyra leaves. It is shaped like a mitre, and is tied down under the ears and under the chin. I procured a specimen for the St. Louis Exhibition. It is called the talaivaraipaddai, or head basket.*

Adverting to the Sarappiddi wells, the late Maniagar informs me that they are said to be 92 in number, but Casie Chitty, in his "Gazetteer," says that "the Dutch had about 400 dug through a body of solid rock." His authority apparently is the "Colombo Journal."

December 6.—The "Serendib" was sighted at 9 this morning coming from Jaffna. It took me about two hours to get on board by means of a Delft boat, owing to the strong current. The jetty at Mavilturai, the port of Delft where I embarked, has been knocked to pieces by the sea since I was here last.

It turns out that the "Serendib" did come to a standstill as we supposed, and was unable to make a foot of progress against the

* I have sent one to the Colombo Museum.

wind and sea on Saturday, and accordingly the captain had to give up attempting to make Mandaitivu and had to go to Kayts instead.

We arrived off Mandaitivu at 3.15 P.M. Weather quite calm now.

Kayts.

December 29.—There is a miscellaneous collection of vessels in the harbour, including half a dozen *vadas* from Masulipatam. This is a vessel of peculiar rig with very thick masts, and these boats are said to be very strong. They carry a large lug sail on the foremast, and some of them are three-masted or rather four, for they all have a small mast like a stick right on the stern, in addition to their masts proper.

There were also two *kala* dhonies from Topputturai. These have both masts close together and are rigged with square sails, very clumsy looking boats, but implicitly believed in by some native merchants. They have square sterns and immense rudders, and are always covered in with a cadjan roof.

There were besides barques, brigs, schooners, and Ceylon dhonies, which are different from the types above described, having an immense bowsprit with five foresails bent on it.

There was a small schooner without square sails, from Tondi on the south coast of India.

The kala dhonies from Topputturai bring paddy, rice, and cattle, and the vadas bring rice. The cattle from Topputturai and Ammapatam are the ordinary white "Coast bulls." Cattle, for slaughter and for up-country butchers, come from Paumben.

Pots and pans come from Pondicherry, Kudulur, and Porto Novo; also chatties, but not pots, from Ammapatam. The Pondicherry pots are much more durable than any made in Ceylon. The best Ceylon pots known in the Northern Province at any rate, are from Koddiyar in the Trincomalee District. No Jaffna-made pots are as good. Tiles and timber come from Ponani, fullers-earth from Kilakhari and Ammapatam. The timber imported is "kaltekku," which is used for boat building. Cowdung for manure is actually imported from Mannar. Paddy was imported from Paumben this year for the first time, the Sub-Collector says, from some fields in Rameswaram island; also from Kottapatam, a port on a river near Masulipatam. A considerable quantity comes also from Akyab.

Kayts is the third port in point of importance in the Island, and, unlike other ports of the Jaffna peninsula, is, owing to its sheltered position, open in both monsoons. During the south-west monsoon vessels come to it from ports on the east coast of India, south of Coconada, such as Devipatam, Tondi, Ammapatam, Kollapatanam, Adriampatam, Muttupet, Point Calimere, Topputturai, Pondicherry, Porto Novo, Masulipatam, Kottapatam, and from Coconada.

During the north-east monsoon its trade is with the South Indian ports and ports on the western coast, such as Quilon, Kolochul,* Alippay, Ponani, Cochin, Calicut, Mangalore, Kilakari.

The trade with India is almost equally divided between the two monsoons. Vessels from Paumben can come in both. Coastwise trade is more active during the south-west monsoon. Vessels come from Mannar, Point Pedro, Valavedditurai, Mullaittivu, Pesalai during the south-west, and from Galle, Beruwala, Negombo, Kalpentyn during the north-east monsoon.

The name Kayts is neither Dutch nor Tamil. The Tamil name of Kayts is Urkavatturai, "port where the village guard is kept." Baldæus corrupts this into "Ourature," and Casie Chitty takes the first part of this word as being the Sinhalese for hog, and says it is the Sinhalese for "hog ferry." So it might be were it not plainly a corruption of the Tamil name by which the place is still known.

Baldæus uses the form "Cays," as the name was originally written, which is the Portuguese for a quay.† It is to be noted that there is really no name for the whole island on which Kayts is situated, except the Dutch name Leyden, now disused. The Survey Department have called it Velanai, but this is the name of the principal village in the island only.

The Dutch called this island Leyden, and the island of Karaitivu Amsterdam. Punkudutivu was Middelburg, and the northern of the two islands of Iranaitivu Enckhuysen and the southern Hoorn.‡ The two together were called "The Two Brothers," a free translation of the Tamil name which literally means "the Double Island," like Iranaimadu, "the Double Tank" on the North road. The name, "The Two Brothers," was used even in British times. Delft is the only one of the Dutch names of these islands that is in actual use nowadays.

The headland opposite the eastern extremity of Karaitivu is known by the realistic and practical, if somewhat undistinguished, name of Vrattimunai, which means "Dry Cowdung Point."

Karaitivu is joined to the mainland now by the Punnalai causeway, which was constructed in the time of Sir William Twynam, is 2 miles long in a perfectly straight line, and has ten bridges. It has been of immense benefit to the people of Karaitivu, who are now very prosperous.

Punkudutivu.

December 7, 1905.—Started from Kayts about 2 P.M. by boat for Punkudutivu; arrived there about 4.30 P.M., and at the dispensary, where I am to stop, at 5. Farther down the road, just beyond the

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* A port near Quilon, noted for its nettali fish, which are largely imported into the Jaffna peninsula.

† See "Ceylon Literary Register," Vol. V., p. 204.

‡ The same names were given to two of the bastions of the Colombo Fort.

Roman Catholic church on the opposite side, is the site of the old Dutch or Portuguese church, now a heap of ruins. There is besides a small quadrangular building almost entirely surrounded by a banyan tree, which may have been the base of a tower.

There is a tank near the dispensary with a bo and a kumbuk tree (*Terminalia glabra*) of a good size, which is said to be the only kumbuk tree in the island. The shores of the island at the landing place, which is called Puliyadi ("place of the tamarind tree"), are green with ellu* and mondi-sami.

The dispensary is situated at a place called Perumkadu, "the great jungle." There is no jungle there now, but paddy fields and gardens. Next door to it is the American Mission church with masonry walls, a belfry of the American Mission pattern which consists of three spikes on top of a piece of rectangular wall, and a roof of palmyra leaves.

The population of Punkudutivu at the last three censuses was 1881, 3,499; 1891, 4,098; 1901, 5,201, so that it has increased by nearly 50 per cent. in twenty years.

Analaitivu.

December 8.—Embarked for Analaitivu at 9.30 A.M. We skirted Punkudutivu as far as Marutadi ("place of the kumbuk tree") point, and then sailed across to Analaitivu, which was reached at 1.30 P.M. Here I stayed in the Hindu school, about three-quarters of a mile from the landing place in this island, which is called Nadavutirutti. The distance by sea from Punkudutivu to the landing place on the south-east side must be about 4 miles.

Analaitivu is a very fertile island, where a good deal of tobacco is cultivated. The fences, as in Punkudutivu, are all of the thorny kilavai (*Balsomodendrum berryi*), and therefore have a very neat appearance, as in fact the whole place has. The village has quite the aspect of the more prosperous villages in the peninsula, *e.g.*, in Valikamam West or Vadamaradchi West, and the soil seems to be similar to the soil in the former division; a good deal of rubble stone has to be dug out of the fields.

Its length is about $2\frac{1}{2}$ miles and breadth $1\frac{1}{4}$ mile. It is intersected by two roads, one running lengthwise and the other across the island. I passed a tank in the north-west corner of the island called Vadalikulam, which the people say is fed by springs; also an abandoned stone-built keni near the cross roads, which is said to contain brackish water.

Between Punkudutivu and Nayinativu there is a small island close to the former called Kurikadduvan, which means "place where the signals are shown" (the word is personified). This is because "people who wanted to go to Nayinativu used to show signals here to the people of this island that they wanted a boat."

* *Sesamum indicum*

A peculiarity of these islands is said to be that there are no squirrels and no jackals, though I believe jackals cross the shallow strait between Velanai and Punkudutivu. Analaitivu has the advantage, too, of having very few pariah dogs; it was quite quiet at night.

In Analaitivu there are only 9 licensed carts and 5 farm carts. The population returns since 1871 are 1871, 1,064; 1881, 1,296; 1891, 1,411; 1901, 1,543; an increase of 45 per cent. in thirty years. The increase in the Jaffna District during the same period is only 21·8 per cent.

I was altogether much pleased with this island, though I hear that some of these people are in debt to the Karaitivu money-lenders, the Jews of Jaffna.

It is described in the directions attached to the naval charts as "$2\frac{1}{2}$ miles long by 1 broad."

December 9.—Walked about three-quarters of a mile to a place called Koddaiyadi ("place of the fort"), which is the starting point for boats going to Kayts, &c., and left for the next island, Elavutivu, due north of Analaitivu. At Koddaiyadi there is a mound of earth and stones, the remains, according to the people, of a Portuguese ("Paranki") fort, which has given its name to the place.

Between the two islands there is a small one called Paruttitivu, "Cotton Island," which, owing to want of water, is uninhabited.

Elavutivu.

Landed at the extreme northern end of Elavutivu, on the side facing Kayts, where there is a good tiled bungalow for the use of the preventive officer, who is stationed here during the south-west monsoon. He is now at Mandaitivu.

This side of the island is all sand, the western side is all coral. Elavutivu is an island of palmyras, which cover it from one end to the other (consequently it is as untidy as Analaitivu is the opposite).

The people live on the palmyra; they make baskets, very strong, as they have a covering of the fibre (nar), and very cheap, the cost of one being 6 cents.

They have never been required to pay road tax as they have no road. They are not now poor, the palmyra fibre industry, now extinct, having put a good deal of money into their—I cannot say pockets—waist-cloths. A road from north to south through the island would much improve it. At present it is all higgledy-piggledy. To get from one end to the other you have to skirt compounds, first on one side and then on the other, pick your way through coral stones and prickly pear, and plough through sand and meander through the palmyras.

Elavutivu is described in the naval charts as "2 miles long, 3 cables' length broad, trees 70 feet high."

I was surprised to see some umbrella trees (*Acacia planifrons*, Tam. udai) growing here. This is the great tree of Mannar island, but there are none anywhere in the Jaffna or Mullaittivu Districts except those in this island, which is curious. They grow on the mainland opposite Mannar island, in places along the Madawachchi road as far as the 25th mile from Mannar, and then cease. What are the conditions in this island which induce the tree to select it, and nowhere else in the Jaffna District, to grow in ?

The only other trees, besides the palmyra, coconut, and the udai tree, are margosa (*Azadirachta indica*), tulip tree (*Thespesia populnea*), and tillai (*Sapium insigne*). There is a jak tree in the Police Vidane's compound, also some mangoes planted by him.

The Maniagar also tells me that male palmyra trees sometimes turn female, which seems a curious thing if true. The Kachcheri Mudaliyar confirms this statement from his own experience.

The population of the island has increased since 1881 from 227 to 324 (1901), or by nearly 43 per cent.

December 10.—Returned to Kayts in the morning. We got over quickly, the wind not being unfavourable. It must have been from the N. or N.W. and not from the N.E. The boatmen say that in the afternoon it would be from the N.E. Fort Hammenhiel, rising out of the sea on the left, is picturesque (for description of this fort see " Ceylon Literary Register," Vol. I., p. 24).

Karaitivu.

December 11.—With regard to the Karaitivu people, the money-lenders of the district, the explanation of their flourishing condition is that they are the most economical of the Jaffna people—the most Jaffnese of the Jaffnese in fact—and it is stated as an instance of the former characteristic that even women of well-to-do families work in the fields, which is not the case elsewhere in Jaffna, though the women of the poorer classes of course do. The Karaitivu people go everywhere, the Straits, &c., and save every penny. Hence it is not surprising that Karaitivu is one of the most prosperous " parishes " in Jaffna.

Nayinativu.

Nayinativu is just opposite Punkudutivu on the west. It is chiefly noted for its festival, which takes place annually in July, lasts ten days, and is attended by from 7,000 to 23,000 people ; and for its chank fisheries carried out by some of its diving population and by Moormen from the Coast. It is 2½ miles long by half a mile wide, and is intersected by a road running lengthwise through it, the temple being at the north end and the Government bungalow

at the other, with three cross roads. I visited it from Delft in July, 1902.

July 14, 1902.—In the evening I went to see the procession round the temple, which started about 9 o'clock. The much-bedizened image of the snake goddess, sitting on the back of a flaming red wooden stallion, holding in her hand a whip and flanked on the right by a small Ganesa under a canopy consisting of a five-headed cobra, and on the left by Kartigesar sitting on a bull, was dragged round the temple to the accompaniment of tom-toms, flageolets or instruments like them, and a chank. Torches consisting of 3, 5, 7, or more lights headed the procession. There were not many people as it is too early yet, and the wind is too high for a large attendance to be expected. On the 19th and 20th there will be enormous crowds if the wind goes down. On the 20th (full-moon day) the images are taken round in perfect silence.

Excepting the temples dedicated to her at Kopai North and Navali, this was until lately the only temple to the goddess Naka Tambiran in the Jaffna District; but one has recently been started at Chandilippay in the peninsula.

The goddess is known as Naka Tambiran or Nakeswara, properly Pushani (a jewel), and is a manifestation of Siva's wife. One of Siva's ornaments and of his wife's ornaments is the cobra, but the cobra is not the vehicle of either, but of Vishnu. It is not the snake, but the goddess that is worshipped.

The explanation of the origin of the cult given me was very hazy. In the time of Vedi Arasan, the fisher king, who is said to have been of Mukkuvar caste, a Brahmin found a stone in the sea off this island, with a representation on it of a serpent coiling, and he established this worship here. The Maniagar says he has seen this stone. It is on the north side of the island, and is exposed at low water.

The Nayinar, who give their name to the island, are a caste of people living at Rameswaram, who were shipwrecked on it. They are temple tenants.

The sacred cobra (nalla pambu) of the Tamils of Jaffna is light coloured, almost white, and is not more than 18 inches long. It only appears on Fridays. It is only this cobra that is sacred, the large cobras which are of pariah caste are not, and no Jaffna man has any scruple about destroying them, but he will give milk to the sacred cobra.

One of the sanitary measures gravely carried out by Government every year at the time of this festival is "not to allow the people to shave their children's heads for devotional purposes within half a mile of the temple." It is curious that this should be a necessity at this festival only, I do not recollect it among the orders issued with respect to other festivals in the Northern Province.

THE BIRDS OF DIMBULA.

By James Ryan (Talawakele).

THERE is a common delusion that birds are scarce on a tea estate, and I have heard Dimbula mentioned as exceptionally poor in bird life. A little careful work with a pair of good binoculars will very quickly show that birds of many kinds are not only common, but are there in large numbers.

As a matter of fact up-country birds are usually crepuscular to a large extent, feeding before dawn and in the gray of the evening, and they are usually silent and furtive in their habits during the daytime, and especially at midday. This may be explained by a number of reasons more or less adequate. I am inclined to think, however, that the principal one is that insect life is more abundant at morning and evening than in broad daylight.

It must be remembered also that the primeval jungle of Dimbula was very dense, and anything like free flight must have been difficult, so birds took largely to creeping and hopping from twig to twig; whilst in tea and coffee it is obvious that the principal food supply lies in the heart, not on the upper surface of the bush. What share the necessity for avoiding snakes, lizards, vermin (rats swarm in the tea field), and hawks may have in determining the furtive habit of estate birds is difficult to appraise.

There can be no doubt, however, that the numerous hawks and eagles levy toll on bird and reptile, and that snakes, and probably some lizards, eat eggs and young birds. It may be remarked that most of the birds appear to be insectivorous, as I have found that mulberries and crumbs put out for the birds are very seldom touched. An exception of course is that "avian rat," the sparrow. Sparrows should be discouraged in every possible way; they do no good, and drive away many more useful and interesting birds. The best way to "out" them is to destroy their nests, but a handful of paddy and an ordinary sieve will soon catch a fair number.

The following list of birds was compiled with the assistance of Mr. H. F. Fernando, Taxidermist of the Colombo Museum. During his four days' visit to Talawakele in July, 1907, in the teeth of the south-west monsoon (7·34 inches of rain were registered, and the wind was exceptionally boisterous), thirty varieties of birds were observed and thirteen shot. It may be remarked that most of the birds were observed in the immediate neighbourhood of the bungalow, where there are a few old seed-bearing tea trees and some fruit trees.

During the last few years there has been a marked increase in the number of Babblers. The Scimitar Babbler only appeared about eighteen months ago, and is becoming almost a nuisance, as he is a noisy bird with a wonderful voice for his size—little larger than the Magpie Robin. The Common Babbler ("Dung Thrush" or "Seven Sisters") has recently put in an appearance. A good deal of cattle manure has been forked out and horse litter mulched broadcast, which probably suits the habits of this family. There are two or three dams in the immediate neighbourhood, and White-breasted Kingfishers are numerous. I have seen a dozen at a time in one ravine, but this was probably a family not yet separated. I have previously never seen more than four young in a brood.

The White-eye, Munia, and Tailor birds are the principal garden birds. It is interesting to see forty or fifty Munias systematically cleaning a seed bearer of insects and then flying on to tackle the next.

Migratory birds mostly come in September and October on their way in, and in March and April on their return; but the Bee-eaters and the Painted Thrush (with the Wagtail) are always about in the north-east monsoon. The Tomtit and the Bulbul are about all the year round, but for some reason not known seem less numerous during the burst of the south-west monsoon. It is possible that they then nest up in the jungle as being more sheltered.

It may be noted that of 358 species recorded as belonging to Ceylon in the Museum Catalogue, 49 are peculiar to Ceylon, and of these 13 have been seen in Dimbula.

The mean annual rainfall at Dimbula is about 100 inches, with a minimum of 67 inches and a maximum of 183 inches.

List of Dimbula Birds (Elevation 4,000–5,000 Feet).

[S = Shot. V = Seen. * = Ceylon only. M = Migratory.]

1. Black Crow, *Corvus macrorhynchus* (seen once only).
*2. Ceylonese Magpie or Jay, *Cissa ornata*. V.
3. Indian Gray Tit or Gray-backed Titmouse, *Parus atriceps*. S.
4. Common South Indian Babbler, *Crateropus striatus*. S.
*5. Ceylonese Scimitar Babbler, *Pomatorhinus melanurus*. S.
6. White-throated Wren Babbler, *Dumetia albigularis*. V.
*7. Palliser's Ant Thrush or Ceylon Shortwing, *Elaphrornis palliseri*. V.
8. Common Indian White-eye, *Zosterops palpebrosa*. S.
*9. Ceylonese White-eye, *Zosterops ceylonensis*. S.
10. Common Iora ("Bush Bulbul"), *Ægithina tiphia*. V.
11. Black Bulbul, *Hypsipetes ganeesa*. V.
12. Madras Red-vented Bulbul, *Molpastes hæmorrhous*. S
*13. Black-capped Bulbul, *Pycnonotus melanicterus*. V

14. Racket-tailed Drongo, *Dissemurus paradiseus* (rare ; resident in the low-country).
15. Indian Tailor Bird, *Orthotomus sutorius*. V.
16. Ashy Wren Warbler, *Prinia socialis*. S.
17. Little Black-backed Pied Shrike, *Hemipus picatus*. S.
18. Common Wood Shrike, *Tephrodornis pondicerianus*. V.
19. Orange Minivet, *Pericrocotus flammeus*. S (pair).
20. Little Minivet ("Sultan Bird"), *Pericrocotus peregrinus*. V.
21. Indian Black-headed Oriole, *Oriolus melanocephalus*. V.
22. Ceylonese Dusky-blue Flycatcher, *Stoparola sordida*. S.
23. Gray-headed Flycatcher, *Culicicapa ceylonensis*. S.
24. Paradise Flycatcher. *Tersiphone paradisi* (seen every two or three years).
25. Southern Pied Bush Chat (Hill Bush Chat), *Pratincola atrata*. V.
26. Magpie Robin, *Copsychus saularis*. S.
27. Pied Ground Thrush, *Geocichla wardi* (seen once only).
28. Blue Rock Thrush [M], *Petrophila cyanus*. V.
29. White-backed Munia, *Uroloncha striata*. V.
*30. Ceylon Hill Munia, *Uroloncha kelaarti*. V.
31. Spotted Munia, *Uroloncha punctulata*. V.
32. House Sparrow, *Passer domesticus*. V.
33. Common Swallow [M], *Hirundo rustica*. V.
34. Nilgiri Bungalow Swallow, *Hirundo javanica* (seen at Wata goda).
35. Gray Wagtail [M], *Motacilla melanope*. V.
36. Purple Sun Bird. *Arachnechthra asiaticus*. V.
37. Ceylonese Sun Bird, *Arachnechthra zeylonica*. V.
38. Indian Pitta or Painted Thrush [M]. *Pitta brachyura*. S.
*39. Red Woodpecker, *Brachypternus erythronotus*. V.
40. Common Indian Bee-eater [M], *Merops viridis*. V.
41. Blue-tailed Bee-eater [M], *Merops philippinus*. S. (not in July).
42. Little Indian Kingfisher, *Alcedo ispida*. V.
43. White-breasted Kingfisher, *Halcyon smyrnensis*. S.
44. Brown-necked Spine tail, *Chætura indica*. V.
45. Indian Edible-nest Swiftlet, *Collocalia fuciphaga*. V.
46. Common Couca or Crow Pheasant, *Centropus rufipennis*. V.
*47. Layard's Paroquet, *Palæornis calthrope*. V.
48. Brown Wood Owl, *Syrnium indrani*. V.
49. Forest Eagle Owl, *Huhua nepalensis*. V.
50. Scops Owl, *Scops giu*. V.
*51. Ceylon Mountain Hawk Eagle (Legge's Hawk Eagle), *Spizaetus kelaarti*. V.
52. Serpent Eagle, *Spilornis cheela*. V.
53. Marsh Harrier [M], *Circus æruginosus*. V.
54. Crested Goshawk, *Lophospizias trivirgatus*. V.
55. Besra or Jungle Sparrow Hawk, *Accipiter virgatus*. V.
56. Ceylon Crested Falcon, or Legge's Baza, *Baza ceylonensis*. V.
57. Common Kestrel [M], *Tinnunculus alaudarius*. V.
58. Bronze-winged Dove, *Chalcophaps indica*. V.
*59. Ceylon Wood Pigeon, *Alsocomus torringtoniæ*. V.
60. Spotted Dove, *Turtur suratensis*. V.

*61. Ceylon Jungle Fowl, *Gallus lafayettii*. V.
*62. Ceylon Spur Fowl, *Galloperdix bicalcarata*. V.
63. Blue-breasted Quail, *Excalfactoria chinensis*. V.
64. The Bustard Quail, *Turnix pugnax*. S.
65. Common Sandpiper [M], *Totanus hypoleucus*. V.
66. The Woodcock [M], *Scolopax rusticula*. A very rare migrant.
67. Solitary Snipe, (?) Wood Snipe [M], *Gallinago nemoricola*, (seen only once). V.
68. Pintail Snipe [M], *Gallinago stenura*. S.
69. Jack Snipe [M], *Gallinago gallinula*. S.
70. Cattle Egret, *Bubulcus coromandus*. V.
71. Pond Heron, *Ardeola grayi*. V.
72. White-breasted Water-hen (rarely flushed but very common). *Amaurornis phœnicurus*.

It will be noted that waterfowl are rare in Dimbula, because water is rarely stagnant, but I suspect the existence of many rails and waterhens seldom flushed.

I suggest that for educational purposes a case in the Colombo Museum containing Dimbula birds would be of great value. I would also suggest that photographs be made of the rarer birds for general guidance from shot specimens. A careful search in the Medakumbura Valley should show many unrecorded species, and some Patena dwelling birds, Pipits, &c., still require identification.

DESCRIPTION OF A NEW SPECIES OF APANTELES FROM CEYLON.

By P. Cameron.

Apanteles acherontiæ, sp. nov.

BLACK, the coxæ, apex of hind tibiæ somewhat broadly, the apex of the basal joint of the first antennal joint narrowly, of the others more broadly, black, the rest of the legs reddish yellow, except that the trochanters are infuscated. Wings clear hyaline, the costa, radius, and stigma black, the other nervures white. Female and male. Length 2·5 mm. Peradeniya, Ceylon. Bred by Mr. E. Ernest Green from larva of *Acherontia lachesis*.

Smooth, shining, the mesonotum finely, minutely punctured. Basal segment of abdomen as long as it is wide, slightly gradually widened, its sides furrowed, the furrows oblique; it is separated from the second segment by a distinct transverse furrow.

In the centre of the second segment is a raised pyriform area (the narrowed end at the base); from the base of this a curved, distinct furrow runs to the outer edge of the apex. Ovipositor short, very slightly projecting.

The fourth abdominal segment is longer than the second or third, the latter being of equal length. Metanotum not keeled. Scutellum raised, separated from the mesonotum by a shallow smooth furrow; on either side of the latter is a wider, more distinct, weakly crenulated furrow.

The larvæ of this species, like many others of the genus, spin in common a large egg-shaped cocoon of white cotton-like substance of the length of 47 mm. and a breadth of 27 mm., having a peduncle by means of which it is attached to a twig of about the same length but very much thinner, the peduncle being about 2 mm. broad at the top and about 10 at its junction with the common cocoon. The larval cocoons are about 2 mm. in length and, like the outer covering, are white. They are enveloped in the cottony mass, which is much thicker and denser on the outer side than in the inner where the cocoons are. It is not uncommon for the larvæ of *Apanteles* to spin their cocoons in company around the caterpillar upon which they have preyed, but I have never seen a pedunculated common cocoon before. Being conspicuous objects, it is not surprising to find that the larvæ of *Apanteles* are preyed upon by other Ichneumons, particularly *Hemiteles* and *Mesochorus*, as well as by small *Chalcididæ*. As *Apanteles* and its ally *Microgaster* are among the commonest enemies of Lepidopterous larvæ, and are

consequently beneficial to the farmer and gardener, *Hemiteles*, &c., must be looked upon as injurious insects, unlike the majority of Ichneumons.

Apanteles taprobanæ, Cam. (Manchester Mem., 1897, p. 38), was reared by Col. Yerbury from an unknown Lepidopterous larva; *A. pratapæ*, Ashm., by Mr. E. E. Green from the larva of *Pratapa deva*, as well as *A. tivacholæ*,* Ashm., from the larva of *Tiracola plagiata*, Walk. (*cf.* Ashmead, Proc. U. S. Nat. Mus., XVIII., p. 647).

* I have not seen the original description of this species, but if this name is correctly transcribed, it must have been based upon a misreading of the name of the host.—E. E. G.

Cocoons of *Apanteles acherontiæ*.

NOTE ON THE PARASITE APANTELES ACHERONTIÆ OF THE CATERPILLAR OF THE "DEATH'S HEAD" MOTH.

By E. Ernest Green.

With a figure.

THE huge caterpillars of the "Death's Head" moth occur commonly upon the "dadap" tree (*Erythrina lithosperma*), and might become a serious pest if they were not kept in check by the parasite described above by Mr. Cameron. This parasite is of almost miscroscopic dimensions, being only one-tenth of an inch long; but makes up for its minute size by the enormous number of individuals that infest a single caterpillar. It is probable that fully seventy-five per cent. of the caterpillars are infested and ultimately killed by the parasites. They feed inside the body of the unfortunate victim until it is fully grown. The caterpillar then suddenly becomes flaccid, and hundreds of tiny grubs make their way through its skin and spin the remarkable compound cocoon—resembling a mass of white cotton wool—that may frequently be observed attached to the leaves of the dadap tree. The empty carcase of the caterpillar usually falls off, and leaves no clue to the origin of the cocoon. Though externally appearing homogeneous, this mass is composed of separate cocoons surrounded and bound together by loose woolly matter. The resulting insects are minute black wasps.

From the smaller cocoon shown in the figure, 1,226 of these tiny insects emerged, and others (probably several hundred more) failed to extricate themselves from their woolly covering. It can scarcely be supposed that this number represents the progeny of a single parent. It seems probable that the insects attack the caterpillar *en masse*.

Mr. Cameron describes the compound cocoon as being attached to a twig by a peduncle, but this is not usually the case. The larger cocoon represented in the figure is closely attached to the leaf for its whole length, and this is the more common formation. The mode of attachment naturally depends upon the position occupied by the caterpillar at the time of its death.

DESCRIPTION OF A NEW PLUME-MOTH FROM CEYLON, WITH SOME REMARKS UPON ITS LIFE-HISTORY.

By T. Bainbrigge Fletcher, R.N., F.E.S.

With Figures in the text.

Trichoptilus paludicola, n.s.

Male 12—13 mm. Head and thorax brownish-ochreous with a few white scales intermixed. Palpi grayish; terminal joint white, fuscous at base; second joint reaching middle of face, about two-thirds of third. Antennæ ciliated (1), whitish, narrowly annulated with dark fuscous, with a black line above. Abdomen ochreous-brown, longitudinally striated with numerous black and white scales, the latter more developed towards base of abdomen and tending to form obscure transverse bands at distal extremities of segments; apex of abdomen with two obliquely ascending divergent hair-pencils and with long hairs concealing genitalia. Tibiæ white, longitudinally streaked with black; posterior tibiæ dilated with dark fuscous scales and slightly tufted at points of emission of spurs; spurs long (proximal about 1·4 mm., distal about ·8 mm.); tarsi banded with black.

Forewings cleft from before middle, segments linear; brownish-ochreous with scattered dark fuscous scales; usually a few white scales mixed with black along basal half of costa; a black spot followed by a white one on inner margin near base; sometimes a suffused white central streak reaching from base nearly to cleft; a patch of dark fuscous scales on lower inner edge of cleft: first segment slightly suffused with darker fuscous, with a white bar before its middle and another midway between the first bar and apex, extreme apex usually with some white scales; second segment with corresponding but less distinct white markings: cilia dark gray on costa barred with white opposite white fasciæ and usually white at apex, on lower margin of first segment mixed with white below fasciæ and with some black scales in middle, on upper margin of second segment with a row of black scales between two patches of white scales opposite fasciæ and a few black scales nearer apex, on lower margin of second segment with a white patch of scales before cleft, another (obsolescent) below proximal fascia, and a third before apex, with four tufts of black scales, first at one-third of segment, last apical.

Hindwings cleft firstly from before one-third, secondly from base; segments linear; dark fuscous; cilia gray; third segment without any scale-tooth on inner margin.

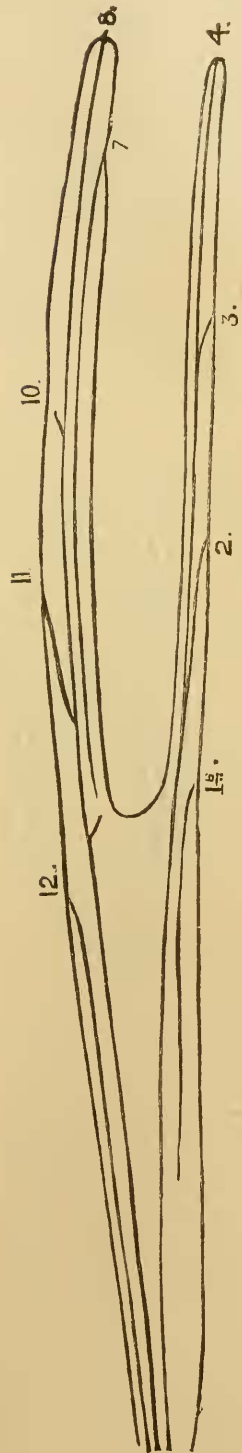

Fig. 1.—Neuration of forewing of T. paludicola. Much magnified.

♀. 11—12 mm. Without hair-pencil at apex of abdomen. Antennæ ciliated ($\frac{3}{4}$).

Otherwise as in male, but usually about 1 mm. less in expanse. Markings similar, but duller.

Neuration.—Forewings. 2 out of 4, 3 very short, not reaching dorsal margin, 4 to apex of second segment, 5 and 6 absent, 7 parallel to 8 running into hind margin of first segment before apex, 8 to apex, 9 absent, 10 very short (sometimes rudimentary or absent), 11 out of 8, 12 reaching costa before cleft. (See Fig. 1.)

Hindwings. 2 out of 4, 3 rudimentary or absent, 4 to apex of second segment, 5 and 6 apparently absent, 7 to apex of first segment, 8 into costa at about one-third.

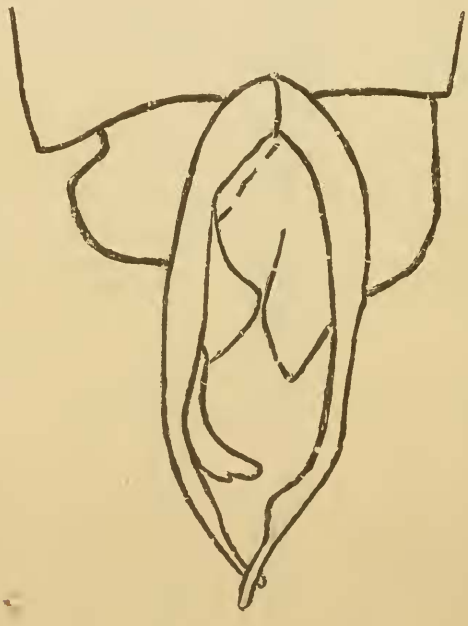

Fig. 2.—Male genitalia of T. paludicola. Magnified.

Comparison of T. Paludicola with its Allies.—This species is extremely similar superficially to *T. scythrodes*, Meyr., from Australia, but Mr. Meyrick informs me (in litt.) that "there is a good and reliable distinguishing character in the different arrangement of the dark scale-teeth in the dorsal cilia of forewings; in *scythrodes* there is a scale-tooth at each end of the dark median band of the second segment, whereas in *paludicola* there is one in the middle of the band, but not at either end."

The Life-History of Trichoptilus paludicola.

Preliminary Remarks.—In the early part of October, 1906, whilst encamped in the Royal Naval Camp at Diyatalawa, I found

a species of " Plume Moth," which was quite new to me. Numerous specimens were taken at sunset on the edge of a boggy piece of swamp, and from its habitat and from the appearance of the moth I suspected at the time that it might prove to be a *Drosera* feeder, in the same way as had been recently proved to occur in the case of *Trichoptilus paludum* in Europe. (*Note.*—" Observations on the Life-History of *Trichoptilus paludum*," by Dr. T. A. Chapman ; Trans. Entom. Soc. Lond., 1906, p. 133.) At that time, however, I was unable to find any *Drosera* plants in the vicinity.

In the following year on my arrival at Diyatalawa I determined to devote my first energies to a search for the larva of this species, and at last, on the 31st July, 1907, in a marshy place which had been cleared at some former time and had not been grown over to any great extent by the ordinary rank paludicolous vegetation, I came across numerous plants of *Drosera burmanni*, Vahl. *T. paludicola* was quite common here, so it seemed a likely place to look for the larva, which was soon revealed by a close search.

It is unnecessary to refer here to the great interest which was excited so recently by the original discovery that *Drosera* is the food plant of *T. paludum*. As is well known, *Drosera* is an insectivorous plant, deriving almost the whole of its nourishment from the insects which it captures and digests, and there was therefore the less reason to suspect it to be the pabulum of a caterpillar which has apparently no means to protect it from being devoured. Dr. Chapman and Mr. Bankes have, however, already shown the fallacy of this reasoning, and in the present instance I have found that *Drosera burmanni* is eaten with impunity by the larvæ of *T. paludicola* and of a Noctuid Moth, whilst the flower stems are attacked by a species of Aphid.

The *Drosera* plants themselves average about 25 mm. in expanse. In appearance the colour varies from light pink to bright red (occasionally pale green, usually in very shady places) ; in reality the leaves and stems themselves are a very pale green looking almost white from the minute silvery glands covering the surface ; the apparent red or pink colour is given by the long red or pink glandular petioles which cover the upper surface of the leaves ; those situated along the external margin of the leaves appear to be clavate at the end, but the other petioles exude a drop of clear gummy matter which forms a round drop at the tip of the petiole, and these gummy drops, as they glisten in the sun, give the plant its rather appropriate popular name of " Sundew." The flowers, which are of a pale pink colour, are borne on a long stem (not gummy), which rises from alongside the centre of the plant and attains a height of 8 or 9 inches. The roots are very small and barely serve to take a grip of the ground, but the plants seem to obtain a liberal supply of insect

food, for nearly every plant examined will be found to have at least one undigested insect caught on its leaves. A small black ant seems to be the most frequent victim, but a small red ant, minute grasshoppers, small moths, &c., are also to be seen.

Egg-laying.—A female moth confined over plants of *Drosera burmanni* laid several ova, most of which were deposited on the seed capsules and unexpanded flower buds. One ovum was laid midway on a petiole on the edge of a young leaf.

Ovum.—When first deposited the egg is of a pale shining green colour, showing prismatic tints. There seems to be a system of rather coarse reticulation disposed regularly over the surface, but the enclosed depressions are very shallow. It is oval in longitudinal, circular in transverse, section. Its length is about ·45 mm., and its diameter about ·18 mm.

Larva.—There are apparently four instars :—

First Instar.—The newly hatched larva is about 1 mm. long. In colour it is a pale transparent yellow which takes a reflected tint from the *Drosera* leaves, thus making the young larva very difficult to see ; the prothoracic segment is a little darker, and the head is brown and comparatively very large. Scattered over the body are short white hairs, but they are neither conspicuous nor plentiful. No warts are visible.

The larva crawls about without hesitation amongst the glandular hairs of the *Drosera* leaf, the gummy tips of the petioles standing up above it, so that it can walk about among their bases with impunity. In this stage it seems to feed entirely on the petioles and gum.

Before undergoing its first ecdysis the larva grows to about 1·5 mm. in length, and the segmental interstices are more plainly marked in a lighter yellowish colour, whereas the segments themselves have become of a darker greenish-yellow.

Second Instar.—About 2 mm. long and rather stout. Colour a greenish-yellow, paler below and on the sides on which the spiracles stand out darkly ; there are apparently small latero-dorsal tubercles which bear rather long white clubbed hairs.

It feeds on the glandular petioles, biting through the base and drawing the stalk into its mouth by a series of movements and finishing by devouring the drop of gum. It seems fairly voracious, but is evidently rather fastidious in its selection of the glandular hairs.

Third (? *antepenultimate*) *Instar.*—About 3 mm. long and fairly stout. Colour a pale green with interrupted pinkish latero-dorsal lateral, and supraspiracular stripes. Tubercles green at base, brownish at points of emission of the white hairs. The disposition of the tubercles is shown in the figure (fig 3).

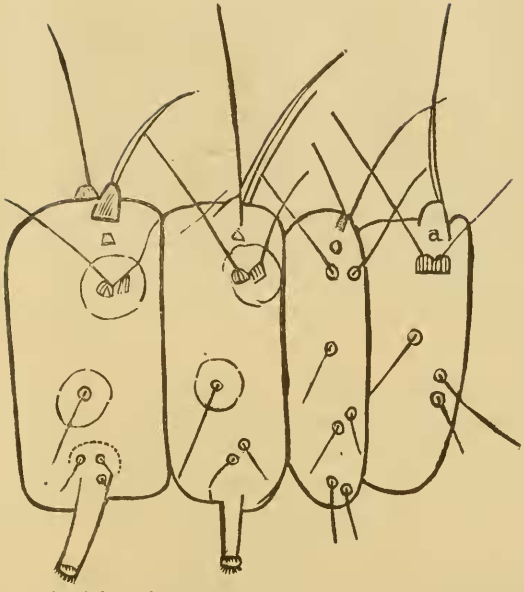

Fig. 3.—5th, 6th, 7th, and 8th Somites of larva of T. paludicola (penultimate instar.). Much magnified.

At this stage the larva feeds indifferently on the leaves and the gummy glands of the *Drosera*.

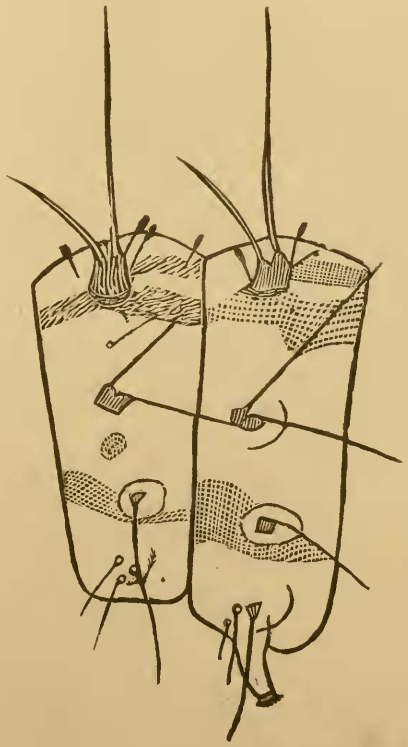

Fig. 4.—6th and 7th Somites of larva of T. paludicola (ultimate instar.).

Fourth (*ultimate*) *Instar.*—A fully fed larva on the point of pupation is just over 7 mm. long, moderately stout, stoutest about middle of body, tapering rather more rapidly towards the head. Colour pale green, a dark rather reddish narrow medio-dorsal stripe ; latero-dorsal tubercles red and surrounded with dark red dashes, which assume rather a longitudinal direction, so that the larva seems to have an interrupted rather broad latero-dorsal stripe. Head pale green with dark ocellar marks on either side. Jaws and mouth parts reddish. Long palps on either side of jaws (fig. 4).

The larvæ, however, vary much, but seem divisible into three types :—

(1) Pale green with a distinctly reddish tinge ; a narrow darker green dorsal stripe bordered on either side by a pale yellowish longitudinal line ; head pale green with dark reddish ocellar patches ; tubercles reddish-brown ; hairs white, as long as diameter of segmental interstices, slightly and regularly dilated towards apex ; prolegs pale green, almost transparent.

(2) Paler green, on which the tubercles show up conspicuously as a bright dark red.

(3) Very much suffused with red, so as to appear of almost as red a colour as the *Drosera* itself.

The intensity of the dorsal stripe is very variable ; in some specimens it is very distinct, in others quite obsolete.

In its final instar the larva shows a decided preference for the buds and seeds of the *Drosera*, eating a hole in the side of the seed capsule and devouring the contents, but it also eats the leaves (fig. 6).

General Remarks on the Larval State.—In all its stages the larva is extremely similar to the *Drosera* and difficult to distinguish. Even a full-grown larva may easily be passed over as a glandular leaf seen edgewise, and *vice versâ*.

Ordinarily the larva seems sluggish, but can move along fairly fast when it likes. It has, indeed, little incentive to move from the food plant. When resting across the centre of the plant, with plenty of food within reach, it seems to remain there for days, until a large pile of flaccid dark-yellowish-green frass accumulates.

In some cases the frass is jerked away by a rapid movement of the anal extremity. In one instance which I noted it went about an inch up into the air and fell on to the *Drosera* plant about half an inch away from the larva ; but usually, I should imagine, it falls clear of the food plant, or there would be no object in flicking it away in this manner. However, as noted above, the frass often does accumulate on the foodplant, so evidently this process of removal is not an invariable habit, but is a peculiarity confined to certain individuals.

When crawling on to a *Drosera* plant the larva seems very careful to keep clear of the gummy petioles, and is assisted to do so by its long hairs, more especially those situated upon the head, for these hairs are seen to have enlarged basal attachments, which are evidently correlated with hypertrophied tactile nerves. (See fig. 5).

When crawling over the leaves the gum is often seen to adhere to the legs of the larva, which then stops, bends down its head, and cleans them by passing the gummy legs through its mouth. The whole process rather reminds one of a cat licking itself clean.

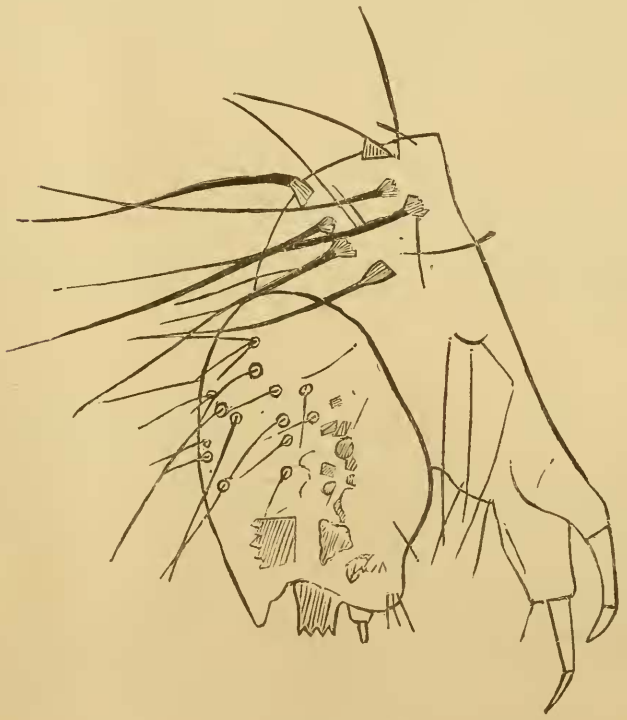

Fig. 5.—Head and Prothorax of larva of T. paludicola showing tactile hairs.

(Note the enlarged basal attachments of these hairs, evidently correlated with a hypertrophied tactile nerve.)

Pupation.—When searching for the larvæ I must have examined several scores of *Drosera* plants, which either contained full-fed larvæ or showed signs of having recently done so, but only in one case have I as yet found the pupa in a natural position, and, judging by the restless behaviour of larvæ in confinement just prior to pupation, I am constrained to believe that the larva wanders away from the plant and fixes itself up for pupation on some grass stem or other similar object, where its discovery would be rendered exceedingly difficult by its resemblance to a pendulous grass seed.

This pupa, which was found *in situ* in its natural position (on 27th August), was on a medium-sized *Drosera* plant, which was growing

under the shade of a tuft of grass. The plant had evidently been badly eaten by the larva, and there was no flower stalk. The pupa was attached by its cremastral hooks to a silken pad spun on the base of a leaf just below the central bud and was lying, dorsal surface uppermost, across some leaves whose gummy petioles had been eaten away by the larva. This pupa was of a greenish-yellow-brown colour, just the tint of the faded sundew leaves, and it looked rather like a grass seed which had fallen on to the plant and stuck to the gum; it may be added that ripe grass seeds are often so found.

In confinement the larva exhibits a certain preference for suspension from the flower stalk of its food plant, whose colour is of a reddish green. Even when the stem is growing at an angle, its double set

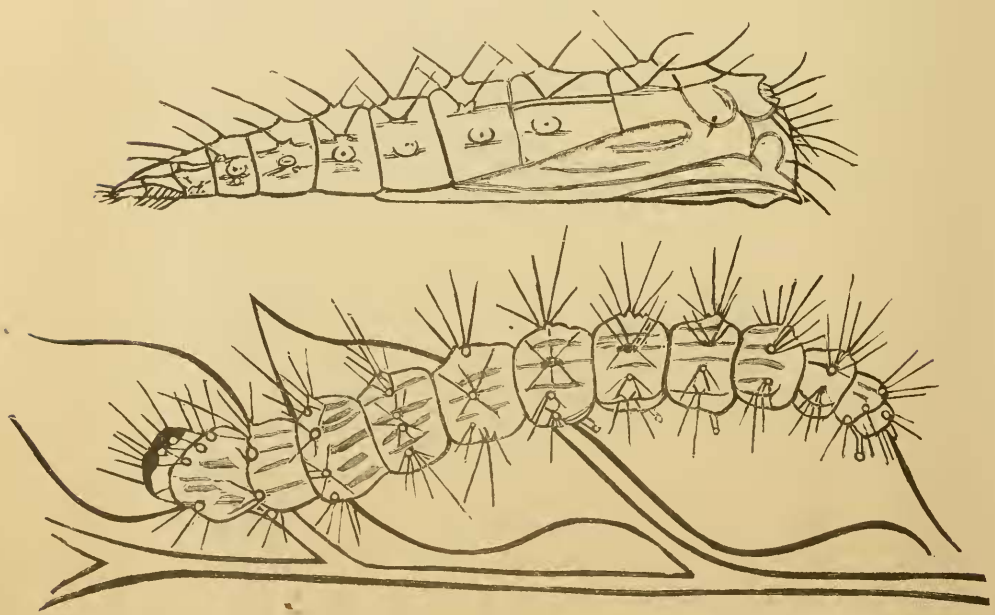

Fig. 6.—(Upper figure) Pupa from the side.
Fig. 7.—(Lower figure) Full-grown larva eating into a seed-capsule.
(From drawings by E. E. Green.)

of cremastral hooks enables the pupa to keep its ventral surface closely appressed to the lower side of the stem, so that it is not suspended freely. It seems possible that this pupa possesses a certain amount of colour adaptability, those pupæ attached to the reddish flower stems having usually an increased red suffusion in comparison with those attached to glass or white paper.

When on an approximately horizontal surface, the pupa is usually found dorsum uppermost; otherwise it invariably suspends itself head downwards and with the ventral surface appressed to its support.

In the case of a pupa in a horizontal position the cast larval skin is sometimes seen lying near it, but quite free and shrivelled up. The

suspended pupa always gets rid of the larval skin entirely. This habit is the exact opposite of that found in *Trichoptilus oxydactylus*, Wlk., whose discarded larval skin is not shrivelled up, but is stretched out along the stem just above the pupa.

When first formed the pupa is of a light apple-green colour, the wing-covers and appendages of a darker green, and a narrow darker medio-dorsal stripe. On either side of this last is a series of eight red tubercles, each bearing two black spines, both pointing longitudinally in opposite directions; on about the eighth somite, however, the foremost of these two spines becomes obsolescent and quite disappears before the anal extremity is reached. (See fig. 7.) The cremaster consists of two portions approximately equal to one another, one in the centre of the ventral surface of the twelfth somite, the other at the anal extremity.

In some cases the newly formed pupa is wholly suffused with a delicate pink flush, which almost becomes a dull red in some specimens.

After a couple of days the bright green begins to fade and ultimately becomes a dull uniform pale yellowish-brown, by which time the eyes and antennæ are clearly marked in black.

The pupa is formed about thirty hours after the larva has suspended itself, and the moth emerges after about nine or ten days in the pupal state.

Emergence of Imago.—The moth always emerges in the morning, usually at about 8 A.M.

The following notes refer to one particular case of eclosion, which was watched throughout :—

" 10th September, 1907, 7.30 A.M.—Pupa of *paludicola* bent away from the supporting stem. Wing covers very dark, the wings showing through; abdomen dark yellowish-brown ; capital extremity lighter.

" 8 A.M.—A dark mark along base of wing covers, which seem quite separated from segments. Pupa quiescent.

" 8.20 A.M.—A reddish suffusion along dorsal segments (about fifth to eighth).

" 8.40 A.M.—A tremulous motion, and the pupa hangs down a little more freely.

" 8.45 A.M.—Segments opposite tips of wing covers look very loosely separated, and there is a constant slight motion in the ventro-dorsal plane.

" 8.48 A.M.—Antenna-case separate ; a distinct split in lower surface near eye. Head emerging. Emergence of thorax quickly follows in rapid gliding jerks.

" 8.50 A.M.—Abdomen is half emerged ; tips of wings still retained ; legs and antennæ free. There is now a distinct pause.

" 8.54 A.M.—A sudden jerk and the abdomen is wholly withdrawn from the pupa case, which is grasped by the first and second pairs of legs. The abdomen now hangs down, the hind legs crossed over it,

whilst the wings are raised over the back. The forewings are now about as long as the abdomen ; they seem comparatively very large on emergence. The anal tufts are erect and separate, but the hairs look a little matted together.

" 9 A.M.—The wings are almost fully expanded, but the cilia are rather matted together.

" 9.07 A.M.—The wings are separated and held in a plane parallel with the abdomen, the costal margins of the forewings being at about a right angle with one another. The third segment of the hind wing is kept separate between the other segments and the abdomen. The cilia still look matted. The antennæ are laid along the costa. The hind legs are now at an angle with the abdomen underneath the wings, which seem rather to be stretched over the spurs. Can these spurs be for the purpose of stretching and drying the wings, a thing which must be somewhat of a difficulty in the case of these long slender segments ? Anyway, it certainly is the case that amongst the Plume Moths there is a correlation between long spurs and extreme fission of the wings. Normally, too, when the moth has flown, the long spurred hind legs are stuck straight out when at rest, well away from the wings.

" 9.24 A.M.—The legs have now been slipped down a little, and each outer distal spur is now pressing on the costa of the second segment of the forewings, separating it out from the first segment, whilst the outer proximal spur similarly opens out the second segment of the hind wings from the first segment.

" 9.29 A.M.—The legs have now been slipped down nearer the body, and are directly beneath the third segment of the hind wings. The outer distal spur is just touching the cilia of the inner margin of the second segment of the forewings, and probably acts as a sort of comb to separate the hairs.

" 9.34 A.M.—The third segment of the hind wings is now resting with its apex on the outer distal spur, which spreads out the long cilia very well. The outer proximal spur combs out the inner marginal cilia of the third segment.

" 9.40 A.M—The hind legs are now laid along the abdomen quite clear of the wings, which are still deflexed.

9.45–9.50 A.M.—The wings are being brought forward very slowly until the costal margins are at about right angles with the abdomen. Meanwhile the antennæ are laid beneath the wings and comb out the basal cilia as the wings are drawn forward."

I would call particular attention to the light now thrown on the *use* of the long spurs which occur on the hind legs of so many Plume Moths. The facts exhibited in the above notes, together with the constant correlation of long spurs with extreme fission of the wings, seem to point out that these spurs have been developed expressly to stretch the wings, to separate the segments, and to comb out the long cilia.

Habits of Imago.—The moth seems to fly naturally from about half an hour before to just after sunset, and again in the morning until about half an hour after sunrise : the flight is fairly swift, but gentle and floating, and not sustained. If flying naturally they rarely seem to fly more than a yard or so at a time, and not more than four or five yards if disturbed. They stop with a jerk and pitch on a grass stem, flower head, leaf, &c., with the wings rolled up and stuck out at right angles on either side, and the long spurred hind legs projecting upwards between the wings and abdomen.

I have never yet seen two *in copula*. Perhaps they pair after sunset, remain coupled all night, and separate at sunrise, the female ovipositing next evening.

Even in localities where it is abundant, *T. paludicola* is a very inconspicuous little insect, and there are so many small Rhynchota and Diptera extremely similar to it when on the wing and abundant in the same habitats that it is at first by no means easy to distinguish it even when one is on the look out for this particular "Plume." Its jerky floating flight will, however, soon become familiar to any one who is searching for it.

The moth is never to be found away from the immediate vicinity of the *Drosera*.

Time of Appearance.—The moth was first found by me in the beginning of October, 1906. On my return to Diyatalawa at the end of July, 1907, it was quite common, and has remained on the wing quite abundantly up to the time of writing, and during the whole of this period the larva has been found in all stages, so that it appears probable that this species is continuous-brooded throughout the year.

Habitat.—Ceylon, Province of Uva, Diyatalawa (4,000 feet). July to October, and probably throughout the year.

Mr. Meyrick informs me (in litt.) that he has also received this species from the Khasi Hills, Assam.

Enemies.—Amongst the agencies destructive to this species must be reckoned the human inhabitants of the districts in which it occurs; these burn off the grass, &c., of the patanas regularly, and these constant fires must destroy vast numbers of *T. paludicola* in all its stages. Luckily, however, for the moth, it is never likely to be wholly exterminated by this means, since the vegetation of the boggy valleys, which form its headquarters, is usually too lush to burn.

The adult moth is preyed on by a small crab spider (*Thomisidæ*) which lives on the seed heads of grasses, with whose colour it agrees exactly.

The larva falls a victim to a small blackish Ichneumonid, which emerges from the larva when it is full grown, and spins a small oval pale yellow silken cocoon on the *Drosera* flower stalk or on a neighbouring piece of grass or occasionally on a *Drosera* leaf. Mr. E. Ernest Green, to whom I had sent some *paludicola* larvæ, was lucky

enough to observe the actual emergence of this Ichneumonid grub from the parasitized larva, and writes as follows :—

"My first attempt was interrupted by the sudden emergence of an Ichneumon grub. Whilst endeavouring to draw this caterpillar a lump appeared between the 7th and 8th somites, inside which vigorous movements were seen. Presently a yellowish grub forced its way through the skin at this point. The grub has a row of rounded tubercles on each side, which it alternately protrudes and retracts during its efforts to free itself from the body of the larva. While its hinder extremity was still attached to the side of the caterpillar, the grub commenced to spin its cocoon. Bulk for bulk, the grub is little smaller than the larva from which it has emerged. Within an hour the grub has completely enclosed itself in a pale yellow silken cocoon. Meanwhile, the caterpillar had completely collapsed."

Roughly, about one-third of the larvæ collected seem to be attacked by this parasite, which emerges from its cocoon after about eight days.

I am indebted to Mr. E. Ernest Green for the drawings of figures 6 and 7.

REPORT ON THE WINDOW-PANE OYSTERS (PLACUNA PLACENTA, "MUTTUCHCHIPPI") IN THE BACK-WATERS OF THE EASTERN PROVINCE (JUNE, 1907).

By Arthur Willey, F.R.S.

With Plate and Text-Figures.

Introduction.

THE first systematic biological survey of the Tamblegam pearl fishery grounds in recent years was carried out by Mr. James Hornell in 1905, and an account of it was published in Part II. of the Ceylon Marine Biological Reports (June, 1906).* There was no inspection of the beds in 1906.

On June 5, 1907, exactly at the break of the south-west monsoon, I proceeded to Trincomalee to examine and report upon the occurrence of window-pane oysters in the estuaries and backwaters lying to the south of Koddiyar Bay. At this time a strong wind was blowing almost incessantly day and night, rendering the harbour and great bay as well as lake Tamblegam, which lies in the midst of a flat plain, very choppy. Shortly after my arrival the Assistant Government Agent at Trincomalee, Mr. C. S. Vaughan, C.C.S.,† informed me that the open season for pearling in the Tamblegam lake had terminated on May 15, according to the terms of the lease schedule, and that it now became necessary to make a fresh inspection of the Tamblegam pearl fishery grounds; accordingly I added this work to my programme.

By the terms of the new lease of the Tamblegam placuna fishery, which commenced on January 1, 1907, window-pane oysters may not be collected during a close season extending from the middle of May to the end of the year, and during the open season, from January 1 to May 15, they may not be collected of a less size than $5\frac{1}{2}$ inches in shortest diameter. As the close season is not known to coincide with the spawning season, it will be seen that these restrictions as to season and size can only have a partial effect on the restoration of the beds to their former productivity so long as there

* Also as Sessional Paper XLVI., 1905.

† I am indebted to Mr. Vaughan for the correct rendering of many of the Tamil names in this paper. The old spellings of the Sambore river and Uppu-aru are retained in the text in place of the new official spellings Sampur and Uppar, respectively. The Savaru is the same as Shava-aru on the maps.

is no ground set apart as a breeding reserve, and that without this provision they might even tend towards the virtual extinction of the spawning oysters.

The placuna beds occur in the backwaters of two neighbouring divisions of the Trincomalee District, namely, Koddiyar and Kiniyai, which are under the supervision of their respective Vanniyas, and are separated from each other by the Mahaweli-ganga. Lake Tamblegam lies within the Kiniyai boundaries, and has long been known as the headquarters of the placuna fishery in Ceylon. There are, however, two other backwaters, the Sambore river and the Uppu-aru, connected with the great bay at Trincomalee, where the nature of the bottom and the salinity of the water offer more or less favourable conditions for the window-pane oyster. The Uppu-aru lies to the west on the Kiniyai side of the Mahaweli-ganga, and is connected with this important river about 10 miles inland by a winding channel called the Savaru, a fact which has a bearing upon the well-being of the placuna beds in the Uppu estuary, owing to the likelihood of an excessive sedimentation and freshening of the water during the rainy season, both of which may act calamitously upon the placuna communities. To the east of the Mahaweli-ganga occurs the Mutur-aru, and beyond this again the Sambore river, of which the most considerable expanse is known as the Kaddaiparichchan-aru. The Mutur-aru forms part of the delta of the ganga, and the water opposite to the present resthouse at the old port of Koddiyar is nearly fresh.

Sambore River.

After consultation with Mr. Vaughan, I took passage in a Koddiyar dhoney and crossed the bay to the Mutur estuary and resthouse, where I met the Vanniya of Koddiyar by arrangement. On the following morning (June 11) the Vanniya accompanied me nearly 2 miles along the Sambore road, across the Batticaloa road, to the Kaddaiparichchan ferry or Paikiraturai, a spot marked by a double tamarind tree and a pile of edible oyster shells perhaps destined to be calcined. This ferry leads to the Topur road across the river. Here I embarked in a large log boat which was in readiness, manned by three boatmen and two divers. A hundred yards or so below the ferry we pass the entrance to the great inlet called the Kaddaiparichchan-aru on the right bank of the river. About a quarter of a mile farther down on the same side there issues another winding ramification named Irattamaddikkali-odai. It is important to note that the main stream of the Sambore river has a fresh water connection with the ancient but recently restored Allai tank, about 6 miles from the sea.

In the lower reaches of the river where the tide runs strongest the bottom is sandy; in the more sheltered recesses there are patches of

mud, some of which have been colonized by window-pane oysters. Such a recess occurs at the mouth of the Irattamaddikkali-odai, shut off from the main current by a long mangrove eyot or "nadutivu." A small quantity of shells thrown upon the bank indicated what had been taken last year. It may be stated at once that the placuna fishery is not an important industry in the Sambore river and hardly shows promise of becoming one, but the occurrence of placuna here is an important biological fact for several reasons.

In his 1905 report, to which I have referred above, Mr. Hornell describes his original investigations into the causation of pearls in *Placuna placenta*, and announces his discovery that the same larval cestode which stimulates the formation of pearls in the Mannar pearl oyster (*Margaritifera vulgaris*), also furnishes the nucleus of the pearls produced by placuna. Mr. Hornell remarks upon the singularity of this parasitological uniformity in divergent environments. The tidal Sambore river introduces us to a third class of conditions of existence, inasmuch as instead of opening to the sea by a wide and comparatively deep strait as does lake Tamblegam, the discharge of the river takes place over a shallow surf-ridden sand bar. Nevertheless, the parasitological conditions remain apparently the same in all essential respects. Later on I shall have something more to say upon the subject of the multiplication and migrations of the parasitic larvæ, which are so abundant in the liver of these bivalve molluscs. Following the usual custom I now pass on to the enumeration of the various stations where samples were collected during my first inspection.

Station I.—At the seaward extremity of Irattamaddikkali-odai; depth 2–4 feet. In spite of the shallowness the water contained so much matter in suspension that the bottom could not be seen from the boat, and the divers waded about depending upon the tactual acuity of their feet to find the shells. This method serves well enough for moderately large specimens in shallow water, but is not sufficiently delicate for the young thin-shelled stages. In the course of about half an hour only six living placunæ were taken, as shown in the subjoined table, the measurements being made with the callipers on a scale of millimetres:—

	Length.	Height.	Remarks.
1 ..	158 ..	143 ..	Pearls found in the right mantle only, a cluster of small pearls inside the mantle opposite the labial tentacles. Copepod ectoparasites with bright roscate ovisacs glided rapidly over the gills.
2 ..	148 ..	135 ..	Several of the red Copepod Crustacea present.

	Length.	Height.	Remarks.
3 ..	150 ..	139 ..	An encysted Nematode worm* observed ; one very small pearl in left mantle.
4 ..	166 ..	150 ..	Two small pearls in right mantle, one in left.
5 ..	156 ..	135 ..	Two Copepods present, and a minute pearl in each mantle.
6 ..	136 ..	117 ..	Many liver parasites, but no pearls were found.

With reference to the above, it is to be noted that the standard height, 5½ inches, is equivalent to 139 mm., and according to Mr. Hornell's calculations, based upon observations extending over the years 1902–1905, represents an age of about two years.

Station II.—Across the river opposite to preceding ; bottom consisting of a mixture of sand and mud. The search yielded one living placuna, length 117 mm., height 94 mm. When held up to the light the shell was sufficiently transparent to allow the beating of the heart to be seen ; some time after removal from water the heart stopped, commencing again after being returned to the water. Fish spawn (goby eggs) and small dome-shaped, sand-encrusted Gastropod egg-capsules, from one of which I liberated 15 operculate veligers, were attached to the right valve. In the normal prone position of the window-pane oyster the flat right valve is uppermost, the shell resting upon the convex left valve as with the edible oyster, which of course adheres to the surface upon which it settles, placuna being free. When the creature is breathing and feeding, these two functions being performed simultaneously as in all lamellibranchiate mollusca, the right valve is raised slightly like a lid, usually about a quarter of an inch or less above the level of the left valve. If the thin blade of a knife be inserted between the gaping valves, touching the sensitive edge of the mantle, they will instantly close, and the entire shell can then be lifted out of the water holding on to the blade. Both large and small specimens retain this grip for many days under artificial conditions.

Station III.—On the western side of the above-mentioned mangrove eyot no placunæ were found.

Station IV.—A short distance up river off the left bank, where there were some remnants of last year's takings. Found only two dead mud-buried placunæ with mud between the valves ; height of the shells about 5 inches.

Station V.—In the Irattamaddikkali-odai (so-called on account of the abundance of an edible cockle "Irattamaddi, blood-cockle,"

* Mr. Hornell recorded the presence of *Cheiracanthus uncinatus* encysted within the adductor muscle of *Placuna*.

Arca rhombea).* The results were chiefly negative. At Marampoddaturai, on the right bank, a likely looking spot marked by a fine "pasari maram," one living placuna was picked up in very shallow water, measuring 157 by 143 mm. Nearer the head of this backwater no more were found.

Station VI.—In the Kaddaiparichchan-aru about three-quarters of a mile along this arm of the backwater, beyond the village of the same name where there is a bifurcated coconut tree and past a slight bend where weathered rocks with cleavage grooves jut out into the water. Here the divers picked up and I subsequently measured upwards of thirty dead and buried placunæ with both valves complete. This is a good example of an entire bed having been destroyed by natural though catastrophic means, namely, mud-burial. In the subjoined table I give a few selected measurements to show the range of size. The insidious nature of the disaster which overtook this bed may be imagined when it is stated that in several cases the delicate ear-like lobes of the shell which occur on either side of the hinge line, especially in young individuals, are still retained (text fig. 1).

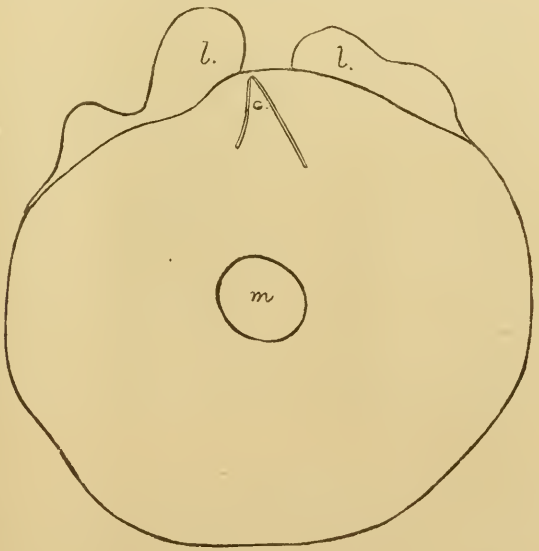

Fig. 1.—Left valve of a Placuna from the inside, from a photograph × ½
l. l. Lobes of the shell. *c.* Hinge area, the longer cardinal tooth is posterior (the figure being reversed). *m.* Muscle-impression.

	Length.	Height.
1	209	168
2	160	151
3	142	124
4	134	111
5	120	110
6	94	85
7	76	64†

* This mollusc has red blood and dark red gills. † Left valve only.

Station VII.—On the left side of the aru, opposite to the preceding station, just above a sandbank occupied by a colony of small crabs with nearly spherical bodies and long slender curved chelæ. I sent a couple of these crabs to my friend Dr. J. R. Henderson at Madras, and he kindly identified them as *Dotilla mycteroides* (H. Milne-Edwards) belonging to the family Ocypodidæ. In Dr. Henderson's "Contribution to Indian Carcinology" (Trans. Linn. Soc. London, Vol. V., 1893, p. 390) this species is mentioned under an alternative title, *Scopimera mycteroides*, the generic name referring to the presence of thin, smooth, soft, oval areas on the meropodites of the legs and on the sterna, which have been termed "tympana." In a very large series of this species only males occurred, and Dr. Henderson tells me that he has never seen a female.

From this station I obtained seven examples of the youngest living brood met with during the entire inspection. The first specimen to be found was picked up casually in company with a dead shell; the other six were obtained by the two divers in about half an hour by the hand-trailing method, which can only be employed in very shallow water. The details are given in the following table:—

	Length.	Height.	Observations.
1 ..	71 ..	59 ..	No parasites were found.
2 ..	75 ..	64 ..	One cystic parasite was found in the liver containing a single contractile endogen (for explanation of the use of this term see below under Parasitic Larvæ). (Fig. 9.)*
3 ..	65 ..	54 ..	One larva only was seen in the liver, without adventitious cyst. (Fig. 8.)*
4 ..	61 ..	58 ..	Preserved whole in formalin.
5 ..	59 ..	52 ..	Do.
6 ..	60 ..	52 ..	No parasites were found.
7 ..	58 ..	51 ..	Do.

The presence of a buried colony on one side of the river and a growing colony on the opposite side should presumably be considered in conjunction with the configuration of the banks at this spot, a rocky point on the one side and a sandy bight on the other, the former causing, the latter indicating, a deviation of the tidal currents and consequent alteration of deposit during the period of maximum sedimentation.

Station VIII.—In a stretch of the river known locally as the Eraiyattiwu-aru, close above the Kaddaiparichchan ferry (Paikiraturai); depth 4–5 feet. At this spot edible oysters of large size occurred, often coated with a yellow encrusting sponge. A placuna

* These refer to the figures on the plate at the end of this article.

valve had edible oysters attached to it. Only two living placunæ were taken here within half an hour, as under :—

	Length.	Height.	Observations.
1	107	98	Many cysts containing 1–12 endogens.
2	112	103	Observed in all about 15 cysts, including one bearing an endogen, another with several endogens, and one free endogen.

About 200 yards further along in a wide, shallow bight on the eastern shore, where the tide was running very slowly, four dead complete shells were taken, three measuring on the average 150 mm. long by 143 mm. high, the fourth smaller, 129 mm. by 105 mm.

The mangroves which border the lower reaches of the river presented a remarkably even line of foliage jutting out over the maze of roots some 3 feet above the level of the water, curiously like the undercut cliffs of some coral islands. Another characteristic feature, at this season, of the complex of waterways which constitute the Sambore river was afforded by the presence of great numbers of Rhizostome Medusæ ("jelly-fish") belonging to the series of forms included under the name *Himantostoma flagellatum*, the eight oral arms carrying superficial fringes and long terminal contractile streamers. In the morning they were to be seen drifting up the river with the inflowing tide against the wind; towards evening the outflowing tide left many of them stranded upon the sandbanks, which were then exposed. They varied in size from about 1½ to 5 inches in diameter, and many of them, both large and small, had a purple spotted umbrella, while others were colourless. It is furthermore worth noting that they occurred up the river as far as the Batticaloa road, beyond the upper limit of the placuna beds.

Lake Tamblegam.

On June 20 I went to Niroddumunai, where the road from Trincomalee to Batticaloa abuts upon the wide channel by which this lake communicates with the sea, the village of Kiniyai lying on the opposite shore. Here, by kind permission of the District Engineer, Mr. W. Brice Gregson, I occupied the conveniently situated Public Works Department bungalow.

The object of my visit, as I have indicated at the commencement of this report, was to make the first official inspection since the passing of "The Pearl Fishery Ordinance, 1906," and since the lease concession 1907. It is currently known that much unlicensed collecting took place in 1906, and that the legitimate fishery this year has not yielded a satisfactory return. It is to be regretted that the

statistical information, which is so freely forthcoming from the Mannar fishing grounds, is utterly wanting at Tamblegam, a somewhat unfortunate deficiency, where everything depends upon numbers. At the same time it is not easy to find a remedy except by the co-operation of the contractors.

Examination of the recent shell-heaps at different points of the shore showed that not less than 50 per cent. were undersized. For instance, the measurements of the heights of 10 entire left valves gathered at random from one pile were 4, $4\frac{1}{4}$, $3\frac{3}{4}$, $5\frac{1}{4}$, $4\frac{3}{4}$, $4\frac{1}{4}$, $5\frac{1}{2}$, $4\frac{1}{2}$, 5, $4\frac{1}{2}$ inches. Evidently an undersized brood had been fished, perhaps during the previous year, and it is hard to believe that the collection can have brought any return worth naming.

I am informed by one of the contractors that during the fishing season of 1907 ten boats were engaged for four or five days only collecting daily 300–400 oysters each; then for about six weeks four boats were employed daily. The season's catch yielded forty-six rupees weight of pearls worth six hundred and ninety rupees, one rupee's weight of placuna pearls being valued at fifteen rupees.*

The topography of the lake and the position of the principal placuna beds were described and illustrated by Mr. Hornell (1905), so that I can proceed at once to record my notes for the present year in the month of June. At this time the salinity of the water, as ascertained from a sample from Nachchikuda, was approximately the same as that of the sea, a ship's salinometer showing a reading of 12, as against 10 in the Sambore backwater.

Station I.—In the mouth of the inlet called Nachchikkuda, about midway between the hill on the east side called Makilankaraimalai (exposing a broad front of rugged weathered rock surfaces) and Vellaikkallumunai (white stone point) to the west; depth about two fathoms. This station lies to the south-east of the coconut planted village of Sinnakkulam. Three divers in fifteen minutes brought up ten large living oysters and a dead one overgrown with hydroids (*Obelia*). No window-pane oysters were recorded at this spot by Mr. Hornell in 1905. In this material I noted two single endogenous larvæ. In most of the individuals patent cysts, visible without magnification, occurred in the anterior portion of

* In a statement submitted by the principal lessee, Mr. Abdul Rasool to the Assistant Government Agent and self at the Trincomalee Kachcheri in October, it is certified that this quantity of pearls was obtained from 627,672 window-pane oysters fished and opened during 125 days by 23 men. The number of oysters can be stated with such precision, because a payment of 25 cents per thousand is made for opening them. The actual yield was indeed greatly below what was anticipated from the examination at the Kachcheri in February, 1906, of a sample of 2,000 oysters, in accordance with a recommendation made by Mr. Hornell. The pearls procured from this sample were valued at six rupees.

the suspensory membrane of the gills; but the pearl yield was poor. I give the sizes for future reference :—

	Length.	Height.	Contents.
1	155	142	No pearls.
2	166	134	Do.
3	151	147	Do.
4	151	141	Do.
5	161	141	Do.
6	146	157	Do.
7	156	141	A minute pearl in each mantle-half.
8	150	133	No pearls.
9	165	148	One small pearl in right mantle.
10	172	150	A small pearl in left mantle edge and a small hinge pearl.

Sheets of encrusting Bryozoa occurred at base and apex of both valves of No. 9; the right valve of No. 10 was bored in four places, the holes being covered internally by thin nacre.

Station II.—Opposite Sinnakkulam Ur, south of the point called Mutalaippiddi "crocodile shallow," in 1½ fathom. In Mr. Hornell's sketch plan of the lake the Nachchikkuda bed is localized between Mutalaippiddi and the head of the bight. Three divers within ten minutes brought up six living and six dead well-grown placunæ. Details of the living specimens are given below :—

	Length.	Height.	Observations.
1	154	143	Many patent cysts; no pearls.
2	159	148	Right valve overgrown with yellow encrusting sponge.
3	152	150	—
4	147	147	Edge newly bordered with thin shell-substance. About a dozen small pearls, eight of which were lying close to the lower border of the adductor muscle.
5	153	149	—
6	142	134	Patent cysts present.

Station III.—Abreast of Mutalaippiddi, where there is a sandy beach with low trees in front of the coconut plantation. Three divers found eight living oysters in about 1½ fathom within five minutes :—

	Length.	Height.	Observations.
1	145	145	Large patent cysts; one hinge pearl.
2	154	148	Double hinge pearl.
3	173	162	No pearls.
4	151	144	One very small pearl.
5	166	153	One mantle and one hinge pearl.

	Length.	Height.	Observations.
6	167	156	One hinge pearl.
7	144	137	Numerous patent cysts; no pearls.
8	151	147	Two mantle pearls and a small hinge pearl.

What I have called "hinge pearls" always occur near the posterior cardinal ridge or tooth imbedded in the fleshy substance of the central triangular lobe of the mantle which lies between the cardinal teeth.

Station IV.—On the Nachchikkuda bed round Mutalaippiddi, nearly opposite to a pile of this year's shells on the beach; depth about 5 feet. From this spot and also from another diving farther up the inlet off an outstanding thicket of mangroves near the Sinnakkulam side I recorded twenty measurements. This station evidently corresponds with Mr. Hornell's station 5*a* (1905), where he found "great abundance of very young *Placuna placenta*," this being the only part of the Nachchikkuda where he obtained any placunæ at all. From this fact we may apparently draw the conclusion that placuna attains the standard size in about $2\frac{1}{2}$ years:—

	Length.	Height.	Observations.
1	140	143	Capulids attached to the right valve in the umbonal region and on the inner upper posterior margin of left.
2	147	143	No pearls.
3	147	137	Do.
4	149	138	Do.
5	149	133	Two small pearls in left mantle; an invasion of mud coated by nacre.
6	153	140	One pearl.
7	157	151	No pearls.
8	160	148	One pearl.
9	163	152	Numerous patent cysts in the usual position.
10	166	151	Right valve with Capulids, left with adherent sand-tube. Many patent lymphoid cysts in the suspensory membrane of the gill.
11	166	159	Patent cysts present, some adjacent to the organ of Bojanus.
12	169	155	No pearls.
13	170	145	Do.
14	171	149	Capulids and sand-tubes on left valve.

	Length.	Height.	Observations.
15	172	157	Two pearls.
16	173	156	None.
17	175	153	None.
18	178	147	None.
19	180	152	Several patent white cysts at anterior base of gills (the usual position) each containing a normal parasitic larva surrounded by adventitia.
20	188	162	One pearl.

A sample for comparison with the above from the same place should be examined towards the end of the year before the next fishery.

The sand-tubes which adhered to several of the shells were inhabited by Polychaet worms, *Eunice indica*, all in the same immature condition, about an inch in length (after preservation), the head entire or but slightly notched in front, antennæ and cirri smooth, gills commencing on the third foot and ending on the 26th–28th feet.

Station V.—Off the Nachchikkuda (east) shore, opposite to Sinnakkulam ; depth about one fathom. Many oysters of the statutory size, several slightly below it ($5\frac{1}{4}$ inches). Ten specimens yielded two hinge pearls and five mantle pearls.

Station VI.—Before Kakkaimunai, "Crow Point," in one fathom ; collected a sample of a dozen. Nos. 1 and 9 contained a hinge pearl apiece, that from the latter measuring 2 mm. long by nearly 1·5 mm. wide.

	Length.	Height.		Length.	Height.
1	120	115	7	109	99
2	117	106	8	123	113
3	124	116	9	120	109
4	121	124	10	116	108
5	111	100	11	122	110
6	113	110	12	136	122

This bed might make a good showing next year ; it corresponds with Mr. Hornell's station 8–8 (1905). Other parts of the Kakkaimunai bed exhibit abundant crops of the sponge called "kadalpalam," referred to by Mr. Hornell, to the almost entire exclusion of placuna. Whether or not it really ousts placuna from its position on the beds is a question which could only be answered after repeated observations, the point to decide being whether placuna would settle down where the sponges now reside if it were given the chance. I think it probably would.

Station VII.—The Sembianar Velanga.* In Mr. Hornell's sketch plan this is regarded as forming part of the Kakkaimunai bed. On this ground there were living placunæ of standard size as well as dead of all sizes. Particularly the young taken at different points of the bed were all dead. I took footrule measurements of the living material, which may be omitted; in general the height ranged from $5\frac{1}{2}$ to 6 inches. One specimen had two hinge pearls adjacent to each other and near to the posterior cardinal ligament; another had as many as six hinge pearls in the same position.

Station VIII.—Palampoddar bed. The Amaikkalam, "Turtle shallow," a submerged sandbank, yielded two live oysters with clean, worn valves, measuring 152 by 129 mm. and 151 by 140 mm., respectively. Steering towards the Tampalakamam-aru we find fine mud, but very few chippi, and these requiring much search. Off the Periya Palampoddar (according to the unanimous declaration of my boatmen, although it is labelled "Sinna Palampat" on Mr. Hornell's plan) only old valves were found. In fact this bed seems to be nearly exhausted. I do not know whether it has ever been notably productive, but the proximity of the rivers is againstit.

Station IX.—Kappalturai bed. Numbers of living placunæ, sparsely distributed, occurred here, the shells being mostly bent and contorted, with worm-tubes on the valves. In point of size they were, as a rule, well over the mark, ranging from about 5 inches to $6\frac{3}{4}$ inches in height. One had a very small pearl in the superficies of the mantle, a larger one at the edge, and a third still larger at the hinge. Another specimen showed two pearls near together over the gastro-hepatic region; and a third had one mantle pearl and a good hinge pearl.

The Tamblegam lake is estimated to cover an area of 5,006 acres. The beds which seem to deserve most attention are Nachchikkuda, Chempiyanar, Kakkaimunai, and Kappalturai, the first-named being especially well placed for future observation and experiment. At no great expense oyster parks could be staked out, and the course of events carefully watched and recorded. The divers can hardly be expected to discriminate under water between shells differing in one dimension by a fraction of an inch, and the lease indenture does not bind them to carry a footrule, nor are they directed to return undersized shells to the water. It is certain that large numbers ought to be returned, not however by rudely casting them overboard, but by placing them by hand the right way up (*i.e.*, resting upon the left or convex valve) on the bottom in a definite space. The heavy log boats of these parts can be moored quite securely against the strong south-west wind by means of a long pole which they carry for the purpose, driving it deeply into the mud. It would be a

* More correctly, Chempiyanar Vilakku.

comparatively simple matter to stake out rough enclosures, which could then be thickly stocked with the window-pane oysters.

Uppu-aru or Uppar.

This backwater is deeper than the Sambore, upwards of a fathom in most parts, so that genuine diving is required. Before diving, and while the divers were under water, the boatmen beat the sides of the boat to scare away sharks and crocodiles should any be in the vicinity.

The beds, such as they are, occur on the Kiniyai side of the wide bay into which the Uppu-aru expands at its mouth. On the opposite side, bordering upon the "Oopah estate" the current is too strong.

Just inside the bay, round the point of the ferry, two bivalve chippi were picked up looking quite normal, but they proved to be dead. It was indeed the common saying that the "muttu chippi" of the Uppu-aru were all dead. Nevertheless, on the north side, which is flanked by a bank of mangroves, whose lower line of foliage was flush with the surface of the water, some living placunæ were found. A sample of half a dozen ranged from 5½ by 5 inches to 7 by 6 inches. I returned all except one, which harboured the same Copepod gill parasites that I found in the Sambore river, but failed to find in the Tamblegam chippi, although I searched carefully for them.*

Proceeding along towards the head of the bay some healthy looking specimens of medium size were procured, but they also were dead; then approaching a kallam in one fathom more dead valves were found. Striking off towards the centre a diver picked up a pale grayish gelatinous sea-hare† (*Aplysiidæ*) studded with bright emerald green areolæ and with retractile pinnate tassels all over the body; they called it "kadalnatthu" (sea-foam). Nearer the shore we took three more dead bivalves.

At the head of the bight between two creeks, among dead remnants, one living placuna of medium size (5½ by 5 inches) was taken, the shell showing the marks of a fish bite. In the mid-bay, opposite to the sea-opening, only dead valves were found.

Parasitic Larvæ.

It is still uncertain how the primary infection of the liver with the flatworm larvæ, which are believed to be identical with the pearl-inducing parasites, takes place, whether they are passively ingested with the food or actively migrate from the outside. However this may be, it stands to the credit of Mr. Hornell to have shown for the first time how secondary infection may occur, namely, by the endogenous formation of a new generation of larvæ within a parent cyst.

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* Since found (October).

† Perhaps *Acclesia cirrifera*.

Out of some hundreds of cysts passed in review under the microscope, Mr. Hornell tells us that he found "in three different instances a miniature reproduction of the parent within the bladder-like posterior division of the body." Mr. Hornell adds: "So far as my observations go only one secondary larva is produced at a time."

Whilst confirming Mr. Hornell's discovery, I find that the endogenously produced larvæ, or briefly the endogens, are not so rarely to be seen as might appear from the above quotations from Mr. Hornell's work, but that, on the contrary, most of the individual placunæ which I examined contained some of them; and secondly, I have to add that the multiple formation of endogens within a single cyst is a common phenomenon. One of my first preparations showed a cyst, 0·38 mm. in diameter, containing numerous (about twenty) endogens, each exhibiting small granules near the posterior end, the larger concretionary granules (calcareous corpuscles) of the parent occurring round about them in the interstices (compare fig. 1).

The encysted larvæ vary much in size, but in general two sizes may be distinguished, a small one less than 0·25 mm. in diameter (becoming greater when turgid with endogens), and a larger one ranging from 0·5 to 1·0 mm. Both forms are capable of producing endogens, and are therefore potential blastogens. For convenience of description and reference it may be useful to refer to the former as microblastogens (in short microgens), and to the latter as macroblastogens (macrogens). A parent encysted larva bearing one endogen is a phase or "instar," which may be described in one word as a monogen; with two endogens it becomes a digen; with three a trigen; with four a tetragen; with many a polygen. The utility of this terminology can perhaps only be appreciated by those engaged in practical investigations of a like nature, but whether this be so or not it happens to suit the occasion.

A complete cyst consists of an outer adventitious fibrous layer surrounding the parasite, sometimes closely investing it, sometimes with an intervening space which may be occupied by a flocculent substance. A spherical or rounded larva closely surrounded by the fibrous cyst-wall may show in its anterior hemisphere a series of backwardly directed bristles such as may sometimes be observed in the endogens (fig. 4). Another appearance occasionally met with is that of a well-defined striated cuticle, the cuticular striæ stretching at right angles between the body of the larva and the inner surface of the membrane which is in contact with the fibrous layer. The striæ are involved in the constant contractions or swaying movements of the body. I do not know what may be the significance of these different appearances, or whether they are connected in any way with the distinction which must exist between the primary and secondary larval generations.

Parasitic infection takes place at an early age, as is indicated by the observations recorded under Sambore river, Station VII. A simple larva with large granules from the smaller of the two infected specimens is shown in fig. 8. The larger (No. 2) had a monogen (fig. 9), the contained endogen undergoing continual movements of contraction and expansion. An older placuna (Sambore river, Station VIII., No. 1) exhibited many different stages, from the barren microgen to the polygen. The irregular shape of the endogens is a consequence of their soft contractile bodies.

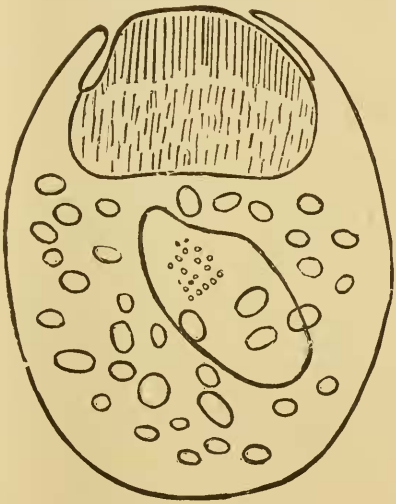

Fig. 2.—Monogen cyst of intermediate size. The large granules are outside the endogen. Zeiss. 3 C. *cam. luc.* Tamblegam.

In fig. 6 the endogen appears like an imaginal disc carved out of the substance of the parent; in this instance the cluster of small granules had not yet formed, those seen in the sketch being peripheral granules of the parent outside the endogen. Frequently when a single endogen is present it occupies the greater part of the body of the parent, but sometimes the contrast in the size of parent and offspring is very great as will be noticed below.

In another cyst from the same host (Sambore river, Station VIII., No. 2) seven endogens could be clearly distinguished, and I noted that, as a rule, the endogens were placed peripherally in the cyst, the bulk of the calcareous concretions internally. In this placuna diatomaceous ooze was seen adhering to the tip of the crystalline style, indicating the nature of the food upon which placuna subsists. Fig. 7 shows a monogen from the same host, in which the endogen appears with its anterior end retracted, and a pore is visible at the hinder end of the parent. In the preparation from which this was taken about eight larvæ were found in the field of the microscope,

but only the one figured contained an endogen. In another preparation a free endogen with small granules was seen, but it may have been artificially liberated.

A trigen, *i.e.*, an encysted larva containing three equally advanced endogens, is shown in fig. 4; close by it in the preparation were two monogens, a macrogen with three endogens, and many simple microgens.

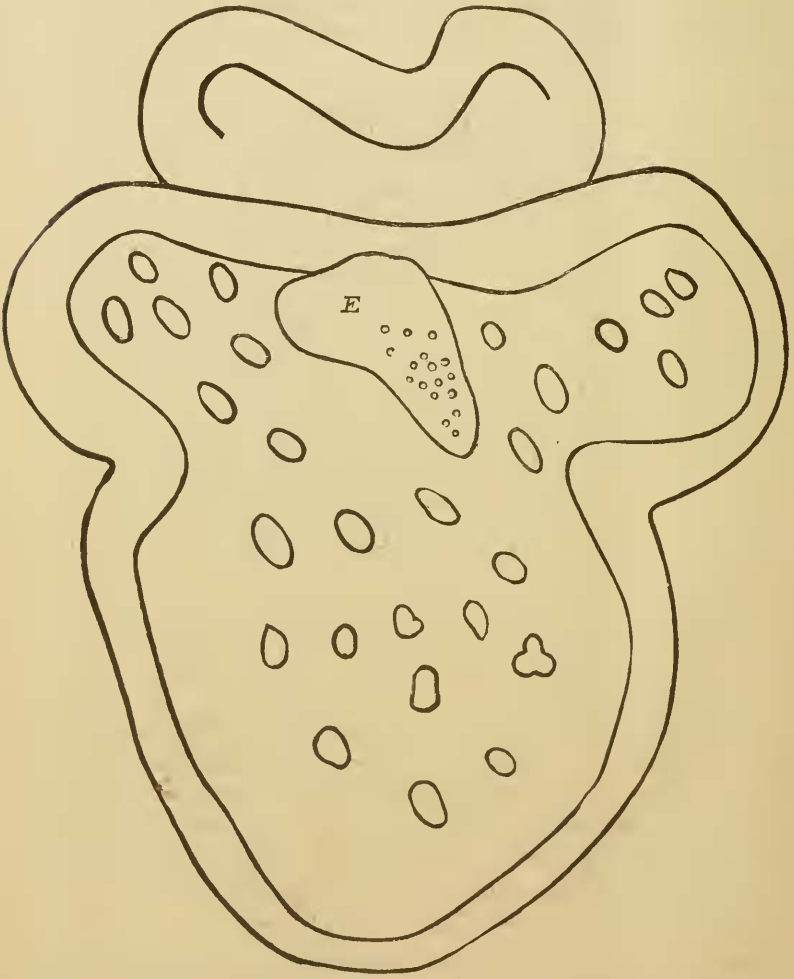

Fig. 3.—Giant monogen in optical section, or macrogen bearing a single endogen (E). Only a few of the large granules are indicated. The body is somewhat contracted and the rostellum is everted. Zeiss. 3 C. *cam. luc.* Tamblegam.

Not only are the normal larvæ contractile within their cysts, but they retain their contractility after they have become spontaneously gravid. The pentagen shown in fig. 2 was very contractile *in toto*, as also were the several endogens. In the same host a polygen with

ten endogens was observed, also a spherical monogen of the ordinary type, and a motile larva in a spacious spherical adventitious cyst. The latter is the outer fibrous layer formed from the connective tissue of the liver in which the larva is imprisoned, and, as stated above, in some cases a cavity is enclosed in which the larva can enjoy a certain amount of freedom (text fig. 5).

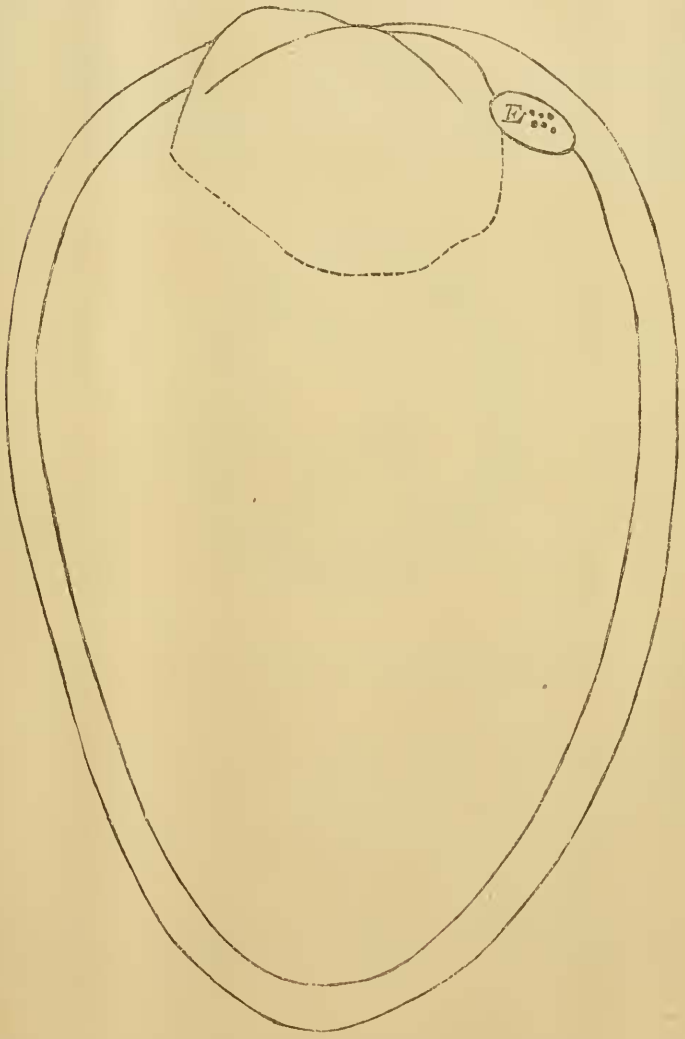

Fig. 4.—Another macrogen of large size with a single endogen (E) adjacent to the retracted rostellum. Large granules omitted; they completely fill the body. Zeiss. 3 A. *cam. luc.* Tamblegam.

When an encysted larva produces more than five endogens, it would appear from my observations and sketches that the individuality of the parent tends to become lost, and the rostellum

gradually disappears. But it also seems that a microgen can grow independently and become a macrogen, with or without the formation of one or more endogens. Thus, side by side, we find microgens containing offspring, and barren macrogens; or a larva larger than the average may bear a single endogen as in text figure 2. I have also noted a mobile macrogen 0·5 mm. in length with only one endogen. But the greatest disproportion between the sizes of the parent and that of the offspring which I have seen is represented in text figures 3 and 4; in the former the contracted body with everted rostellum measured 0·9 mm. in length, the latter was over a millimetre long. In each case the body was crowded with the usual large concretions, but there was only a solitary endogen.

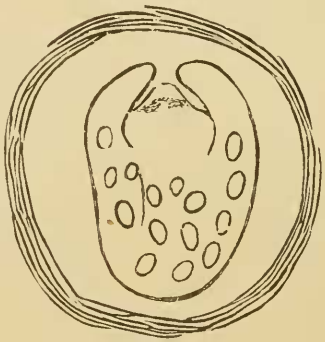

Fig. 5.—Encysted larva from liver of "pakku maddi" (*Venus* sp.). Sambore river. Zeiss. 3 C. *cam. luc.*

I should mention that I have seen a tetragen, *i.e.*, an encysted larva containing four endogens. Fig. 11 is a sketch of what I take to be an endogen having emerged from a ruptured cyst, about to give rise to a new cyst; it will be noticed that it contains both large and small granules; its greatest diameter is 0·1 mm.

The greatest number of endogens which I have counted in a single cyst is upwards of twenty (Sambore river, 12-VI.-07). The example shown in fig. 1 on the plate has fourteen endogens (Lake Tamblegam, Station IV., No. 11).

I have also found the same kind of larval forms in other bivalve molluscs which live in the sand and mud of the Sambore river, namely, in the "irattamaddi" (*Arca rhombea*) and in two species of *Venus* called pakku maddi" and "valukkal maddi" (see text fig. 5). In a liver preparation from the last-named I observed a free larva moving swiftly along by the alternate protrusion and retraction of its rostellum; on the addition of sea water it pressed itself between the lobules of the liver and became motionless.

The multiple endogeny which I have described as occurring in these parasites finds a parallel in the life-history of the common liver-fluke, where a ciliated free-swimming larva actively penetrates into the liver of a gastropod mollusc and there becomes transformed into a so-called sporocyst, which produces offspring, endogenously. All those larvæ in the liver of placuna which carry endogens are therefore in the condition of sporocysts.

The general type to which these parasitic larvæ belong is known as the Cysticercoid, and a close analogy with the phenomena noted in connection with the proliferation of the Cysticercoids of Placuna seems to be afforded by the proliferating form named *Polycercus* by Villot (1883).* This form was discovered by Metschnikoff in the earthworm *Lumbricus terrestris* in 1868, and was described without being named. An account of it, quoted from Leuckart's work on "Die Menschlichen Parasiten," is to be found in a paper by Professors Haswell and Hill,† describing a new species from the earthworm *Didymogaster sylvatica*, Fletcher, common under stones and dead timber in New South Wales. These authors say that the infested earthworms usually contain immense numbers of cysts of sizes grading up to 1 mm. in diameter, adhering in clusters to the outer surface of the alimentary canal. Each cyst contains usually 8–12, sometimes 30 Cysticercoids, which have arisen by a peculiar method of budding from a primordial larva. This species was subsequently named *Polycercus didymogastris* by Hill (1894).‡ In its earliest stages it is a solid, spheroidal mass of small-celled tissue.

Metschnikoff's larva may be called *Polycercus niloticus*, since it is now known to be the bladder stage of the tapeworm *Tænia nilotica* out of *Cursorius europæus*.§ "In its mature condition it consists of a thin-skinned bladder, which contains a varying number (up to 13) of small Cysticercoids. Although the latter lie quite free in the interior [of the cyst], and possess, like the ordinary Cysticercoids, the distinctive caudal bladder, they are of very unusual origin, inasmuch as instead of developing directly from the six-hooked embryos, they arise by proliferation of the wall of the surrounding bladder. The bladder is thus the brood-capsule of the enclosed Cysticercoids, and corresponds in some respects to the brood-capsule of the *Echinococcus*,

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* Mémoire sur les cystiques des Ténias. Ann. Sci. Nat. Zool. (6), XV., 1883 (reference taken from Haswell and Hill).

† W. A. Haswell and J. P. Hill. On Polycercus, a proliferating Cystic Parasite of the earthworms. Proc. Linn. Soc. N.S.W. (2), VIII., 1893, pp. 365–376, two plates.

‡ J. P. Hill. Contribution to a further knowledge of the Cystic Cestodes. Op. cit., Vol. IX., 1894, pp. 49–84, 3 plates.

§ See W. B. Benham. Platyhelmia, &c., in Lankester's Treatise on Zoology. Part IV., 1901, pp. 142–143.

or perhaps to a *Cœnurus* bladder, and, like these, is undoubtedly to be referred to the six-hooked embryo. The first developmental stage observed by Metschnikoff appeared to be a solid ball of about 0·08 mm., with an unusually thick cuticular envelope and cellular contents. The latter subsequently became clear on attaining a diameter of 0·14 mm., when the embryo lies on the inner surface [of the cuticle] in the form of a cellular layer. Soon the buds begin to form, and that exclusively from the cellular wall, which becomes thicker at certain spots and sends little projections into the inner cavity. Although at first flat and connected by their broad bases with the cellular wall, the protuberances, as they grow larger, gradually detach themselves from the subjacent layer."

Thus although the proliferating Cysticercoid of placuna is not a *Polycercus*, yet it is an analogous form, for which the provisional name *Merocercus* may be suggested. Looked at broadly it seems to represent a type intermediate between *Monocercus* and *Polycercus*. The latter, according to Haswell and Hill, "is not nearly related to *Echinococcus*, but finds its closest ally in *Staphylocystis*" (out of *Glomeris*).

Mortality of Placuna.

The direct observation of mud-burial in the Sambore river and the collection of many prematurely dead specimens in lake Tamblegam indicate the existence of a destructive agency in the rainfall.

Mr. H. O. Barnard, Superintendent of the Meteorological Branch, has kindly supplied me with information on this matter (see the Appendix to this report), from which it appears that there was in fact an exceptional downpour of rain at Trincomalee in January, 1907, the bulk of the rain falling within the space of a few days. This is of the nature of a torrential or catastrophic cloud-burst, causing freshets and floods and boding ill to placuna.

The average rainfall for the month of January at Trincomalee for the last 37 years is 5·66 inches; in January, 1906, the actual rainfall was 2·28 inches; in January, 1907, 10·23 inches, of which 5·42 inches (*i.e.*, nearly the whole average) fell during the first four days of the month. The actual figures are January 1, 0·29; January 2, 2·27; January 3, 2·00; January 4, 0·86. The figures for the other months of the rainy season at Trincomalee are given below, the average being reckoned for the last 37 years :—

	Inches.
October average	7·83
1905	3·90
1906	8·68

	Inches.
November average	14·23
1905	15·5
1906	24·3
December average..	14·91
1905	5·39
1906	11·39

The above figures show clearly enough a disturbance of meteorological conditions in the rainy season immediately preceding the placuna fishery of 1907, and the same indications are continued during February and March :—

	Inches.
February average	2·16
1905	0·93
1906	0·00
1907	1·48
March average	1·48
1905	0·03
1906	0·22
1907	1·94

Regeneration of the Tamblegam Beds.

The main object of placuna fishery investigations in Ceylon must be to foster the Tamblegam fishery in particular. I have already pointed out that it is not enough to limit the season and the size.

In order to replenish the partially exhausted beds, some control should be exercised over the breeding facilities so as to ensure an adequate reserve of spawning oysters. It is an axiom among European and American ostreiculturists "that the amount of spat annually occurring in a region appears to be directly in proportion to the number of spawning oysters in that region."* This is evidently a safe principle.

The Nachchikkuda, being devoid of rivers opening into it, and being by its position secluded to a great extent from other outside influences, is peculiarly suitable for the introduction of simple and inexpensive cultural operations. I would recommend the immediate laying down of an enclosure about 30 feet square and thickly planting the bottom with placunæ, of which the average size has been ascertained by previous measurement. By such means information could in course of time be expected concerning actual rate of growth, natural longevity, maturation, spawning, and distribution of the fry.

It is important to note that in spite of the mortality recorded in this report, placuna is none the less a hardy mollusc, and can be

* Bashford Dean. Report on the European Methods of Oyster-culture Bull. U. S. Fish Commission for 1891, pp. 357–406. Washington, 1893.

kept for hours or overnight out of water in a cool place with impunity. In the excellent wide-mouthed chatties which are made at Koddiyar, they can be kept almost indefinitely in sea water renewed every other day. There is, therefore, no difficulty to be met in regard to the manipulation of the window-pane oysters.

Explanation of the Plate.

Fig. 1.—A polygen cyst containing 14 endogens. Tamblegam, Sta. IV., No. 11. 22-VI.-07. Diameter 0·32 mm. Zeiss 3C, cam. luc.*

Fig. 2.—A pentagen cyst. The whole body is mobile independently of the mobile endogens. Tamblegam, Sta. IV., No. 5. Most of the calcareous concretions are omitted from the sketch.

Fig. 3.—Another pentagen with crowded endogens. Sambore, Sta. VIII. 14-VI.-07.

Fig. 4.—A trigen cyst bearing a triplet of endogens. The latter show stiff cilia pointing backwards. Tamblegam, Sta. VI., No. 10.

Fig. 5.—A digen cyst. In front of the upper endogen in the figure is seen the rostellum of the parent. From same host as fig. 3.

Fig. 6.—Encysted larva containing a transparent homogeneous endogen surrounded by a rim of the parent sarcode. All granules seen are outside the endogen, and, upon focussing through it, there appeared a continuous sheet of concretions on the other side. Zeiss 3D. Sambore, Sta. VIII., No. 2. r = rostellum of parent.

Fig. 7.—Monogen from same host as preceding, containing a more advanced endogen. Zeiss 3D.

Fig. 8.—Young larva, 0·12 mm. in longer diameter, from liver of young placuna. Sambore, Sta. VII., No. 3.

Fig. 9.—Encysted larva containing an endogen (e) with small granules, surrounded by the large granules of the parent. r = rostellum of parent. Sambore, Sta. VII., No. 2.

Fig. 10.—A monogen from a Tamblegam placuna; stiff cilia or bristles are seen at the surface of the endogen. Zeiss 3D. 23-VI.-07.

Fig. 11.—A microgen which may have arisen from an escaped endogen since it contains both large and small granules. This occurred in the same host as the macrogen shown in text figure 4, and was lying close to it. Tamblegam, Sta. IV., No. 11.

Appendix.

Tables and diagram of curves illustrating the distribution of the rainfall at Trincomalee from 1900 up to date, prepared by Mr. H. O. Barnard, Superintendent of the Meteorological Branch.

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* The magnification is always the same except when otherwise stated.

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

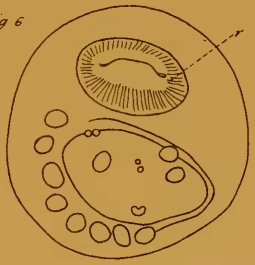


Fig 7

Fig 8

Fig 9

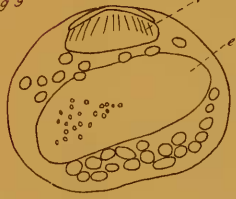


Fig 10

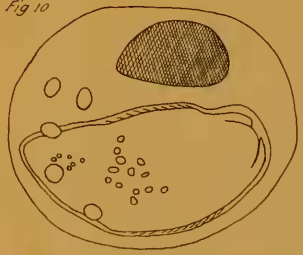


Fig 11

Table I.—Actual and Average Rainfalls at Trincomalee from 1900 up to Date.

Year.	Jan.		Feb.		March.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total for the Year.	
	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.
1900 ..	5·03	12	0	0	0	0	5·41	9	1·45	5	0	0	1·04	5	5·48	5	2·41	4	9·81	20	20·66	18	7·79	18	59·08	96
Means during 31 years ..	5·68	11	2·15	4	1·40	4	2·13	6	2·37	6	1·37	3	2·12	4	4·49	8	4·50	8	7·99	16	13·63	19	15·35	20	63·18	109
1901 ..	1·90	8	2·48	6	7·79	12	2·47	6	2·10	3	1·00	2	0·58	2	1·70	4	11·39	9	2·68	9	13·67	13	9·69	14	57·45	88
Means during 32 years ..	5·56	11	2·16	4	1·60	4	2·14	6	2·36	6	1·36	3	2·07	4	4·40	8	4·72	8	7·82	15	13·63	19	15·17	20	62·99	108
1902 ..	11·06	9	3·45	9	3·19	6	0·18	3	0·36	2	2·05	4	0·30	2	1·91	6	2·04	3	10·82	23	26·67	25	15·28	18	77·31	110
Means during 33 years ..	5·73	11	2·20	5	1·65	4	2·08	6	2·30	6	1·38	3	2·02	4	4·32	8	4·64	8	7·92	16	14·04	19	15·17	20	63·45	110
1903 ..	4·21	7	4·70	3	0	0	0·60	6	5·75	9	3·24	2	1·59	4	1·55	6	10·48	10	9·62	12	6·48	13	11·05	14	59·27	86
Means during 34 years ..	5·68	11	2·28	5	1·60	4	2·04	6	2·40	6	1·43	3	2·00	4	4·24	8	4·82	8	7·97	16	13·81	19	15·06	20	63·33	110
1904 ..	11·56	17	1·70	4	0	0	0·65	3	3·35	5	0	0	3·64	7	1·42	3	0·57	4	7·28	19	16·50	11	19·84	16	66·51	89
Means during 35 years ..	5·85	11	2·26	4	1·55	4	2·00	6	2·43	6	1·39	3	2·05	4	4·16	8	4·69	8	7·95	16	13·89	19	15·19	20	63·41	109
1905 ..	2·25	8	0·93	6	0·03	1	9·25	15	1·26	5	0·11	2	2·03	2	3·64	9	3·56	8	3·90	13	15·52	21	5·39	11	47·87	101
Means during 36 years ..	5·75	11	2·22	5	1·51	4	2·20	6	2·40	6	1·36	3	2·05	4	4·14	8	4·66	8	7·83	16	13·91	19	14·91	19	62·97	109
1906 ..	2·28	9	0	0	0·22	2	2·28	4	1·50	4	0·55	3	7·82	5	6·27	12	5·92	11	8·68	19	24·33	24	11·39	17	71·24	110
Means during 37 years ..	5·66	11	2·16	4	1·48	4	2·20	6	2·37	6	1·34	3	2·21	4	4·20	8	4·69	8	7·85	16	14·23	19	14·81	19	63·20	108
1907 ..	10·23	14	1·48	4	1·94	4	4·23	7	3·20	3	0·07	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Means during 38 years ..	5·78	11	2·14	4	1·49	4	2·26	6	2·39	6	1·30	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table II.—Groups of Heavy Rainy Days at Trincomalee from 1900 up to Date.

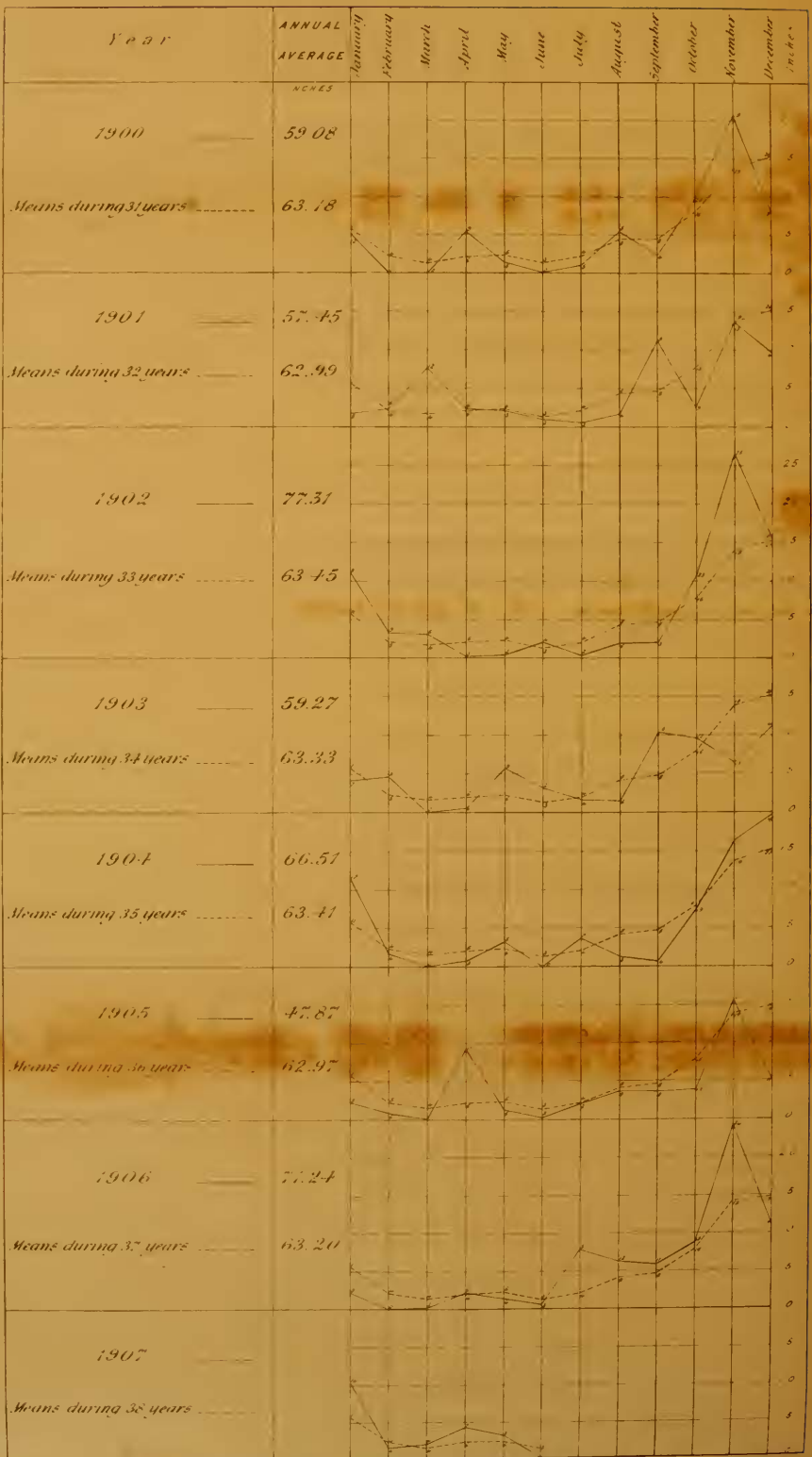
Year.	Month.	Dates.	Total Fall. Inches.
1900	January	29–31	2·84
,,	April	23–24	2·82
,,	Do.	29	1·38
,,	August	25–29	5·48
,,	September	4–6	2·37
,,	October	2–5	2·91
,,	Do.	28–Nov. 1	4·43
,,	November	16–20	6·12
,,	Do.	27–Dec. 1	5·86
,,	December	16–20	4·06
1901	March	3	2·32
,,	April	28–29	2·12
,,	August	18	1·52
,,	September	17	2·80
,,	Do.	26–28	5·32
,,	October	28–29	1·14
,,	November	8–12	5·37
,,	December	8–10	3·62
,,	Do.	16–19	3·45
1902	January	2–4	6·29
,,	Do.	6–7	3·77
,,	February	9–13	2·51
,,	March	8–9	1·43
,,	Do.	27–28	1·64
,	June	19–21	1·27
,,	September	18–19	1·98
,,	October	9–13	3·68
,,	Do.	23–27	3·38
,,	November	8–12	7·12
,,	Do.	19–23	6·87
,,	December	2–6	5·27
,,	Do.	7–11	7·13
1903	January	2–6	3·98
,,	February	10–12	4·70
,,	May	9–11	2·96
,,	June	29	3·06
,,	July	8	1·26
,,	September	7–11	4·83
,,	Do.	25–27	4·21
,,	October	23–27	3·89
,,	November	13–17	3·32
,,	December	22–26	6·71
1904	January	8–12	4·86
,,	Do.	19	3·90
,,	February	10–12	1·27
,,	May	10–11	1·72
,,	Do.	17–18	1·56
,,	July	11–13	3·22
,,	August	18	1·18

Comparison of Actual & Average Rainfalls

FROM 1900 UP TO DATE.

AT TRINCOMALEE

Figures along the Curves denote the Number of rainy days



H. C. Barnard del. et fec.

Year.	Month.	Dates.	Total Fall. Inches.
1904	October	8–12	4·32
,,	Do.	19–23	1·93
,,	November	20–21	11·17
,,	December	2–5	6·99
,,	Do.	17–19	8·45
1905	January	6–7	1·79
,,	April	15–18	5·81
,,	May	8–12	1·26
,,	August	1–2	2·17
,,	Do.	18–19	1·92
,,	September	16–18	1·69
,,	October	12–14	2·70
,,	November	13–17	5·95
,,	Do.	21–24	4·55
,,	December	2–6	4·15
1906	April	2	1·10
,,	May	1	1·08
,,	Do.	19	1·20
,,	July	9–10	2·99
,,	Do.	12	2·77
,,	August	4–8	2·98
,,	Do.	15–17	2·85
,,	September	10–12	2·36
,,	Do.	15	1·67
,,	October	17–21	3·64
,,	November	16–20	9·91
,,	December	3–6	3·35
,,	Do.	13–14	4·51
1907	January	2–5	5·42
,,	Do.	13–17	3·12
,,	February	18–19	1·33
,,	March	9–11	1·90
,,	April	10–13	3·10
,,	May	4	1·08
,,	Do.	28	2·09

NOTE ON THE POSSIBLE TRANSMISSION OF SARCOCYSTIS BY THE BLOW-FLY.

By W. S. Perrin, B.A., Gonville and Caius College, Cambridge.

WHEN we were examining the gullets of some sheep infected with *Sarcocystis tenella*, it occurred to Mr. Adam Sedgwick and myself that the Blow-fly (*Calliphora*) or the Flesh-fly (*Sarcophaga*) might afford a means of transmission of this parasite. Accordingly experiments were instituted to test the hypothesis, but owing, partly to pressure of other work and partly to the difficulty experienced in obtaining material richly infected with *Sarcocystis*, the experiments, which had hitherto yielded only negative results, were discontinued. At Dr. Willey's suggestion I thought, however, that it might be useful to publish the following account of our theory in *Spolia Zeylanica*, in the hope that some one may be induced thereby to test it in Ceylon, where material abundantly infected with *Sarcocystis bubali* is provided by the carcases of buffaloes slaughtered for meat.*

The experiments necessary to be performed are few and simple, and a month's work might be sufficient to prove or disprove the hypothesis; while, if the result of the experiments were to show that the hypothesis is correct, a discovery, not only of scientific, but also of considerable economic importance, would be made, as the presence of *Sarcocystis* in meat spoils it for human consumption.

As is well known, *Sarcocystis* is a Protozoan parasite which belongs to the Sporozoa, and is found in the muscles of various vertebrate hosts. Nearly all sheep† and pigs are infected, while horses, oxen, buffaloes, mice, and rabbits frequently are. The effect produced by the parasite upon the health of the host differs for different animals. *Sarcocystis* causes death in mice, the host becoming rapidly overrun with the parasite, while in other forms, *e.g.*, buffaloes and sheep, the infection although widespread gives rise apparently to no inconvenience.

Sarcocystis forms elongated, whitish cysts in the muscles of the host, which in the case of *Sarcocystis bubali* measure a half to one inch in length and about a quarter of an inch in diameter. The most frequent seats of infection are the œsophagus and the trunk muscles in the region of the stomach, although any or all of the muscles may be infected with the cysts. The cysts contain numerous minute sickle-shaped spores which in *Sarcocystis tenella* are

* See *Spolia Zeylanica*. vol. II., part VI., 1904, p. 65.

† Bertram records that 182 of the 185 sheep he examined for *S. tenella* were infected (Zool. Jahrb. Abth. f. Anat. V.).

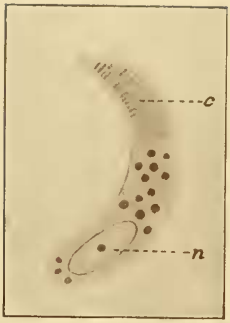


Fig. 1. Spore of *Sarcocystis tenella* (from Minchin, after Laveran and Mesnil).

n Nucleus with karyosome.

c Striated body (? polar capsule), not visible in stained preparations.

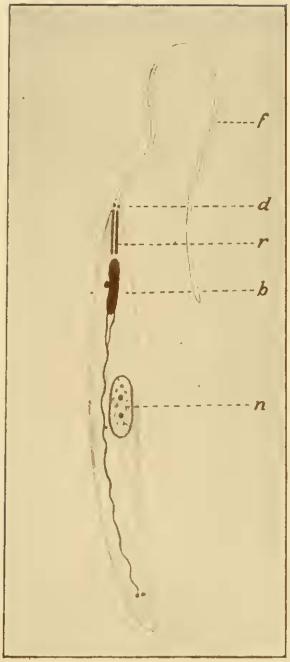


Fig. 2. *Herpetomonas muscæ domesticæ* (after Prowazek).

f Double flagellum

d Diplosome, two deeply staining granules from which the flagellum takes its origin.

r Rhizoplasts, two strands of deeply staining material running between diplosome and blepharoplast.

b Blepharoplast, the smaller of the two nuclei possessed by *Herpetomonas*.

n Main nucleus.

about 0·014 mm. long and 0·003 mm. broad. These measurements are probably the same for the spores of *S. bubali*.

The spore is rounded at one end and pointed at the other. A large nucleus containing a central deeply staining body, the karyosome, is present near the rounded end, while the faint striations at the pointed end mark the position of a body which is possibly identical with the polar capsule found among the Myxosporidia. It is these structures which presumably carry the infection. Now these spores possess no firm outer investment, which in the case of the closely allied Myxosporidia is exceedingly well developed and resistent. In fact it seems impossible to avoid the conclusion to which such authorities as Wasielewski and Laveran and Mesnil have come, that there must be an intermediate host conveying the parasite from vertebrate to vertebrate.

In the case of mice Smith* has shown that murine cannibalism may account for the conveyance, but such an explanation is impossible in the case of herbivorous forms, such as sheep and buffaloes. Might not, however, some such insect as the blow-fly be the carrier? The blow-fly lays its eggs upon meat, and the larva, which feeds upon the flesh, would, if it were infected with *Sarcocystis*, take the spores into its gut, where it is conceivable that their further development might result in the production of resistent cysts. These cysts might persist inside the larva through the metamorphosis and then gain access to the alimentary canal of the vertebrate host, either by the adult blow-fly being swallowed alive, an untimely fate which must not seldom overtake unwary individuals, or by the decomposition of dead blow-flies upon the grass. It is also possible that the adult blow-fly may transmit the infection direct by feeding upon infected carrion or upon open sores of the living animal displaying the cysts. That infection of the vertebrate host probably takes place by the alimentary canal is indicated by the fact that the most severely infected areas are always the œsophagus and trunk muscles near the stomach.

To test this hypothesis all that is necessary is to shut up a number of blow-flies in a wire cage with a small quantity of sugar for food and a piece of freshly killed buffalo meat containing ripe cysts of *Sarcocystis*. In a few hours eggs are deposited upon the carrion, and these in a warm atmosphere develop rapidly into fat, white blow-fly larvæ. After the larvæ have fed for some time upon the meat, the gut of the larva should be dissected out and examined for spores of *Sarcocystis* or possible developmental forms.

The method recommended for examining the gut contents is as follows: The gut is cut out and slit open with a fine pair of scissors, and the contents scraped out gently with a scalpel on to a coverslip. The coverslip is then rapidly placed on a glass slide, and the edges

* Theobald Smith. Journ. Exp. Med., Baltimore, VI., pp. 1–21.

sealed with wax. When the larva is large and the gut contents considerable, the fluid is divided between two or more coverslips according to the size of the gut. Stained preparations can readily be made by gently spreading the fluid over the surface of the coverslip and allowing the film so obtained to dry. The dried film is then immersed in absolute alcohol for ten minutes, again dried, and finally stained for fifteen minutes in an aqueous solution of Giemsa's ready prepared solution of eosine and azure II., one drop of the stain to one cubic centimetre of distilled water. After staining, the film is washed in water, allowed to dry, and finally mounted in cedar wood oil. This method is very barbarous, but it has the advantage of not consuming much time. It proved very convenient for diagnosing the presence of *S. tenella* in the gullets of sheep, which did not present well-grown cysts. For accurate investigation of structure some wet method of fixation must of course be adopted.

In the one set of experiments which I performed with gullets of sheep infected with *Sarcocystis tenella* negative results were obtained with the larvæ, but as the gullets used had no cysts upon them, the parasite only having been detected by microscopic examination of teased fragments of the gullet, the results cannot be regarded as by any means conclusive. Assuming either that the spores of *Sarcocystis* or developmental forms of these are shown to be present, the next step would be to allow some of the larvæ to develop into adult flies and to examine the organs of the adult for further stages. It seems unlikely that these later stages would be found in the gut of the full-grown blow-fly, as the histolysis which takes place at the metamorphosis is so complete that the larval organs entirely disappear, the adult organs being reconstituted entirely from the imaginal discs.*

Finally, experiments upon transmission to uninfected buffaloes would be made.

There is a parasite present in the gut of the blow-fly with which any one working with blow-flies is likely to meet, and of which a short description may be useful. This is a biflagellated organism allied to the Trypanosomes and belonging to the genus *Herpetomonas*. Two allied species, *H. muscæ domesticæ* and *H. sarcophagæ*, both of which give rise to cysts, have been fully investigated by Prowazek.† It seems very improbable that this form has anything to do with the life-cycle of *Sarcocystis*, but in view of the protean transformations

* *Vide* "The Blow-fly," Lowne, vol. I., p 4.—"If the pupa-case be opened just before it becomes black, it will be found to contain nothing apparently but a white cream-like fluid; but on careful microscopic examination some of the imaginal discs will be detected and many of the muscles of the larva still remain at the posterior end."

† Die Entwicklung von *Herpetomonas*. Arb. a. d. kais. Gesundheitsamt. Bd. XX., Heft 3, 1904.

which take place among unicellular animals, it is a possibility which should not be entirely forgotten.

Herpetomonas possesses two nuclei, one larger or the main nucleus, one smaller called the blepharoplast. From the latter two strands of deeply staining material, the rhizoplasts, pass to the diplosome, which consists of two deeply staining granules, from which the double flagellum takes its origin (see Fig. 2),

Even if, as indeed is very unlikely to be otherwise, *Sarcocystis* has no connection with *Herpetomonas*, a flagellated stage might well be present, as the structure of its spore rather indicates.

Minchin,* in his article upon the Sporozoa, mentions the blow-fly and also the burying-beetle as possible transmitters of *Sarcocystis*, though he does not state how he supposes the infection to be carried out in either case. From a consideration of the habits of the burying-beetle it does not seem likely that this form transmits the infection. The cockroach (*Periplaneta*) is far more likely to be the second host if the blow-fly is not, since cockroaches, especially in hot countries, are by no means particular as to their diet.

* Sporozoa in Lankester's Treatise on Zoology, 1903, p. 305.

NOTES.

1. *Leaves from my Log.*—

Flying Foxes (Pteropus medius) *at Barberyn.*—On February 23, 1907, I had another opportunity of landing on Barberyn Island to have a look at the flying foxes. Of thirteen specimens obtained, eleven were males and two females; of the males, only one seemed to be old by the appearance of the teeth, the others being young adults. One of the females was shot singly, the other was hanging alongside a male (? her mate), and both came down to one shot; each female contained a single well-developed fœtus in utero. The presence of these females renders necessary an amendment to my previous note on these bats (*Spolia*, IV., 36.)

Besides wishing to ascertain the sexes of the individuals in this colony, I was desirous of obtaining more specimens of the Nycteribia (*N. sykesii*) parasitic on these bats, and in this was quite successful. Not a single bat was wholly free from these insects. Some of the male bats only harboured three or four *Nycteribia*, but the average was about a dozen; of the females, one had about half a dozen, the other a single individual only. Perhaps this points to the fact that the male bat is more attractive to the parasite than the female, probably on account of the blood in the latter being temporarily poorer owing to the drain on the system caused by reproduction.

The roosting habits of these bats and crows in Barberyn has a very noticeable effect on the trees they affect. The branches of the coco-palms have a most ragged and bedraggled appearance, practically only the ribs of the leaves being left.

Cicindela biramosa.—This handsome "Tiger-beetle" seems to be abundant along the sandy beaches all round the Island. It is especially fond of running along the damp sand on the very edge of the water, having indeed to take to wing sometimes to escape a wave; but, as a rule, it does not seem to fly much. I have watched one for about half an hour, during which time it only flew twice, and then only for a few inches. A small gray muscid fly is common in the same localities as the beetle, and is often its victim. I have seen one or two beetles make a clumsy attempt at a fly, but they were always unsuccessful; usually they catch the flies on the wing, in which case their movements are too swift to follow. On several occasions I have seen a *Cicindela* crawl under a piece of wood or similar substance, which was lying on the beach, as if in search of *Gammarid* shrimps.

Cicindela trilunaris, from Madagascar, is stated to have the power of running upon water, and it occurred to me that probably

C. biramosa would be found to have some similar faculty, since it is so fond of running along the very edge of the waves. When at Trincomalee at the end of June, 1907, I watched *C. biramosa* on the beach, to find out whether I could see any running along on the water. This I failed to do, but I saw one overtaken by an incoming wave, which washed right over it, yet the beetle ran up the beach quite unhurt. I then tried to see if I could drive them over the water to make them settle on it. This was very difficult to do, as they generally flew *up* the beach, but I was able to corner them on a sandy spit, whence they had to fly over the water. Amongst numerous specimens which I made to fly over the water in this manner, I distinctly saw one settle on the water; rise and fly a few yards, settle again, then rise again and fly out of sight. A second specimen I saw settle on the water, but then lost sight of it, as the water was rough here.

I next determined to see whether they could rise up from the water if actually immersed in it, as they would be when caught by a wave on the beach. Three beetles were therefore caught and experimented with as follows :—

(*a*) Thrown into the water ;
(*b*) Held under water about half a minute ;
(*c*) Held under water for a full minute.

In all these cases the beetle flew off from the surface of the water without hesitation.

This shows, I think, that *C. biramosa* can stand an occasional wetting by an incoming wave, or even by being blown into the water.

False-warning Coloration in a Syntomid Moth.—Colombo, March 12, 1907. This morning our First Lieutenant caught a battered specimen of *Euchromia polymena*, which had flown on board the ship. One of the bluejackets advised him not to touch it, thinking it a wasp, and said it had bitten one of the men ! This seems a certain amount of evidence as regards the warning nature of its colour pattern.

Swallows and Seed-dispersal.—On the evening of March 16, 1907, I was watching some swallows flying about over the ramparts at Galle, and noticed one of them with something white attached to its tail. It appeared to be some fluffy seed—such as thistledown or cotton—and was firmly attached, as it remained there, whilst the bird was rapidly hawking on the wing. This is interesting as an example of means of dispersal, particularly in the case of such a far-flying bird as a swallow.

Resting Position of a Butterfly.—On April 20, 1907, there were a good many *Limnas* (*Danais*) *chrysippus* along the ramparts at Galle, congregated together quite gregariously in one place. It was just about sunset, and they were evidently settling down for

the night. I noticed that they exhibited a distinct preference for resting on small *dead* bushes, whose dry and withered leaves approximated closely in colour to that of the under surface of the butterfly.

Leaf-nesting Ants.—Trincomali, June 22, 1907. I was much interested to-day in watching the common red tree ants (*Œcophylla smaragdina*) making a new nest. They were dealing with two separate leaves, one of which they were rolling up transversely, the other one longitudinally, but the process was the same in both cases. The ants laid hold of the edge of the leaf with their jaws and hauled on it until they curved it over, a dozen or twenty working side by side according to the size of the leaf. In some cases the space between the surface of the leaf (on to which they were clinging to get a grip for their pull) and the edge of the leaf (on to which their jaws were fastened) was too great to be spanned by the body of a single ant, and in this case the ant holding on to the edge was gripped in the jaws of another standing on the leaf; if the two together could not span the gap, the second ant was gripped by a third, so that the middle ant was suspended between the two others without touching the leaf at all. I did not see more than three ants (on two occasions) hauling on to one another like this, and that only in the centre of the leaf where the space was greatest, but in many cases there were two ants, the hindmost tailing on to the fore. But if they could reach the edge themselves, they seemed strong enough to hold it.

This nest was evidently just being begun. Although, when I repassed it in the evening, the leaf seemed quite rolled up, it was still being held in position by the ants, and no larvæ had been brought down to spin it together with their silk.

Twenty-four hours later the leaf had been sewn up, but was not finished, as the ants had two or three larvæ inside still, and seemed to be still engaged on the construction of the nest.

A scarce Moth.—Capnodes tetraspila seems to be quite a rare moth in Ceylon collections, but it appears to be fairly common at Trincomalee, where I took it in June, 1906, and in the beginning of July, 1907. It is to be found in shady places under trees, where there are plenty of dead leaves, from amongst which it is readily disturbed.

Behaviour of Frogs when confronted with a Snake.—I have noticed a curious action of the part of some frogs (*Rana cyanophlyctis*) put into its cage as food for a "Green Keel-back "snake (*Macropisthodon plumbicolor*). As the snake was moving about, whenever its head came near a frog, the latter raised itself on its legs (whereby the rump was elevated aloft, whilst the head was almost on the ground) at the same time blowing itself out. However, the snake took no notice of the frogs; it was not hungry at the time, being about

to cast its skin. Messrs. Green and Austen have recorded (*Spolia*, III., 196, and IV., 32) a similar defensive action on the part of toads, but my frogs did not "alternately raise and lower the hinder part of the body" as their toads did.

T. BAINBRIGGE FLETCHER.

H. M. S. *Sealark*,
September 13, 1907.

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2. *Rare Colombo Birds.*—On January 6 last I saw two Alpine Swifts (*Cypselus melba*) hawking within twenty feet of the ground near the General Cemetery. The appearance of these birds, which rank amongst the speediest birds in existence, in Colombo, is, I think, worthy of record, as they are not often seen as low as this. Legge says :—"It takes up its quarters amongst the upper regions of the Kandyan Province," and adds "but, being a bird of such immense powers of flight, it wanders with ease, in the course of a day's hawking, over all parts of the Island."

During last December and January a flock of seven Black-sided or Sociable Lapwings (*Chettusia gregaria*) (see *Spolia Zeylanica*, II., p. 190) were to be seen on the racecourse. They were very tame, and allowed riders to come quite close before taking wing.

I should be glad if any ornithologist can tell me whether the Wire-tailed Swallow (*Hirundo smithii*) has been observed in Ceylon. I am almost certain I saw one hawking over the sides of the Colombo lake on July 1st of this year. The bird was very much like *H. rustica*, but the length of the outer tail feathers, white underparts, and conspicuous white spots on the rectrices attracted my attention. If it was not *H. smithii* it must have been a common swallow in full summer plumage, and its presence here on the above-mentioned date is somewhat unusual, and I think worthy of record.

W. A. CAVE.

Colombo, September, 1907.

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3. *Window-tapping by Birds.*—Various species of birds have been noticed to indulge in the above habit. In the hills a species of Wagtail is a constant performer. But I do not think that the common honeysucker (*Cinnyris zeylonicus*)* has been included in the list of window-tappers.

The window of my laboratory in the Peradeniya Gardens has recently been assaulted in this manner. The birds were building in

* Now named *Arachnechthra zeylonica*, the Purple-rumped Sun bird. (Fauna Brit. Ind. Birds, vol. II., p. 364)

a shrub close by, and the male bird amused itself by repeatedly scrabbling and pecking at the windowpanes.

E. E. GREEN.

Peradeniya, May, 1907.

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4. *An Eighteenth Century Relic.*—There is an annual pilgrimage in the Jaffna peninsula to the church of St. James the Great at Kilali on the Jaffna lagoon between Chavakachcheri and Pallai, which is attended by from 1,500 to 3,000 people. It takes place in July on the festival (25th). The church possesses an image of the Saint, who is represented as a mounted warrior wearing a military cloak and in seventeenth or eighteenth century costume. There appears to have been a shrine here dedicated to the Apostle in the Portuguese period, when the village was inhabited by Parawas from Tuticorin. During the time of the Dutch the church was destroyed, but it is said that about 100 years ago, during the early years of the British occupation, a box was dug up here by Samerasekara Mudaliyar *alias* Don Louis Poothar, who acted as guide to the British forces on an expedition into the Vanni, which contained this image, a representation of it cut on a piece of wood and a gold hat belonging to the image, all of which are still preserved.

It is the hat to which I wish to draw attention. It is of the three-cornered shape characteristic of the middle of the eighteenth century, with a Portuguese inscription giving the name, I presume, of the donor : " Servo do Santiago Mayor, Ls. Ferras " (or Ferrar?), the meaning of the description being that he was a " Servant of St. James the Great." It is a curious instance of the survival of the Portuguese language among a Tamil caste.

It weighs $1\frac{1}{2}$ ounce, the length of each side of the brim is $2\frac{1}{2}$ inches and the diameter of the crown nearly $1\frac{1}{2}$ inch. I give drawings of the exact size of the hat. While the image is of clay or pottery, the hat is of gold. The present Samerasekara family have provided a gold sword.

Samerasekara Mudaliyar rebuilt the church and founded the pilgrimage, which has gone on now for five generations.

Kilali was a stage on the old Jaffna Coast road, and had a resthouse in Dutch and early British times.

J. P. LEWIS.

Kandy, September, 1907.

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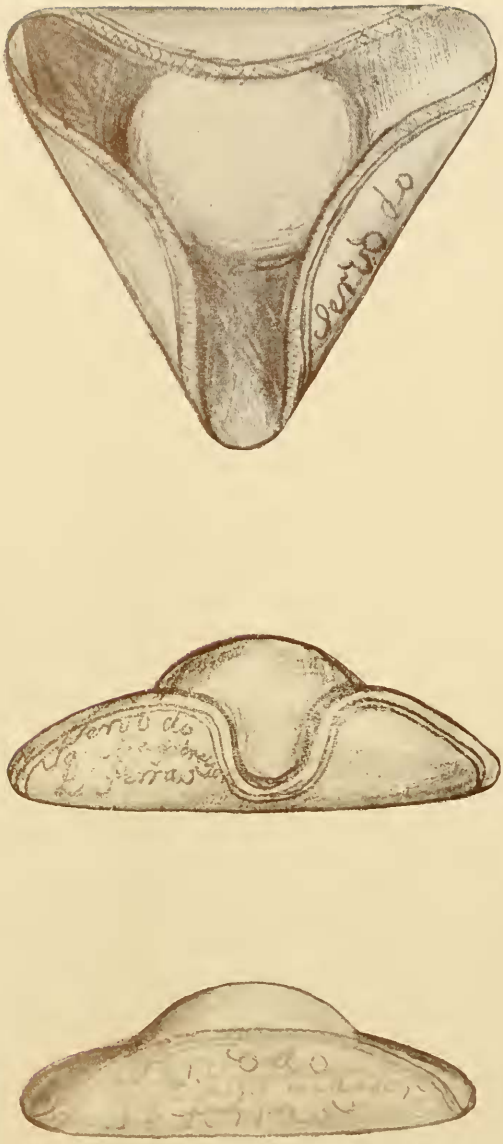
5. *Leocyma sericea.*—In November, 1906, hearing of the great number of moths coming to the electric lights round the Boer camp at Diyatalawa, I became a guest of one of the officers there for three days.



Each evening, within half an hour of the lights being lit, the moths appeared in numbers and great variety, and by a quarter past seven there were myriads whirling around the lamps. Predominant among them was *Leocyma sericea*, a pure white satin-winged Noctuid, about $1\frac{5}{8}$ inch. across the wings.

In walking from the various military quarters to dinner in the mess house, quite short distances, every one was so covered with this moth that we presented the appearance of having come through a snowstorm. The strange thing about *Leocyma sericea* on this occasion was that amongst those caught or examined I did not see a single male, and as one of the soldiers was helping me we must have seen thousands.

Most of my work was in the morning from 5.30 to 7.30 searching the ground, foliage, lamp-posts, and any buildings where the moths had pitched and rested during the night well into the morning. At one place near the hospital there must have been from five thousand to ten thousand moths, large and small, visible within a radius of twenty yards. The sentry walk was a sludge of wings and bodies, some of the former indicating rare species.

By 8 A.M. what with the crows, sparrows, swifts, frogs, and heat of the sun scarcely a moth was to be seen, and yet each evening while I was at the camp their numbers seemed as great as ever.

Ordinarily *Leocyma sericea* is not a plentiful moth in Ceylon, and at the period of emergence from the chrysalis in September to November one is fortunate in getting three or four of a night at ordinary light, and on these occasions I have not found the females outnumbering the males more than two or three to one.

F. M. MACKWOOD.

Colombo, September 17, 1907.

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6. *Singing Fish of Batticaloa.*—As one who has lately visited Batticaloa and heard the so-called singing fish in the lagoon there, I wish to give you my impressions of the phenomenon.

The sound produced (from whatever cause) is not easy to describe, but it may be said at one time to resemble, though may be remotely, that given out by a loose banjo string when struck, and at another to remind one of a distant (very distant) motor horn. I have tried to reproduce it on the piano, and find—at least to my mind—that it corresponds as nearly as possible to the discord produced by striking the notes *b* and *c* (natural) together, with the soft pedal down. I noticed that the pitch of the singing fish varied at times, going up and down by intervals I could not determine. I will not attempt to formulate a theory with regard to the origin of the musical sound, but I might mention that it recalled to me the high-pitched cry (not the exasperating guttural note) of the frog

which one hears when, after a prolonged drought, there is a heavy downpour of rain. But the "song" of the fish is more subdued. Whether these observations will suggest a clue is more than I can say.

C. DRIEBERG.

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7. *Crows as Diggers and Weeders.*—At Weligama resthouse on the morning of May 15 I watched a company of crows actively engaged in digging the soil and wrenching out grass plants with their beaks, cawing lustily at the same time. This was after a heavy shower of rain. I tried to assign a purpose to this digging and weeding operation combined, but without satisfactory issue.

(1) The grass was wanted for nest making, but it was not being carried away. If it is supposed that the grass was being left to wither before use, why were the birds working fresh areas when there was so much dry grass lying about as the result of previous work ?

(2) The crows were in search of bulbs of the nut grass (S. Kalanduru), *Cyperus rotundus*, but the grass on examination proved to be wild kurakkan (S. Belatana), *Eleusine indica*, and there was no nut grass about.

(3) The birds were digging for earthworms, but I did not observe any worms being unearthed and swallowed. Besides, the wholesale uprooting of grass seemed hardly necessary to get at them. The resthouse-keeper who examined the ground declared that there were no traces of worms. In the absence of direct corroboration of any of the above theories, I am inclined to think the last the most plausible, *i.e.*, that the crows were *in search of earthworms*, which are known to come up to the surface after rain and there deposit their casts. In this instance the birds might have been on the wrong track. That they have a great partiality for earthworms cannot be denied, and their behaviour on the occasion referred to may be taken as an indication of the pains they will take to get at the worms, for hoeing up the ground and wrenching out grass tufts cannot be very easy work for a crow.

Some one suggested the idea—rather far fetched to my mind—that the birds were only amusing themselves, with no other object than giving way to a sense of exhilaration.

C. DRIEBERG.

THE SUBMERGED PLATEAU SURROUNDING CEYLON: SOME CONSIDERATIONS REGARDING THE FORMATION OF THE COAST LINE.

By Commander Boyle T. Somerville, R.N.
(Late of H.M.S. "Sealark.")

With Diagrams.

I.—General Remarks.

THE Island of Ceylon has the peculiarity of being surrounded by a submerged plateau, which extends to an average distance of twelve miles from the land. The edge is strongly marked: first by a drop, in most places of 400 feet in about 200 yards, and then of 3,000 feet more in two miles; the oceanic depth of 6,000 feet (or 1,000 fathoms) being reached at about eight miles beyond that again. (See figs. I., II., and III.)

To the northward the plateau merges into that surrounding the south-eastern coast of India, off which a similar formation prevails; but to the southward it gradually deepens, still preserving its shelf-like form along the eastern, western, and southern coasts of the Island, and is both narrowest and deepest (as regards soundings) in the vicinity of Dondra Head.

The 100-fathom line, which may be taken as the outside edge of the plateau, follows the general trend of the coast line; but off the eastern side of the Island there are several remarkable deep and narrow notches, the two most notable of which are off Trincomalee (Koddiyar Bay) and five miles north of Batticaloa respectively, where the point of the deep water approaches to less than a mile off the shore in the first instance and to within two miles in the other.

I am unable to speak definitely of the rest of the plateau, except of that part which occurs within the limits of the "Sealark's" survey during the last two years, as represented in fig. I., and in that area but one notch occurs, namely, off Panadure, where the 100-fathom line approaches the coast to within about nine miles.

In fig. I. it will be seen that the plateau shoals progressively from the south towards the north. The average depth at the southern part is about 36 fathoms, and this continues to abreast of Barberyn lighthouse, at which point a gradual shoaling begins, until, just northward of Colombo, the plateau is covered by only 20 fathoms of water.

A characteristic feature of the plateau is that there is a slight deepening—a sort of irregular channel—running along its central line and parallel to the outer edge throughout nearly the whole of its length.

Where the plateau is of an average depth of 35 fathoms this depression is, roughly speaking, of a depth of 42 fathoms; and where, as off Moratuwa, the general depth is 23 fathoms, the depression is about 33 fathoms. Near Colombo, however, this feature becomes lost; and, instead of a depression, there is, on the other hand, a series of banks: one with a depth of but 10 fathoms, the others less shallow.

The 20-fathom line also, which gradually increases its distance from the coast between Galle and Mount Lavinia, takes a most decided bend outward at this point, and, together with the banks referred to, causes a marked general shoaling on the plateau in this neighbourhood.

Fig. II. represents a section taken from the "Haycock" (Hinidumakanda) to the coast at a spot about ten miles eastward of Galle and through the narrowest part of the plateau.

Fig. III. gives a section from the same mountain through Waal island (at the south-west corner of Ceylon), and again through the plateau into the deep water beyond, the plateau at this point being of average width and normal character. The vertical scale in each case is the same as the horizontal scale, so that the plateau and the fall into deep water are shown with their true relativity, though the central gully is scarcely realized.

A section taken through Colombo would exhibit very similar features to both figs. I. and II. as regards the plateau, but the land being low and level for many miles inland it would scarcely be apparent as an elevation on this scale, which is 6,000 feet to one inch.

The above characteristics may therefore be thus summarized:—

(1) The plateau extends on an average to a distance of twelve miles from the coast with depths slowly shoaling from the southward to the northward from 40 to 20 fathoms.

(2) In all parts a sudden and very well-marked drop into oceanic depths occurs at the outer edge.

(3) A slightly deeper channel or gully is found in the centre, tapering off to the northward, and ended by

(4) A marked shoaling, and the existence of banks, beginning off Mount Lavinia and extending to the northward.

II.—Effect of the Plateau upon Current and Swell.

It must be supposed that such a natural barrier fringing the coast would cause some considerable modification in the direction and speed of the ocean currents reaching the vicinity of Ceylon, as

well as on the swell accompanying the monsoons, on each side of the Island.

Currents.—It would be beyond the scope of these remarks to discuss the ocean currents of the Indian Ocean, the Bay of Bengal, and of the Arabian Sea; but it is necessary to note that Ceylon lies within touch of all three systems; and it is probably due to their mingling near these shores that so many perplexities and discordances have been recorded by navigators approaching the Island.

The main oceanic currents alter their path (but not their direction) throughout the year, moving north and south with the sun. The change of monsoon is also occasioned by the same alterations in position of the source of heat, and it is thus convenient to refer to the currents in connection with the monsoons, for the changes in each take place, necessarily, at about the same times of year. It seems improbable that one is actually occasioned by the other: the currents by the monsoons, or *vice versâ*. The effect in either case would seem too great for the cause under such a hypothesis.

The combined general effect on the coast of Ceylon, however caused, is that the currents circulate round the Island in the direction of the hands of a watch during the north-east monsoon period, and contrary to the hands of a watch during the south-west monsoon. At the change of monsoon the currents are variable; that is, they do not alter suddenly from one direction to the other.

As regards their rates, the greatest recorded occur off the eastern coast during the months of December and January, and then vary from $1\frac{1}{2}$ to 4 knots. (One knot means one nautical mile per hour.) Off the western coast the current never runs more than about one knot, being strongest in January and August.

The above statements of the direction and speed of the currents must be taken as very broad; for, in my own experience, when sounding off the western and southern coasts of the Island, or at anchor (when definite observations for current alone are possible), the surface currents were often found to be of the "wrong" character for the time of year; and not only that, but on steaming outwards on a line of soundings from the coast (which necessitates the accurate positioning of the ship by the land every few minutes), two perfectly distinct sets of the current have not infrequently been observed, running in diametrically opposite directions, within a mile or less of one another and parallel to the shore. This has also been reported on the eastern side of Ceylon.

The plateau probably has a considerable part in producing these results. The actual depth of oceanic and indeed of all currents is still a matter of great controversy; and such observations as exist for the Indian Ocean and these coasts refer solely to *surface* currents. It is very possible, and indeed probable, that the lower layers of water are moving with different speeds and directions to that of the surface, actuated by differences of temperature, salinity,

by the topography of the bottom over which they are travelling; and other reasons. It cannot therefore definitely be said how the outer wall of the plateau acts as a deviator of the ocean currents in this case. If the current is deep, it would of course play a very important part, but if shallow, less so. In any case the increase which would be caused in the ocean temperature by the sudden alteration in depth from 1,000 fathoms to 35 fathoms within a few miles must have a profoundly modifying effect. It may also be conjectured that the gully in the middle of the plateau may produce some alteration in the speed of the currents, if the currents reach so far down.

Swell.—As regards swell, it is possible to speak more definitely. How and where the motion *through* the water known under that name originates it would be difficult to say; but it is certain that its effect is greatly increased, and finally converted into motion *of* the water—*i.e.*, breaking waves—on coming into shallows.

This is clearly seen along the south-west coast of Ceylon, where it is no doubt aggravated by its 12-mile journey over the plateau before it reaches sufficiently shallow water to break, as it does, in enormous rollers on the beach.

The shoaling of the plateau to the northward, and especially the presence of the banks before mentioned (which lie exactly in the line of the south-west swell on its path towards Colombo), make an extremely well-marked difference in the amount of the swell, which is both higher and more constant in this locality than, say, 30 miles farther south, as at Barberyn (Bentota district).

Had this fact been known, it should have been an additional reason against the attempt to build a harbour at Colombo which should be clear of swell—an attempt which, as we see, has hitherto been attended by failure. Almost any other notch in the coast to the southward (and especially Galle, off which bay the plateau is considerably deeper and narrower) would have offered a better chance of success from this cause.

Character of the Bottom.—During the course of sounding operations it is usual to obtain specimens of the material forming the floor of the sea. On Fig. I. the general appearance of these specimens is given beneath the figures representing the depths. Dr. Willey, to whom the samples were sent, reports that the specimens from the shore plateau consist of shelly and coralline *débris*, worm tubes, bryozoa, echinoderm spines, foraminifera, &c., almost entirely calcareous. A sample from 185 fathoms, on the other hand, from outside the plateau, though on its exterior slopes, consists of caked and powdery mud, principally calcareous, with a few minute quartz grains, siliceous spicules, and organic particles. In fact the bottom in the deeper water over the edge of the plateau consists of fine mud, essentially the same at all depths and all stations, containing numerous calcareous remains of foraminifera, chiefly Pulvinulina.

The deep sea mud off the plateau of Ceylon has a greenish coloration, which Mr. M. Kelway Bamber, F.I.C., F.C.S., pronounces to be organic in nature, dissolving out in hot alcohol, and leaving an amorphous green colour on evaporation, easily soluble again in alcohol. Mr. Kelway Bamber has kindly undertaken a chemical analysis of this mud, and the results are given in the Note accompanying this paper.

It is noticeable that the area in which occurs what I have termed "green mud" is the deep water outside the plateau, whilst on the plateau we found only brown sand, broken shells, and occasionally broken coral, always in very small quantities. This would seem to point to the probability of currents existing along the bottom over the surface of the plateau, preventing the accumulation of soft material composed of light particles, such as is represented by the "green mud" of the greater depths. When at anchor in 12 fathoms on the easternmost of the three small banks off Mount Lavinia, a diver from the ship procured a specimen of the bottom for investigation. He reported the surface to be flat, smooth, and hard, without sand or any loose material lying on it. The specimen, which had to be levered up from its position with an iron bar, consists of coral, which Dr. Willey informs me to be Porites coated with nullipore in places.

The green colour above noticed is usually associated in bottom specimens with "terrigenous" material, and is found only on continental slopes. On reaching true oceanic depths the deposits are almost invariably coloured gray, or pale brown (except in the cases of recent volcanic upheavals).

More extended collection of specimens round the outside of the plateau will, no doubt, produce the correct reasons for the occurrence of the green coloured deposit, and also the outside limits at which it is found from the coast, but since the material is not of a properly constituted "oceanic" colour, but rather "terrigenous," we may suppose that its greenness is due to the finer washings of the detritus from the rivers, which, held in suspension for a considerable period in the sea water by reason of their lightness, have been carried by the surface current over the edge of the plateau and not deposited until deep water has been reached; while the coarser and heavier particles have remained behind to be acted on by bottom currents near the land and on the plateau. These conjectures refer solely to the southern and western surroundings of the Island, no specimens having yet been obtained elsewhere.

III.—The Coast Line of Ceylon.

I do not know whether the considerations which I now propose to set forth have been previously advocated, but while dealing with the plateau, the currents, and swell, I should like to point out an effect on the coasts of the Island, which is probably due to these

oceanic causes, in combination with others originating in meteorological conditions affecting the land. I refer to the growth and changes in the coast line.

My attention was drawn to the matter first of all by the strange absence of coral reef the whole way round the southern half of Ceylon, from Chilaw to Trincomalee. It is true that little patches occur here and there, as at Hikkaduwa and Galle, but after a considerable experience of tropical seas, it seemed remarkable to me that there was not only no wide fringing or barrier reef to Ceylon, but that scarcely any specimens were brought up on the lead whilst sounding.

The brown colour of the sand forming the beach round the southern shores would alone point to the absence of coral, being so dissimilar to the typical glaring whiteness of the beach behind a coral reef.

The first explanation that occurred to me was when journeying by the coast railway. I saw in the vicinity of Ambalangoda the strange spectacle of natives digging coral out of an apparently not very ancient reef, which is now about half a mile from the coast, and covered by four or five feet of black humus.

It is thus apparent that the coast line, in that locality at any rate, is in process of extension outwards ; and it seems possible that the following considerations point to such a process being not only continuous, but sufficiently rapid to prevent the growth of coral, except in favoured corners, such as that now to be seen by the resthouse at Hikkaduwa, or as in the case of the reef, now overcome by the accumulation of soil, that I saw from the train, which may originally have been similarly circumstanced.

Attention is now called to the existence and distribution of the lakes that fringe the coast line of Ceylon, as exhibited in fig. IV., and it will be noticed that—

(1) These lakes or lagoons occur practically all round the Island ; but

(2) In much greater frequency on the east coast than on the west, and to the north than to the south ;

(3) That while those to the southward are now all enclosed from the sea and become fresh, those to the northward—Negombo, Puttalam, Jaffna, and Batticaloa, for example—are still open to the sea and salt ; and that

(4) While those still open to the sea on the west of the Island have been formed by bars of sand, &c., pointing to the north, those on the east of the Island have their bars pointing in the other direction, namely, to the southward.

It will further be remarked, under the above numerical headings, that—

(1) The contributing causes must be of a similar nature in all cases ; but

(2) Differing in degree, not only according to the side of the Island, east or west ; but

(3) Also as between north and south ; and that

(4) One of the moving causes emanates from the south, and the other from the north.

I beg to offer the following suggested explanations :—

Firstly, in a large and general way, it is noticeable that Ceylon is constructed in two marked divisions, namely, mountain country and flat country ; there is scarcely any midway between them ; and the hills, whether isolated or taking the mountain district as a whole, appear each to be swimming in a flat ocean of soil (if one may use such a simile) from which they spring abruptly.

The next large point to be noticed is that the greater part of the flat country is spread out to the northward of the hills, tailing off in a point of lagoons and shallows ; but that there is also a spreading out of flat land to the eastward and westward, though not so extensive, and practically none at all to the extreme south.

A consideration that here intervenes is the probability that the mountain region of Ceylon has never been submerged at any time ; or if it has, not for any great length of time, and this is evidenced by the entire absence of chalk or sedimentary limestone, or of any calcareous aqueous deposit. The Ceylon mountains have existed, it may confidently be stated, in their present average condition since their first formation, giving a condition of stability and a field for the continuous action of denudation for immense ages.

What the meteorological conditions of Ceylon were at the time of its first appearance it would be hard to say ; but a good antiquity may be predicted for the monsoons, which have probably existed as long as the ocean, though modified in degree by the changes in the obliquity of the ecliptic.

And, springing from the same cause as the monsoons (namely, the annual movement of the sun and its heat focus), the ocean currents have similarly visited the Island with equal regularity and antiquity.

The point to which I am leading is this, namely, that the low-country of Ceylon has, on the whole, been derived from the denudation of the mountain country, and has been laid down on a plateau, of which we now find remaining a 12-mile fringe surrounding the Island.

Following these prefatory remarks, I now refer to the four points for consideration above stated in numerical order :—

(1) The soil of Ceylon is on the whole friable, and easy to be detached and washed down by the monsoon rains on either side.

This, one may suppose, has always happened, as it is now happening, each river carrying to the coast from the inland vast loads of detritus on every day that it is affected by the monsoon rain—material which, on reaching the coast, has been carried by the sea currents and deposited until it has formed the outline of the shore that we now see, an outline which it is still extending and altering.

The method of extension seems to be, first, the formation of bays along the coast, by the gradual banking up of sand and detritus at some little distance from the shore line, banks originally induced perhaps by some obstacle, such as a slight rocky ridge. The banking process seems to continue until the bay becomes a lake—at first salt, then more and more brackish by degrees, and finally, after many monsoons, perfectly fresh.

The succeeding process would no doubt be that such a lake would slowly fill up with vegetable humus and detritus due to the rains, until it assumed its final stage as a slight depression in the land or as a swamp.

Note should here be made of the fact that the coast extension work probably takes place chiefly during the south-west monsoon period on the western side and during the north-east monsoon on the eastern, for it is during these periods that the heaviest rainfall occurs in each case, bringing the necessary material down to the coast.

(2) There is, however, a marked difference to be noticed in the results, due to the different character of the two monsoons.

The south-west monsoon rains, speaking generally, fall steadily and constantly, and the greater amount of moisture in the air throughout the year on the western side of the Island induces a dense vegetation, which tends to hold together the particles of soil.

The north-east monsoon rains, on the other hand, though less in total amount, fall with great violence and suddenness on a soil which has for several months been exposed to the action of a fierce unclouded sun and an intensely dry air, so that it is in a defenceless condition against the momentum of the sudden torrents of water by which it is assailed.

It is probable, therefore, that a larger amount of detritus is carried down to the eastern coast than to the western, thus occasioning a larger number of lagoons on that side; and also the fact that the low-country, taken as a whole, is more extensive on the eastern side of the mountains than on the other. There are, besides, many more water-courses from the hills to the eastward to bring down material, though many of them cease to flow during the dry season.

(3) The fact that the lagoons of the northern side are still open to the sea is probably due to the much greater distance that the material has now to be carried from the hills, the freshets not being sufficiently strong to carry it, except, as it were, in loads, a bit at a

time, down to the coast line. The flatness of the course of the streams must also greatly reduce their velocity.

(4) Sufficient time and sufficient material, with transport for the same having now been provided for the formation of the low-country by denudation, it remains to be seen why the extension should have taken place chiefly to the northward. The fact is undoubted; but the explanation of it is not at all obvious. The currents, at a little distance off the shore at all events, run throughout the year to the southward just as much as to the northward, and on the eastern side with a greater velocity to the south than to the north.

The meteorological conditions in ages past and the trend of the ocean currents may have been different, when the Island of Ceylon was represented by the mountain country, from those now existing, and in any case the gradual northward growth of the land would slowly deviate the courses of the streams in the sea.

No observations have yet been made, but it seems at least possible that there is, on the western plateau at all events, a steady current *along the bottom* making to the northward. The diver employed in obtaining the bottom specimen from the 10-fathom bank off Mount Lavinia (see above) could scarcely keep his legs, owing to the strength of the north-going current over the bank, which itself had been swept bare of sand or other loose matter, no doubt from this cause.

It is this which may have formed the protecting arm of Negombo lake, and the still greater one enclosing Puttalam; and it may quite possibly be the agency that covers with sand and again uncovers the pearl banks. The only evidence of its existence is the barrenness of the plateau to the southward, and its greater depth, as compared with its sandiness northward of Colombo, and shoalness.

The shapes of the mouths of the rivers that occur on fig. I. (which are presented on fig. V. on a larger scale) may be additional evidence as to a north-going current of the present day, so far as the western coast rivers are concerned, since all are formed with sandy peninsulas across their mouths trending to the northward. This is very clear in the case of Colombo, where both the interior peninsula and the present exterior bar of the Kelani-ganga point north, and all the points in the Colombo lake have the same direction.

At Panadure-ganga the flood water breaks out at a weak spot to the southward it is true, yet the *interior* peninsula has grown to the northward; and there is a small lagoon northward of it again, which may indicate a former mouth. The land in that vicinity is at present occupied by the town of Moratuwa, and human agencies may have been at work to make the river or lake (as it really has now become) empty itself at a different spot.

The Kalu-ganga, having been gradually headed by a bar working up from the south, has now broken out at the northern end; and the Bentota-ganga bar is a complete instance of a northward trend.

The mouth of the Randomba lake (connected with the Madu-ganga), which meets the sea at Balapitiya on the western coast, has a northward pointing peninsula of beach fronting it, and so also has the Madampe lake, not far to the south of it, at Ambalangoda.

The mouths of the Hikkaduwa-ganga and of Ratgama lake (near Dodanduwa) have sand spits directed to the southward; and the Gin-ganga, the next outlet of fresh water along the coast to the southward, has a very decided sandy bar pointing to the south-east.

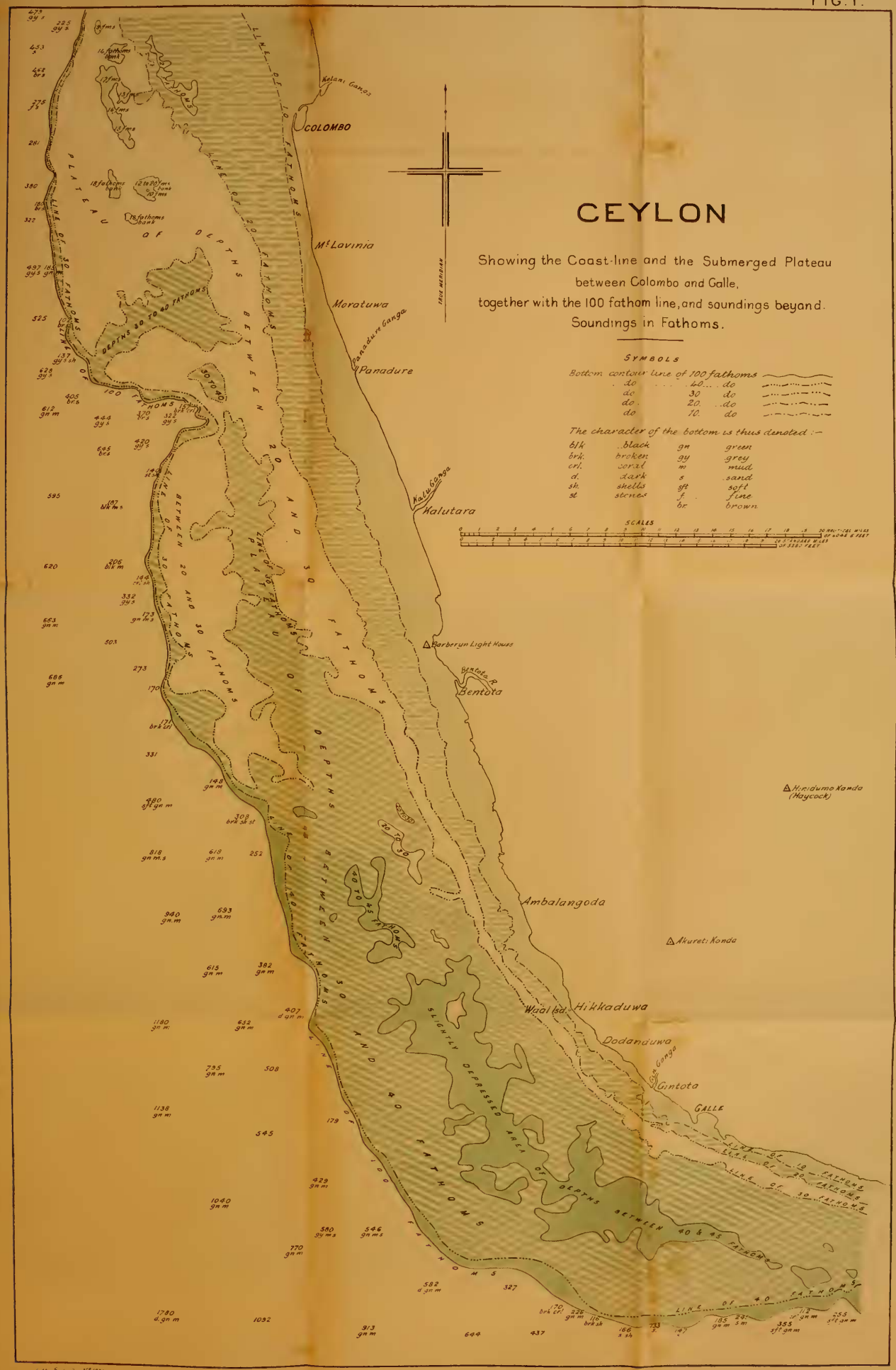
This introduces another proposition as to the formation of the lagoon and river bars, namely, that when the material is brought down the rivers, it is at the time when the monsoon is blowing strongly; and there is not only a "wind-slop" of waves driving before the wind, but also a heavy swell running in the same direction. It is not at all improbable that these forces combined may form a current of no great width—a forced current, as one may say—running along the beach to the northward up the western coast, and to the eastward and southward past Galle, towards the Basses. This theory may possibly suffice to explain the whole phenomenon of the growth of the coast line, but until properly systematized observations of currents with a current meter are taken at various depths over the plateau the problem must remain in doubtfulness.

On the eastern side there is less difficulty of explanation, for the current is running most strongly to the southward at the time of the north-east monsoon and its rains, and thus all the requisite conditions are fulfilled.

It cannot be predicted how long it will be before the coast lines will have worked outwards all round to the 100-fathom line, for there is no reason to suppose that the coast-forming work has now reached a standstill. On reaching the edge of the plateau it will practically cease, from the great depth that would have to be filled up with detritus. This is probably beginning to be felt in the case of the Mahaweli-ganga at Koddiyar Bay, where the edge of the great alluvial plain which has been formed by the river now approaches the head of the deep bight that there occurs in the 100-fathom line, within little more than half a mile.

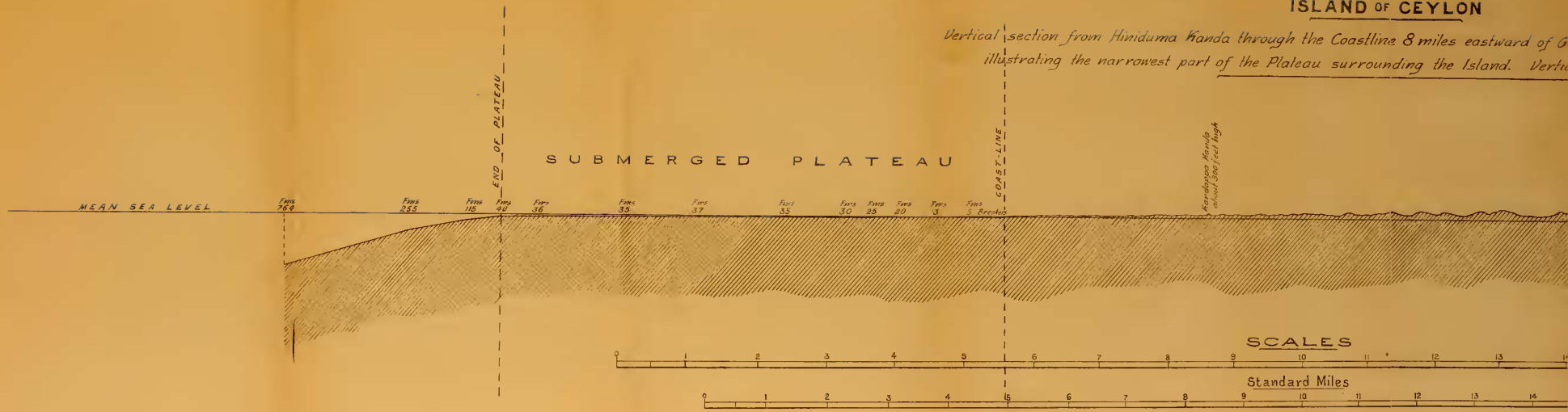
On fig. IV. I have included the more important of the artificial tanks scattered over the low-country. These certainly indicate depressions, which in former days may have held swamps or small lakes, whose presence suggested to the tank builders the improvement of their depths or dimensions. These tanks need not necessarily have once been coastal lagoons, though it is quite within the bounds of probability to suppose so, and especially those that occur near the courses of rivers.

FIG. 1.


CEYLON
Showing the Coast-line and the Submerged Plateau
between Colombo and Galle,
together with the 100 fathom line, and soundings beyand.
Soundings in Fathoms.
SYMBOLS
Bottom contour line of 100 fathoms
do 40 do
do 30 do
do 20 do
do 10 do
The character of the bottom is thus denoted :-
blk black
brk broken
crl coral
d dark
sh shells
st stones
gn green
gy grey
m mud
s sand
sft soft
f fine
br brown
SCALES
COLOMBO
Kelani Ganga
Mt Lavinia
Moratuwa
Panadure Ganga
Panadure
Kalu Ganga
Halutara
Barberyn Light House
Bentota
Hikkaduwa
Ambalangoda
Akuret: Konda
Hiriduma Kanda (Haycock)
Waalla
Dodanduwa
Gin Ganga
Gintota
GALLE
PLATEAU OF DEPTHS BETWEEN 20 AND 30 FATHOMS
LINE OF 100 FATHOMS
LINE OF 20 FATHOMS
LINE OF 30 FATHOMS
DEPTHS 30 TO 40 FATHOMS
SLIGHTLY DEPRESSED AREA OF DEPTHS BETWEEN 40 & 45 FATHOMS
LINE OF 10 FATHOMS
LINE OF 40 FATHOMS

ISLAND OF CEYLON

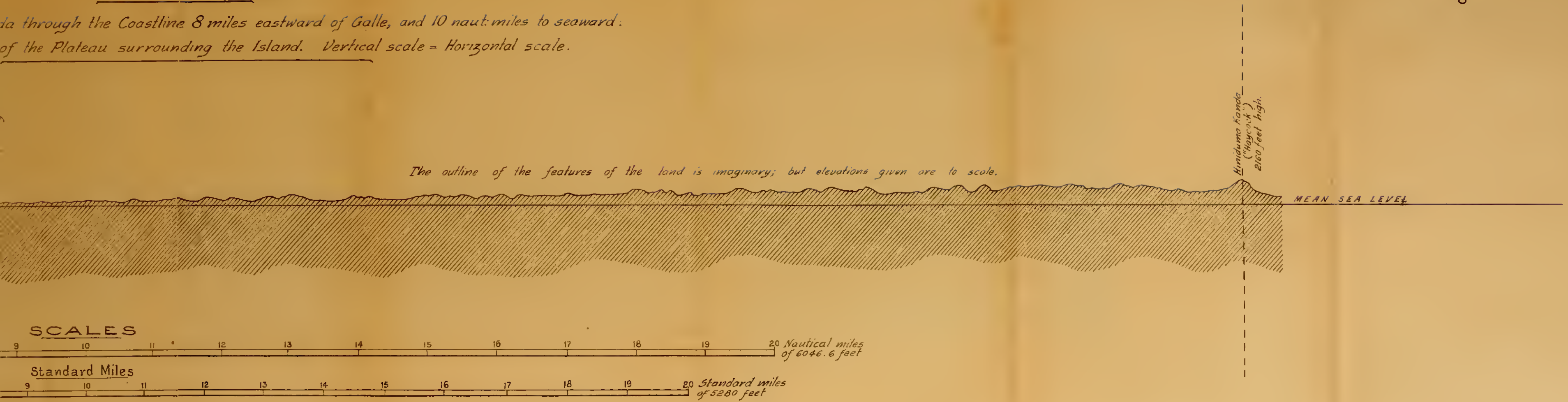
Vertical section from Hiniduma Kanda through the Coastline 8 miles eastward of G
illustrating the narrowest part of the Plateau surrounding the Island. Vertu



ISLAND OF CEYLON

Fig: II

...da through the Coastline 8 miles eastward of Galle, and 10 naut: miles to seaward.
...of the Plateau surrounding the Island. Vertical scale = Horizontal scale.



No 104/07

ISLAND OF CEYLON.

Vertical section from Hinidumo Kanda through the Coast-line at Hikkaduwa (West Isd.)
illustrating the average width of the submerged Plateau surrounding the Island

Vertical scale = Horizontal scale

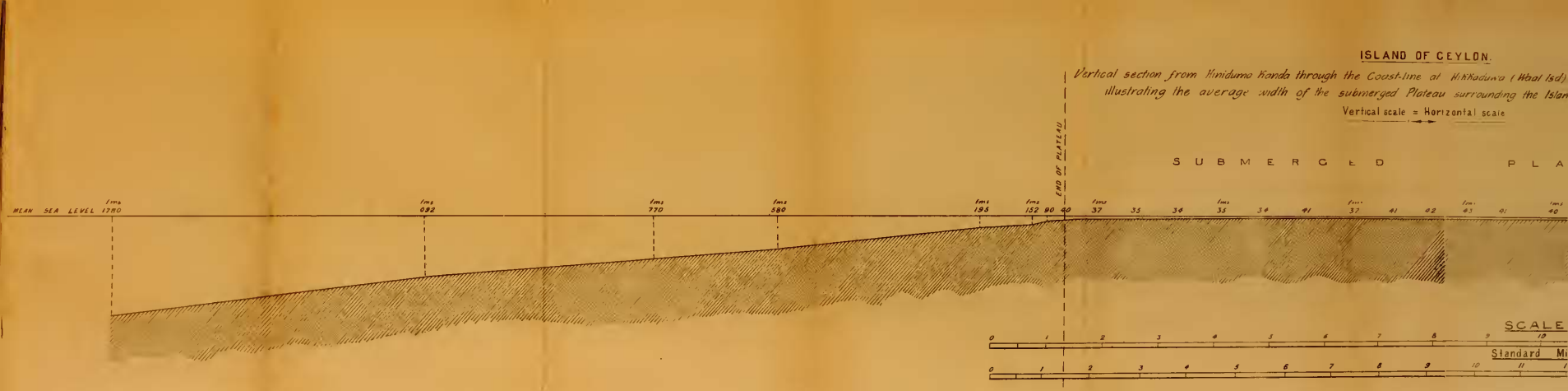
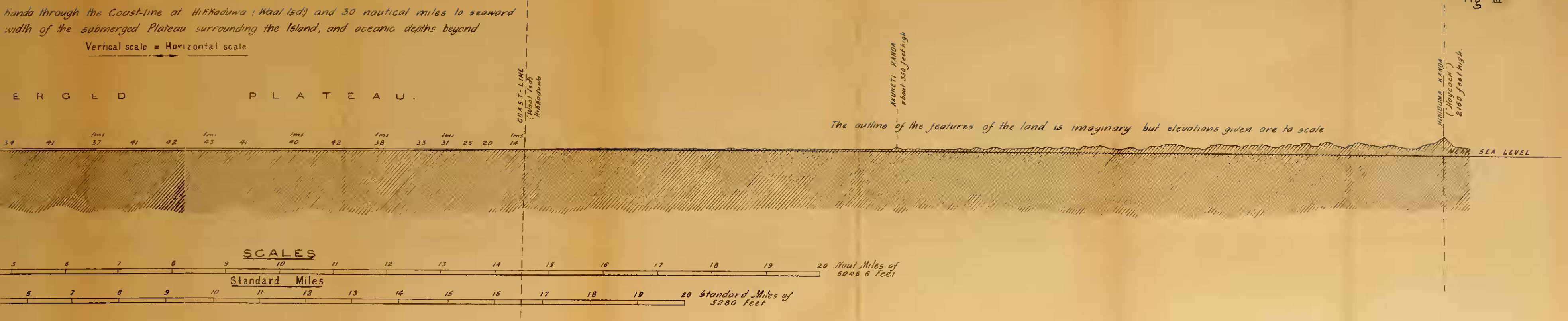


Fig III

ISLAND OF CEYLON.



No 105/0


CEYLON
Scale. 12 Miles to an Inch
Illustrating the salt lagoons and lakes forming the Island together with the principal Rivers and Tanks
The general outline of the mountain district is also indicated
JAFFNA
Elephant Pass
Manaar
ANURADHAPURA
Trincomalie
Vendelois Bay
BATTICALOA
KURUNEGALA
KANDY
Negombo
MOUNTAIN
DISTRICT
BADULLA
COLOMBO
RATNAPURA
GALLE

FIG V

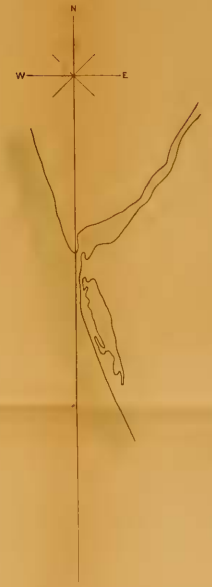
RIVER MOUTHS ON SOUTH-WESTERN COAST OF CEYLON

SCALES.

Kelani Ganga & Colombo Lake

Panadure Ganga

Kalu Ganga



Bentota Ganga

Gin Ganga

A comparison of the species of fishes and other forms of life inhabiting these tanks, with those of the lagoons, both salt, brackish, and fresh, at present situated on or near the coast line, would be of great interest, and would possibly aid in the proof of the conjectures as to their origin, which are here put forward on other grounds.

Note to Commander Somerville's Article.

Analyses of Sea Mud Deposits, by M. Kelway Bamber, F.I.C., F.C.S., &c.

Sample No. 1 is from 615 fathoms, 18 miles west by south from Ambalangoda; No. 2 is from 1,138 fathoms; No. 3 is from 1,180 fathoms, 20 miles west from Dodanduwa. All the samples were of a gray brown colour, which became a greenish gray on drying. When dry all passed through a mesh of 90 to the linear inch, or 8,100 per square inch, the material being in an impalpable condition:—

CHEMICAL COMPOSITION.

	No. 1. Per Cent.	No. 2. Per Cent.	No. 3. Per Cent.
Moisture	4·730	4·480	4·500
Organic matter and combined water	3·850	3·250	3·600
Oxide of Iron	2·400	2·805	3·600
Oxide of Alumina	1·250	1·361	1·482
Manganese	·140	·130	·800
Lime	37·272	32·480	29·200
Magnesia	1·137	·921	1·137
Potash	·366	·550	·424
Phosphoric Acid	·089	·181	·102
Sulphuric Anhydride	19·000	24·850	31·600
Carbonic Acid	27·930	24·720	21·680
Sand and Silicates	·739	3·230	1·634
Undetermined	1·097	1·042	0·241
	100·000	100·000	100·000
	Per Cent.	Per Cent.	Per Cent.
Containing Nitrogen	·308	·336	·476
Equal to Ammonia	·374	·408	·578

Additional Note on bottom samples (*see above, p. 72*).—A sample from 133 fathoms taken on April 6, 1906, 14 miles west off the Clock Tower, Colombo, consists of small calcareous nodules, and shells of foraminifera and pteropoda (pelagic molluscs). Another sample from 155 fathoms, taken on the same date, 13 miles west on the northernmost line, consists of a larger ($1\frac{2}{3}'' \times 1'' \times \frac{2}{5}''$) porous calcareous nodule; this is exhibited in the Mineral Gallery at the Museum, together with dried samples of the green mud from the greater depths.

NOTES ON ADAM'S PEAK AND SOME OF THE PATHS IN THE RANGE.

By J. Still.

THE areas and paths explored by me during a fortnight spent in the Peak range in December, 1902, were as follows :—

(1) The Maskeliya-para, including all its ambalams.
(2) The cone of the Peak itself, including the caves and cliffs on the eastern and north-eastern faces.
(3) The Gilimale-para and its ambalams as far down as Palabadalla.
(4) A path which pushes under the northern cliffs of the Peak and connects Idikatu-pana ambalam on the Maskeliya-para with Andiyamalatena on the Gilimale-para.
(5) A path which connects the Heramiti-pana ambalam on the Gilimale-para with the path over the range to the north of the Peak.
(6) A small part of the Erane-para.
(7) An abandoned path connecting Dharmaraja-gala and Heramiti-pana ambalam, both on the Gilimale-para.
(8) The deep gorge below the cliffs at Nilihela on the Gilimale-para.
(9) The large cup-shaped valley between Adam's Peak on the one side and Bena Samanala-gala on the other.
(10) About 1½ mile of the bed of a stream in the jungle on the heights to the E.S.E. of Nissangala ambalam on the Maskeliya-para and above the first ambalam.

Nos. (4), (5), (6), (8), (9), and (10) were archæologically drawn blank, though they possessed other interests. I am inclined to believe that although I was unsuccessful in the last of the places mentioned, there is something there worth hunting for.

Maskeliya-para and Ambalams.

The first ambalam on the Maskeliya-para is only a boutique, and is of no interest whatever. From here to the second ambalam, which is called in Sinhalese Nissangala-lena and in Tamil Kalpodavu, must be a mile or more, and the path contains nothing of interest until it crosses a suspension bridge a few hundred yards below the second ambalam ; here a stream runs between high banks, on one side clothed with jungle, and on the other planted with tea.

In the jungle, at a height of about 20 ft. above the stream and some 50 yards below the bridge, there is a curious cave running straight into the side of the hill for about 15 ft. or rather more ; the peculiar part of the cave is that it is almost round, with a diameter of about 5 ft., and looks rather as though bored by some gigantic awl. The walls, which are of gneiss, show no signs of having been cut or worked in any way, but a number of flowering trees, evidently planted round the mouth, testify to occupation fairly recently. There are no tenants now except a few swallows, which build in the roof.

Up a steep path and on a little level slab is Nissangala-lena ; here there is supposed to be buried a great treasure, including the regalia of the king, from whom the cave takes its name [Nissanka ?]. The cave is formed by an enormous mass of rock that overhangs and shelters a space about 130 ft. long by 18 ft. wide ; the height varies from about 10 ft. in the front of the cave to 5 ft. at the back. The rock is split into two portions, one about half as big again as the other. A drip ledge runs along the entire length. There is no inscription, nor any remains of a wall.

The remainder of the path from here to the third ambalam has been described so often, and with such blood-curdling exaggerations, that I have nothing to add, except that at the foot of the Peak, where the Kehelgama-para joins the Maskeliya-para, a good new bridge has been built within the last two years, taking the place of the rather dangerous ford. A signpost and pointing hand with a burnt-in inscription, apparently in Chinese, makes the way impossible to miss.

The third and last ambalam on the Maskeliya-para is called Idikatu-pana in Sinhalese and Usimalley in Tamil. Just above it is the first set of chains, now replaced by an iron rail. The rock on which these chains are fastened contains a few short inscriptions in modern Sinhalese, but nothing old.

When last I visited this ambalam the pilgrim season had not yet begun, and the whole of the rather ramshackle buildings were buried in a cloud of yellow calceolaria, while all the rock ledges were beds of pink begonias. From this ambalam to the summit there is nothing of any archæological interest, save a few caves, &c. ; which will be described together with the eastern cliffs.

Cone of the Peak and Eastern Cliffs.

To start with, it is necessary to explain what is meant by the "cone" of the Peak. I have taken it to mean the rocky bell-shaped point that rises from the main range.

The southern and western faces of this cone seem to be too abrupt to be climbed, save where the pilgrims' path winds its way up. The northern face is a series of precipices that might possibly be climbed, but which would probably contain no caves ; my explorations were therefore confined to the eastern and north-eastern faces.

Some 70 or 80 ft. below the level of the summit, and about 20 yards to the north of the Maskeliya-para, is a cave formed by an overhanging rock, along the whole length of which is cut a drip ledge. The cave, which faces east, is 40 ft. long, 8 to 9 ft. broad, and varies from 7 ft. in height at the front to 2 ft. at the back. Part of the back wall, however, is higher, and on this there are two rock-cut inscriptions, one shorter and seemingly more modern than the other. The larger is written on ruled lines; it contains thirteen lines of writing, each 5 ft. $2\frac{1}{2}$ in. in length. The smaller is unruled, and contains only seven lines, each 8 in. long. Both are in the Sinhalese character. Forbes, in his "Eleven Years in Ceylon," mentions this cave by the name of Bhagawalena.

A little below this and on the south side of the path there are three small caves, the two further of which are reached by means of notches cut in the stems of the rhododendron trees.

These caves show no sign of ancient occupation, but recently one of them was occupied by a Chinese devotee; he is said to have lived in the same cave for seven years as a penance. There are Chinese letters scraped on the wall of the cave and gilded; these are quite modern to my certain knowledge. It is possible to climb past these caves, but nothing is to be gained, as one is brought up short by a steep slope ending in a precipice.

I climbed along the ledges of the eastern cliffs wherever it was practicable and found four more small caves, none of which were of interest. In one place a ledge ceases suddenly, and to proceed it is necessary to climb along the tops of the rhododendrons.

About 150 ft. below the summit and just to the right of the path there is a pool and spring, evidently used for generations. The spring just below the summit, which is reached by a path that descends from the "belfry" in the south corner, shows no signs of workmanship either ancient or modern.

The rock on which the shrine is placed has a number of short inscriptions on it, some in Sinhalese, a few in Tamil, and some in Chinese. The latter I know to be modern; some of the Sinhalese ones may be old, but they do not look so.

There are a few stone lamps in the shrine, very similar in shape to those found in Anuradhapura, but I am told they are modern.

The only piece of stonework on the summit that seems old is one of the steps up to the shrine on the western side; this step is formed of what looks like a pillar alternately square and octagonal. The footprint is edged with cement, and two Muhammadan pilgrims told me that when they visited it several years ago the length of the footprint was 4 inches more than at present, owing to the *improvement* of the toes by cement. This would account for the various sizes different authors ascribe to it. Several writers mention a metal case which used to fit into the footprint, and which was kept there in the pilgrim season. In the course of five visits to the

Peak I have never seen this, nor heard of it, so it has probably been discontinued.

Just in front of the shrine a large iron bar, bent at an angle, is fixed in the rock. This is said to have supported the royal umbrella.

Gilimale-para and various Paths, Valleys, &c., connected with it.

The first objects of interest met with in the descent of the Gilimale-para are the chains, which are of all shapes and sizes; in places there are eight or nine sets hung one above the other in bunches. I only noticed two inscriptions on the chains, but there may be more. The two I saw were both on iron plates let in between the links; one plate measured 1 ft. long by 3 in. broad, the other measured $9\frac{1}{2}$ in. by $2\frac{1}{4}$ in., and had besides its inscription, the figure of three birds engraved upon it, two at one end and one at the other. A short distance from the summit, and just below the main set of chains, there is a rock-cut inscription measuring 4 ft. by $2\frac{1}{2}$ ft.; it contains twenty-three lines, and is modern.

A few hundred feet below this there is a dilapidated hut and a small flat space. Until last year this was the Menik-lena ambalam, so called from the cave of that name; but the monsoon of 1901 so loosened the rock which formed the cave that it slipped and fell into the valley half a mile below. A Sinhalese man, who knew the place well, told me that there used to be an inscription on the rock, but that now it is buried, being on the underside of the rock as it now lies. Neither Skeen nor Forbes mentions this inscription, so perhaps it did not exist.

Between this and Andiyamalatenna there is nothing of interest.

From Andiyamalatenna a path runs round the neck of the Peak, under the northern precipices, to the third ambalam on the Maskeliya-para.

I followed the path, which is very rugged and overgrown, but found nothing except masses of beautiful flowers and innumerable traces of elephants.

From Andiyamalatenna to Heramiti-pana ambalam the path, though steep, is in no way dangerous.

Even above Menik-lena, where the chains are, no part of the path is in the least difficult or dangerous in ordinary weather; but most people who have written accounts of the ascent of the Peak from this side describe it as little better than the Matterhorn. The fact that women frequently climb it with children astride their hips is sufficient to disprove this; I have seen a man with one leg swollen to an enormous size, two blind men, and numerous very old men and women make this climb at night, and a cooly with a 60 lb. weight on his head by daylight.

From Heramiti-pana four paths start. First the path to the summit just described ; second, the main path down to Ratnapura, the Gilimale-para ; third, an abandoned path that crosses the Ganguli-helli gorge and again joins the Gilimale-para at Dharmaraja-gala ; fourth, the Erane-para, which branches at about a mile from the ambalam, one branch crossing over into Maskeliya and cutting into the Maskeliya-para at its junction with the Kehelgamapara, and the other descending rapidly towards Kunudiya-parawida and Higgashena. This last I only explored for a mile or two and found nothing. In one place, just off the path, I found a space about 20 ft. square beaten quite flat and hard by elephants ; it was like a small room, being walled with thick bamboos.

The abandoned path descends very steeply below a cliff called Yaku-at-awa to the Sitala-ganga, which is crossed by a very rocky ford, where tradition says many lives have been lost in rainy weather ; certainly nothing seems more probable, and it is possible that this may have been the reason for the newer and easier route being substituted. From the ford the path rises a little and then proceeds along a level ridge for some distance before descending to the two caves known as Telehi-lena or Sanguli-galge.

Below this level ridge and to the south of the path a small stream runs, on the other side of which there is a jumbled mass of rocks containing many hollows and a few caves. One of these caves, though it has no drip ledge, has at one time been inhabited, as can be told from the floor being roughly levelled, stones being jammed into the hollows between the rocks.

Telehi-lena consists of two caves. One formed by an overhanging rock is 21 ft. long, 12 ft. wide, and quite high enough to stand up in ; it has a drip ledge all along its length. The floor is roughly paved with different sized dressed stones, and just outside the cave is one short wedge-marked stone pillar. From the mouth of the cave a good view may be had of the Peak. The other cave, which is formed by one large boulder lying across two others, measures 16 ft. by 6 ft., and varies from 9 ft. to 3 ft. in height. Several flat dressed stones lie in it, one of which looks like a curry stone.

From here the path lies through a fairly level piece of ground overgrown with thick bamboos, and crossed and re-crossed by elephant tracks. It joins the main path at the top of the Dharmaraja-gala flight of steps.

This abandoned path, which is known as Gangulihelli-para, is entirely overgrown and has trees lying across it ; if it were not for the cut steps in all the steep rocky places, it would be hard to find and harder to climb.

I tried to climb the Yaku-at-awa cliff, but only succeeded in reaching a ledge about 20 ft. up, where water was standing in a little pond.

Dharmaraja-gala has been described by various writers, some of whom say that the inscription on the side of the path is modern. It looks old, and a Sinhalese who was with me could not read it, though he could read ordinary Sinhalese. The inscription contains sixteen ruled lines, each 4½ ft. in length. The figure of a man which is traced in the rock just below the inscription is 5 ft. 5 in. in height; from the waist to the ankles a cloth is depicted, and the hands hold a rosary up before the face. The figure is neither sunk nor in relief, but merely outlined. From here down to Gatanetula the path passes two abandoned ambalams, both of which, with their legends, are described by Skeen. At Gatanetula there are the remains of an ambalam, and on a stone there, just by the side of the path, there is a curious design traced. It consists of a pointing hand with five fingers and a thumb, a circle, and something that might have been meant for an elephant; the length of the hand is 4¼ in., that of the "elephant" 6¼ in., and the diameter of the circle 4 in.

Shortly below this is Nilihela ambalam, perched on a high narrow tongue of the hills, where they run into the low-country. To the south-west the pilgrims' path follows along the ridge down to Palabadalla. To the north the hill slopes steeply down to a river; while to the south is a great cliff opposed by another greater cliff, with a deep valley between them. It is from a legend concerning these cliffs that the place takes its name, viz., Niliakka was a young mother of the dhoby caste, and she lived on the verge of the cliff. One day, having put some clothes to dry on a bush that grew near the precipice, she sent her little son to bring them in. He could not reach the clothes, and in stretching up the bush he fell over the cliff into the valley more than 1,000 feet below. The distracted mother rushed to the edge and plunged after her child. The Sinhalese say that to this day that if one shouts across the cañon, Niliakka will answer. Certainly there is a wonderful echo.

Just below the ambalam, on the south side, there is a small cave, which has not been improved by art in any way. A path in the same direction leads to a spring; to the north, in the jungle, there is another spring, but neither of them seems to have been built in, though doubtless they are old. I explored a good deal of the jungle to the north, but found nothing.

The tremendously deep valley below Nilihela on the south contains a great number of boulders, under some of which are caves. Two have been occupied recently, but none shows signs of ancient workmanship. The "fierce leech" here flourishes.

I followed the pilgrims' path down as far as the outskirts of Palabadalla, but found nothing of interest.

There still remains to be described the valley between Adam's Peak and Bena Samanala-gala and the stream on the hills above the first ambalam. The valley is full of caves, especially under

Bena Samanala; but none of them have been occupied. I must have examined scores, some of them very suitable for building up.

I followed the main stream to its source, worked along the ridge, and broke back through the bamboo, but found nothing. The undergrowth is very thick indeed, and is composed of tough wiry bamboo. Except where there are elephant paths, it is hard to make one's way. Altogether, exploring this valley, five days were spent in vain.

The last place, the bed of the stream on the heights above the first ambalam on the Maskeliya-para, was nothing but a series of enormous slab rocks and waterfalls; stretches of rock 50 yards square rose in terraces, divided one from another by broad waterfalls some 20 ft. high. These are where the princesses of old used to bathe. This legend possibly refers to the Veddas. After leaving this place I was told by an old Sinhalese man that there is a stone ruin in the jungle there and a cave with an inscription. My guide knew nothing of it.

There still remains to be explored the Kehelgama-para and the Erane-para. I am told, both by Englishmen resident in the neighbourhood and by natives, that the former of these contains both ruins and inscriptions.

MIMICRY IN INSECT LIFE, AS EXEMPLIFIED BY CEYLON INSECTS.*

By E. Ernest Green, F.E.S., Government Entomologist, Royal Botanic Gardens, Peradeniya.

With Illustrations.

BEFORE describing some of the more interesting instances of so-called mimicry in insect life, I must ask you to disabuse your minds of the idea that such mimicry is in any way conscious. One frequently hears the epithets "wise," "clever," and "ingenious" employed in connection with some particularly successful case of adaptation, and it is often difficult to avoid such misleading terms in ordinary conversation.

As a matter of fact it is probable that these wonderful arrangements of form and colour are the result of natural selection unconsciously working upon accidental variations or mutations through countless generations, those favourable to the organism having the better chance of being perpetuated and accentuated.

The word "mimicry" itself is unscientific in this connection, but is the term that has been generally adopted for the phenomena in question.

In studying animal mimicry, two main classes or purposes may be at once distinguished, *protective* and *aggressive*, though the latter may—and often does—serve both purposes. Protection may again be subdivided into *protective resemblance*, where the insect simulates some inanimate object, and *protective mimicry* proper, in which the insect assumes the appearance of some other species that is naturally protected either by some weapon, such as a poisonous sting, or by some unpleasant taste or odour. Of the former class—protective resemblance—we have abundant beautiful instances in Ceylon. The best known is that of the leaf insects.

(*Fig.* 1.) Our more common Ceylon species (*Pulchriphyllium crurifolium*) carries its disguise throughout every stage of its existence. The eggs are remarkably like the seed of some plants, and they are shed upon the ground, and lie amongst the dead leaves just as might the seeds of any tree. I must confess that I have never found the particular seed that matches them, but I am confident that such exists. If I were to send a packet of these eggs to

* This article is the substance of a lecture delivered by the author in Kandy in 1907.

some horticultural friend in Europe, he would almost certainly plant them carefully and expect to raise some interesting tropical plant from them. When first hatched the young insects are of a bright reddish colour, harmonizing with the young leaves of many of our shrubs and plants, and it is upon such tender leaves that they feed during this early stage. As they grow older they prefer the more mature leaves, and at the same time the red tints are gradually changed to green. The upper surface of most leaves is darker and more glossy than the underside. In the half-grown insect we find a reverse arrangement of the tints. The back of the insect is of a dull pale green tint, while the underside is of a deeper colour and more shining surface. This at first sight would appear to be faulty adaptation; but such is far from being the case, for the habitual attitude of the insect in this stage is head downwards, with the hinder leaf-like part of the body re-curved over its back, in which position the under surface of the body is uppermost. So perfectly leaf-like are the full-grown insects that they may be said to partially defeat the purpose of their disguise, for they are sometimes mistaken by their fellows for actual leaves, and may have parts of their wings nibbled off before they realize what is happening. Perhaps, though, this accident may really enhance their disguise, for the ragged insect looks like a leaf that has been partially devoured by a caterpillar.

(*Fig.* 2.) The allied "Stick Insects" (*Phasmidæ*) resemble the stalks of grasses or the thin twigs of bamboos and shrubs. One species frequents the common yellow-stemmed bamboo. It has a smooth cylindrical yellowish body, jointed at intervals like the bamboo upon which it lives. Another is covered with thorn-like processes and simulates a piece of bramble. Their eggs, like those of the leaf insects, resemble seeds of various kinds. They are either attached to the leaves of plants or shed upon the ground.

Another small insect (belonging to the family *Membracidæ*) apparently relies upon its similarity to the thorns of the plant upon which it is most frequently found. Both the young and the mature insects resemble thorns, but in a different manner. The young insect is green, and has a single erect-pointed prominence on the back. It frequents the young shoots where the natural thorns are soft and green. The adult insect has a pair of backwardly directed curved black horns, and may often be found on the older shoots where the thorns are dark coloured. To obtain the highest degree of imitation the young insects should rest with their heads towards the base of the stem, while the adult insects should adopt the opposite position. And this is most frequently found to be the case. By so doing the curve of the horns of the insects takes up the direction of the thorns of the plant. This thorn-like Membracid is named *Leptocentrus substitutus*, Wlk., and the thorny plant upon which it lives is *Capparis sepiaria*, L.

(*Fig.* 3.) The "Leaf Butterfly" (*Kallima philarchus*) is a very beautiful example of protective resemblance. While it is on the wing the bright blue tints of the upper surface render it a conspicuous insect, but when the wings are folded together in the resting position, their form and colouring exactly imitates a withered leaf. The markings take the form of the midrib and veins of the natural leaf, while the resemblance is heightened by a blunt tail-like process from the hind wing, which takes the place of the stalk of the leaf. It even copies the frequent blemishes that are found on a dead leaf. There are often irregular dark-coloured blotches, such as are caused by fungus diseases of the plant, and in some examples there is a small transparent spot suggesting a hole in the leaf. In natural history books this insect is usually represented perched on a leafy branch, in which position the brown tints of the wings would not harmonize with their surroundings. But in nature the insect more usually settles head downwards on the trunk of a tree, and it has acquired the habit of swaying gently from side to side. It might then be mistaken very easily for a detached leaf that in its fall has hitched up in a cobweb and is being shaken by the breeze.

Then there are many insects that habitually rest on the bark of trees. These have assimilated themselves most perfectly to such surroundings. And as bark is very frequently spotted and mottled with gray and greenish lichens, so these particular insects are usually variegated with similar markings. Moths of various kinds, certain beetles, several Homoptera, and a few grasshoppers exhibit this form of protective resemblance.

(*Fig.* 4.) Even such a large and bulky insect as our large Wood-boring Moth (*Duomitus leuconotus*), which has a wing expanse of nearly 8 inches, can conceal itself very successfully by its resemblance to a patch of lichen-covered bark. Its wings are closely mottled with gray and black. Another large moth (*Elphos hymenaria*), with similar markings, rests with outstretched wings on the trunks of trees, where it is in perfect harmony with its surroundings.

The large "Hawk Moth" (*Pseudosphinx discistriga*) becomes practically invisible when resting in similar situations.

A large beetle, common in the Kandy districts, is ornamented with irregular streaks of light and dark brown, and looks curiously like the fibrous surface of wood where some branch has been torn off.

(*Fig.* 5.) Another beetle (*Alaus speciosus*), which, when seen by itself, appears to be most conspicuously marked, when resting—as it frequently does—on the charred stump of some tree in a newly burned clearing, would be mistaken for an irregular patch of white ash. But in this case it is doubtful if the apparent adaptation is real, for the insect cannot of necessity confine itself to recently charred stumps, and the gradual evolution of this pattern must date

back to a period long before the clearing of our forests commenced. Possibly the scheme of coloration was unconsciously modelled upon the form taken by some of the shapeless white fungi that grow upon decaying wood.

(*Fig.* 6.) There is a common long-horned grasshopper with mottled brownish wings, which clings close against the branches of the trees upon the leaves of which it feeds. Its wings partially encircle the branch, and its back is rugged like the bark. When at rest in this position it looks merely like some natural excrescence of the branch itself.

(*Fig.* 7.) And a small Homopterous insect (*Atracis neitneri*) is so like—in texture and colouring—to a patch of gray-green lichen that it is indistinguishable until it is disturbed and flies off.

Another common form of protective resemblance, in which the insect imitates a small lump of earth, has been adopted by many members of the beetle tribe. Such species are of a dull brown colour, and have a rough granular or warty surface. They do not necessarily live in the soil, but have acquired the habit—when alarmed—of suddenly dropping from their perch and falling to the ground, where they lie perfectly motionless, with limbs close pressed to the body, until the danger has passed. The habit of feigning death is itself a form of protective mimicry.

As a general rule, predatory animals will not touch even their natural prey when it is dead or motionless. A preying mantis, one of the most voracious of insects, will take no notice of a motionless insect, but will seize it as soon as it shows any signs of life. Many defenceless insects, therefore, have acquired the habit of lying inert and to all appearances dead when alarmed.

Insects that inhabit grass land have very generally assumed an elongate narrow shape that assimilates itself to the form of the stems and blades of the grasses amongst which they conceal themselves. Examples of many different families may be found exhibiting this device. We find in the patanas long narrow grasshoppers, stick insects, mantises, bugs, caterpillars, and even moths of the same general form.

The caterpillar of a small green moth (*Thalassodes*, sp.) disguises itself by fastening pieces of leaves and withered blossoms to the fleshy spines on its back.

The phenomenon of protective mimicry proper is closely involved with that of warning colours, in which an insect has assumed conspicuous colours or markings that are recognized by insectivorous birds and other animals as associated with something dangerous or distasteful. In contradistinction to *protective resemblance*, which results in rendering the object inconspicuous, *protective mimicry* usually tends in the direction of conspicuousness. The wasp tribe are usually brightly banded with orange and black, and any bird

that had once been stung by a wasp would instinctively avoid another insect similarly coloured. We consequently find that many harmless insects have acquired this type of marking, and so escape molestation by their resemblance to their self-protected models. Thus, there are certain moths and flies with banded bodies, and beetles in which the same pattern is produced on the closed wing cases. Even members of the spider tribe have found the advantage of mimicking better protected insects. That very pugnacious insect, the "red ant" (*Œcophylla*), is naturally protected not only by its powerful jaws, but by the copious secretion of pungent formic acid, which renders it obnoxious to most insectivorous creatures. It is imitated both in form and colour by several other insects, more especially by a slender "hunting-spider." So close is this resemblance that most persons to whom I have pointed out the spider have declared unhesitatingly that it was verily the red ant itself. We have in Ceylon a whole series of such ant-like spiders, each apparently modelled upon some particular species of ant. Spiders are possessed of eight legs, while ants have only six apiece ; but this does not interfere with the resemblance, for the first pair of the limbs of the spider take the place of the antennæ of the ant. The deception is only noticeable when the spider becomes alarmed by a close inspection and lets itself down by a silken thread—a feat that is impossible to any kind of ant.

While on a recent tour in the neighbourhood of Trincomalee I saw on the ground what I supposed to be a species of *Mutilla*—a peculiar genus of wasp, the females of which are apterous and brilliantly coloured. Knowing that these insects are armed with a powerful sting, I was careful to pick it up with a pair of forceps, and it was not until I had bottled it that I realized that my capture was of much greater interest. It was a species of spider that had adopted the characteristic form and colouring of a *Mutilla*. I subsequently captured a second specimen, of the opposite sex, which apparently mimicked yet another species of *Mutilla*.

Large groups of insects, containing many widely distinct species, genera, and even families, are sometimes found to have acquired a type of coloration and pattern common to all of them. Such an association is distinguished by the term "Müllerian," after the famous naturalist (Fritz Müller) who first drew attention to the phenomenon. Each individual of such a group is usually itself protected by some disagreeable property, but by their common likeness to each other it is supposed that they contribute to the safety of the other members. This may require a little explanation. Every animal has to learn for itself what is good, wholesome food, and what is injurious or distasteful. An inexperienced young bird or lizard would not know that a certain gaudily coloured insect had an unpleasant taste until it had discovered the fact by actual experiment. But once learned, the lesson is never forgotten. The

victim of the experiment itself is none the better off for its warning colouring, but its sacrifice has probably saved the lives of many others. The more general the particular type of coloration, the fewer subjects for experiment are required, whereas, if each separate species adopted a distinctive danger signal, they would each have to pay toll for the education of their mutual enemies.

Such Müllerian associations of self-protected insects are not quite so conspicuous in Ceylon as in some other countries, notably in Africa and South America, but we have a few instances.

Thus, amongst the butterflies we find two species (*Danais chrysippus* and *Hypolimnas misippus*) belonging to distinct families (the *Danainæ* and *Nymphalinæ* respectively) that are practically indistinguishable except by the most close examination. In the second species it is curiously the female only that has adopted the warning colour. The male is such a different looking insect that the relationship of the two sexes would never be suspected. A still more remarkable fact is that there are two varieties of the *Danais* and two corresponding varieties of the female *Hypolimnas*.

Yet another species of another family (*Telchinia violæ*) has somewhat the same general appearance. Though the similarity is not so complete, this insect probably reaps some advantage from its partial resemblance to the other two.

Four other Danaine butterflies (all different species of *Euplœa*) and a species of *Papilio* form another associated group. Here, again, we have the remarkable coincidence that the *Papilio* has two very distinct varieties, one of which resembles the *Euplœas*, while the other has the likeness of another self-protected species (*Danais septentrionis*).

A common type of warning colour, found in nearly all parts of the world, consists of a uniform reddish tint in front, followed by a more or less sharply defined hinder part. The members of this group comprise various species of beetles, bugs, wasps, flies, and moths.

Under protective mimicry may be classed the menacing markings that have been adopted by many insects.

(*Fig.* 8.) The most common form of this is the development of eye-like markings on various parts of the body. The true eyes of an insect are usually inconspicuous, but the ocellated spots—the sham eyes—found on the wings of so many butterflies and moths attract attention at once by their intense colouring and disproportionate size. Though in some cases these specialized markings may serve the purpose of distracting the attention of a formidable enemy from a vital to a non-vital part, as by allowing an insect to escape from a bird with the comparatively unimportant loss of a fragment of wing, in others the eye-spots have a more directly protective function. We have in Ceylon a particular kind of praying mantis that preys principally upon butterflies. I have kept a living specimen of this mantis in a

cage for some time, and have fed it upon a small species of butterfly that happens to be very abundant in the immediate neighbourhood—a species that is ornamented with several conspicuous eye-spots. I have noticed that while one of these butterflies is walking quietly about the cage, when its markings are clearly visible, the mantis seems to be afraid of it : but as soon as it commences to flutter and the markings are obscured by the rapid movement of the wings, it is promptly seized and devoured.

The caterpillars of many of our large "Hawk Moths" show a pair of large and brilliantly coloured false eyes on the front part of the body that gives them a very alert and formidable appearance. These markings must be distinctly protective.

(*Fig.* 9.) Akin to this form of protection is that in which the markings simulate a sham head at the opposite end of the body, while the real head may be much less conspicuous than the false one. This is found in some small hopping insects, whose principal enemies are the "hunting-spiders" that spin no snare, but stalk their prey, endeavouring to take it unawares and seize it from behind. These hunters would be puzzled—when stalking one of these double-headed creatures—to know which was its blind side, and might be likely to approach it from the wrong end, and so give it timely warning of its danger.

Aggressive mimicry is adopted by predaceous insects, and usually takes the form of some disguise that enables them to approach their prey without alarming it. The disguise at the same time affords the wearer protection from its own enemies.

All the disguises that we have seen adopted for protection are repeated for the purposes of aggression. Thus, we find praying mantises that simulate leaves, others that frequent the trunks of trees and resemble lichen-covered bark; and one peculiar species (*Gongylus gongylodes*) with leaf-like body and wings, while just behind its head is a hood with brightly coloured lining that is thought to imitate a flower. This is the species that has already been described as feeding upon small butterflies. It takes its stand on some leafy branch and awaits its opportunity. The head is elevated to display the coloured area. Presently a passing butterfly is attracted by the patch of pink, it approaches in expectation of finding a honey-laden flower, and finds itself seized by a pair of cruel arms arrayed with formidable teeth like a steel rat-trap. "And the subsequent proceedings interested it no more." The juicy body is soon devoured, and the unnutritious wings are dropped.

There are several small hunting-spiders that have adopted the same kind of manœuvre. They are of a bright yellow colour, and lurk among the yellow stamens of flowers. From this coign of concealment they pounce upon small flies and moths that come to feed at the flower. When insect hunting I have on several occasions been deceived by some moth that appeared to be busily engaged in

sipping honey, but on attempting to capture it I have found myself forestalled, and the specimen already in the jaws of one of these little spiders.

Other predaceous insects assume the proverbial "sheep's clothing," and imitate the form of the creature upon which they prey. (*Fig.* 10.) An interesting example is that of a large fly (*Hyperechia xylocopiformis*), which so closely resembles a species of "Carpenter Bee" (*Xylocopa fenestrata*) as to completely deceive its victim. I have watched one of these flies mount into the air to meet a passing bee, which appears to welcome it as a mate, with fatal results to the bee. One might suppose that the bee could protect itself with its powerful sting, but it discovers its mistake too late, when the fly is firmly perched on its back and has driven its sharp beak into the body of its victim.

It is possibly the same purpose that has led to the similarity of colour and pattern between two distinct insects of the bug tribe (*Antilochus nigripes* and *Serinetha augur*), for the former preys upon the latter.

Another device employed by one family of predaceous bugs is to cover their bodies with dust and small particles of rubbish until they look like anything but living insects. In this disguise they lie in wait and pounce upon their prey—other small insects—or are able to creep up within striking distance without being observed.

In these few examples of mimicry that I have described I have touched but the fringe of a most interesting and complicated subject. There are endless other instances to be seen around us by any intelligent observer. In fact it is probable that fully one-half of the insects that exist in Ceylon exhibit in some degree one or other of the several forms of mimicry.

Fig. 1. Leaf Insects feeding upon guava leaves.

Fig. 2. Stick Insects on a dried twig.

Fig. 3. Leaf Butterfly at rest, head downward, on the trunk of a tree.

Fig. 4. Wood-boring Moth on tree-trunk.

FIG. 5. An Elaterid Beetle, *Alaus speciosus*, on a charred stump.

FIG. 6. Long-horned Grasshopper, *Sathrophyllia rugosa*, at rest on twig and on the wing.

FIG. 7. *Atracis nietneri* on lichen-covered trunk.

FIG. 8. Butterflies and Moths with ocellated markings on the wings.

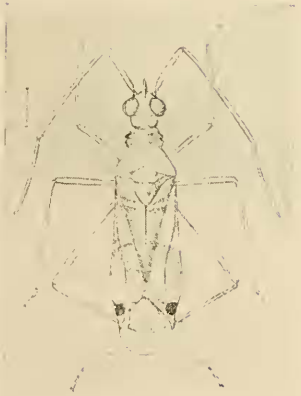


Fig. 9. *Armachanus monoceros*, Distant.
An insect showing false eyes behind.
The natural size is shown on the left of the figure.

Fig. 10. The upper figure is a Bee; the lower a two-winged Fly, which mimics the former.

ON THE LARVA OF "PRODENIA SYNSTICTIS,"

Hampson.

By T. Bainbrigge Fletcher, R.N., F.E.S.

ON August 3, 1907, whilst searching on plants of *Drosera burmanni*, Vahl., at Diyatalawa, for the immature stages of *Trichoptilus paludicola*, I found a small dark noctuid larva beside a *Drosera* plant, on which it was feeding. It was placed on sundew, and on the next day was observed to have taken up a position on the underside of a grass stem preparatory to undergoing an ecdysis.

On August 7 it was noted as feeding on the red glands of the *Drosera*. It was then naked and nearly black in colour; each abdominal segment bore a square black dorsal spot; the thoracic segments bore a narrow interrupted dorsal line; each segment had a black sub-dorsal spot bordered below by two contiguous yellow dots; there were also numerous minute yellow dots scattered over the larva. The head was nearly black, with a paler Λ-shaped mark, and the mouth parts of a dirty orange colour. Legs all present, the same colour as the body—a very dark fuscous, almost black. On the head and prothorax were numerous short black hairs; probably these, as in the case of *T. paludicola*, act as "feelers" to prevent too close contact with the *Drosera* gum.

On August 10 the larva is noted as being 9 mm. long and proportionately stout. When not feeding it liked to rest on a grass stem, especially if the stem was within reach of a *Drosera* plant.

On August 12 it was feeding on the flower buds and unripe seeds of the *Drosera*, and at a casual glance it looked quite black.

By August 18 it had attained a length of 19 mm., and was eating the *Drosera* flower stems.

On August 20 the larva was about 20 mm. long, stoutly built, almost black in colour, sprinkled with minute yellowish dots (which were not distinguishable except under a lens), with a series of creamy yellow dots along the latero-dorsal region, these last giving to the naked eye the appearance of a narrow yellow stripe. "The larva is very voracious, and prefers to feed on the seed pods and buds of the *Drosera*, though it will also eat the leaves, and has now apparently little fear of the gum."

On August 23 the larva had just undergone an ecdysis and assumed a very handsome appearance. "It is 23 mm. long, stout,

jet black, interstices of segments whitish. The dorsum of each segment bears two or three minute yellow dots, which do not form a dorsal stripe. A fairly narrow latero-dorsal stripe may be described as composed of a series of yellow spots almost united to form a stripe. Just below the spiracles passes a similar stripe composed of a row of yellow dots, but it is not so distinct as the upper stripe. Below the sub-spiracular stripe the black surface is sprinkled over with minute white dots, most numerous along the lower edge of the yellow stripe. Legs black. Prolegs black, feet and claspers yellowish, head black."

On August 29 this larva was very nearly full-fed, and presented a very handsome appearance. A description made at the time reads as follows :—

"It is 30 mm. long and 5·5 mm. broad. Its colour is jet black, the segmental interstices (except between head and prothorax) broadly creamy white. The prothorax has anteriorly three bright yellow spots, one medio-dorsal, the other two sub-dorsal; the other segments bear a few scattered medio-dorsal pale yellow spots, which hardly make a line; a fairly broad latero-dorsal longitudinal line is seen to be composed of numerous irregular pale yellow markings on each segment behind the prothorax; just below the spiracles runs a similar pale yellow stripe, a little broader and less sharply defined than the latero-dorsal one; this sub-spiracular stripe is bordered below by small white dots scattered irregularly over the whole ventral surface, which is of a very dark glaucous green, almost black. The margins of the anus are of a bright orange. Legs black; prolegs greenish yellow, the upper exterior parts black. Head black, with a narrow obsolescent creamy ∧-shaped mark across the face and an obsolescent orange spot just above the jaws; the head is thickly studded with short, black, bristly hairs. There are a few very short black hairs scattered over the body segments, but they are so inconspicuous that their positions cannot be distinguished even under a strong lens, as they are only visible when viewed against the light. This larva is very voracious, and feeds indiscriminately on the *Drosera* leaves, but seems to prefer the stems, eating buds, seeds, stem, and all."

On the afternoon of August 31 the larva excavated a chamber in the earth beneath a small clump of *Drosera*, but it did not pupate until the night of September 3/4. A slight but regular cocoon was formed. The pupa seems very small in comparison with the bulk of the larva; it is black, the abdominal segmental interstices yellowish.

The moth emerged about 7.30 A.M. on September 22 and proved to be *Prodenia synstictis*, Hmpsn.

Although there is little doubt but that this particular larva of *P. synstictis* was actually feeding on *Drosera burmanni* when found,

and that it throve exceedingly well on a diet of this insectivorous plant, yet it seems to me improbable that this forms its usual pabulum. One of my reasons for this conclusion lies in the fact that no other specimens of this larva were found during a close search, on probably several hundreds of plants, for larvæ of *Trichoptilus paludicola*; but perhaps other searchers may be more successful. At any rate a certain interest is attached to any insect which subsists with impunity on so essentially entomophagous a plant as sundew.

NOTES ON SNAKES FROM DIYATALAWA, CEYLON.

By T. Bainbrigge Fletcher, R.N., F.E.S.

DURING a stay in camp at Diyatalawa (4,000 feet) between July 27 and October 9, 1907, I obtained a few specimens of various species of snakes, and as all information concerning the distribution of even the commonest snakes in Ceylon seems to be rather a desideratum, it may be of interest to give a list of them here.

Rhinophis blythii.

One specimen, $10\frac{3}{4}$ inches long, was taken on October 2, amongst flood refuse washed down by a small stream after heavy rain on the previous night. The ventrals in this example number 192, and the proportion of its length to diameter is as thirty-seven to one, so that its length is comparatively greater than usual, as shown both by its greater slenderness and by the increased number of ventrals. This specimen is now in the Colombo Museum.

Aspidura trachyprocta.

One specimen, taken in June on Craig estate, Bandarawela (about 5,000 feet), was given to me by Mr. J. F. Jowitt. Although this is probably not an inhabitant of Diyatalawa in the strict sense of the word (*i.e.*, "water plain"), yet this specimen seems sufficiently interesting to record here; the head scales are asymmetrical, the præocular being present on the left side of the head but totally absent on the right side. The other scale peculiarities (much broader frontal, &c.) leave no doubt that this specimen is *trachyprocta.* Wall records a specimen with no præocular ("*Spolia*," III., 145), but in his example the variation was presumably symmetrical.

Oligodon sublineatus.

One specimen was taken on August 12, just below the Railway station.

Zamenis mucosus.

Common all round the camp, and large individuals are often seen on the rifle range. During the forenoon of August 27 a rat-snake shed its skin in the drain just outside our hut; the cast skin was quite perfect, and measured 6 feet 5 inches.

Tropidonotus stolatus.

(1) One ($15\frac{5}{8}$ inches + $5\frac{3}{8}$ inches) on September 3.

(2) One (about 18 inches) seen on the range on September 6.

(3) A mangled example (about 18 inches) found on a path on October 4.

Fairly common; found on the dry hillsides as well as in the marshy valleys.

Tropidonotus asperrimus.

A hatchling ($8\frac{1}{2}$ inches) was brought to me on September 3. It is a fairly common snake at Diyatalawa.

Macropisthodon plumbicolor.

On August 19, just before 8 A.M., I noticed a crow on the hillside a couple of hundred yards away. The crow seemed to be attracted by something on the ground but appeared afraid of it, as it kept jumping about around the object of attraction. I thought it was probably a snake, so took a stick and went over to investigate; sure enough, when I got to the place (the crow having flown off at my approach), I found a fine example of this snake there. It did not seem to have been hurt by the crow, but was defending itself by flattening itself out along the ground in a most peculiar manner. The head was raised slightly off the ground, and the whole of the body (especially the forepart just behind the neck) was flattened out so as to appear very broad. The snake did not attempt to bite, or even hiss, when I picked it up. It was a fairly large specimen, 22 inches long.

This snake ate three small frogs and a young *Calotes* on August 23, but refused to take any more frogs or lizards, although both were kept constantly in its cage. On October 5, however, a large toad (*Bufo melanostictus*) on being introduced, was at once attacked and ingested.

On October 8 I caught a second and smaller specimen of this snake; this was also taken in the early morning. This individual did not flatten itself out at all when caught, nor make any attempt or threat to bite.

In spite of its particularly gentle disposition and harmless character the natives appear to be very much afraid of this snake, and I think that they are quite unable to discriminate between this species and the "green tic-polonga" (*Lachesis trigonocephalus*). The local name for it is "pala-polonga"; *pala* apparently means "a herb," so the name may be translated "herb-green viper." I was told a strange tale of a native who had "pinched one of these snakes and afterwards rubbed his eye with his fingers, with the result that he had a very bad eye for some days." Any foundation of fact in this

yarn might be explained by the possibility that the snake communicated some secretion from the parietal gland of a toad with which it had recently had an encounter.

M. plumbicolor appears to be fairly common on the patana around Diyatalawa.

Naja tripudians.

On September 21 a native brought along a cobra which had been killed in the camp. Its length was 29¼ inches + 6 inches. On dissection its stomach was found to contain a frog. The head scales were quite normal.

On October 4 another example (31 inches long) was killed in the Naval camp.

Probably the cobra is fairly common at Diyatalawa, but not often identified as such. A planter, resident in the neighbourhood, who saw the first-mentioned specimen when it was brought in was positive that it was "only a rat-snake," because the hood was not expanded.

Vipera russellii.

In spite of the local inhabitants' assertions to the contrary, the "tic-polonga" appears to be quite a common snake at Diyatalawa.

(1) On August 21 an example about 3 feet long was brought in by the natives.

(2) On September 4 a baby specimen, only 9½ inches long, was caught near the Railway station. Even at this early stage the fangs are well developed, and there is a reserve fang almost as large as the first one.

(3) On the evening of September 12, when it was getting dark, my companion, who was walking just in front of me on our way back to the camp, stepped right over an individual which was lying on the path. Luckily for him it had just swallowed a shrewmouse, and so was too torpid to strike at him. It measured 16¾ inches + 2¾ inches.

(4) On September 20 one of our men (W. Humphreys, able seaman) brought along the skin of a Russell's viper which he had just killed close to the camp. This specimen was a female, about forty inches long, and in skinning it he had removed twelve fully-formed young ones *in utero*. Each fœtus was enclosed in a roughly oval membranous packet about 43 mm. long by 20 mm. broad, the membrane being liberally supplied with blood vessels filled with red blood. Nearly half of the packet was filled with a glairy opaque whitish albuminous matter; in the other half the young viper was coiled up, the tail in the middle of the coil, ventral surface of tail next enveloping membrane; further up the body took a half turn, and the dorsal surface was appressed to the membrane; the head

was not visible, and was apparently next to the albuminous matter. The immature males had the usual double set of genitalia fully extended.

As brought to me, there was one string of five membranous envelopes, one of three, a single one detached, and three small vipers which had been freed. The dimensions of these last were: (i.) male, 7 inches; (ii.) male, $7\frac{1}{4}$ inches; (iii.) female, $7\frac{3}{4}$ inches. The fangs were quite developed in these unborn vipers, being about 3 mm. ($\frac{1}{8}$ inch) long.

(5) Humphreys told me that he had killed a number of snakes around the camp lately, finding them driven out on the paths when the hillside vegetation is set on fire. A short time before he had got a larger *V. russellii* and showed me the skin, which measured 40 + 5 inches, the extremity of the tail being absent.

(6) A male ($34\frac{1}{2}$ + $5\frac{1}{2}$ inches) was brought in by a native on September 24. On dissection the stomach was found to be empty.

NOTES.

1.—*A new Species of Hesperiidæ in Ceylon.*—At the end of 1902, when I was leaving Ceylon for England, Mr. F. M. Mackwood handed to me a species of *Abaratha* which he was unable to name, and which he wished presented to the British Museum. The Museum had one other similar specimen, captured by the late Major Watson in the Shan States. These insects have recently (Ann. Mag. Nat. Hist., ser. 7, vol. xx., p. 432) been named by Colonel Swinhoe *Abaratha siamica*, Swinhoe, the type being Watson's insect. I remember Mr. E. Ernest Green showing me a similar specimen to Mr. Mackwood's in his collection, which I believe was captured somewhere in the Kandy district; and I have seen a third specimen in Mr. Oswin Wickwar's collection captured at Ratigalla. Mr. Mackwood's was taken at Haldummulla; it is therefore widely distributed and apparently very scarce. Its geographical range is very extraordinary, and the Shan States, so far as I know them, have a far more temperate climate than the Ceylon hills. In all probability, however, it will eventually be discovered in the hill districts of India.

London, November 30, 1907. N. MANDERS.

2. *Re Mr. F. M. Mackwood's Note in "Spolia Zeylanica," November* 17, 1907, *p.* 67.—There must be some error in the date. The electric plant was dismounted some time before the year 1906.

On an earlier visit I collected a large series of *Leocyma*, and upon examination of the frenulum found that both males and females were almost equally represented. As the male of *L. sericea* is readily distinguished from its female by the peculiar form of the front wing, I came to the conclusion that the Diyatalawa species must be *L. cygnus*, Walk. (now referred to *tibialis*, Fabr.), a species in which the two sexes have similarly shaped wings, and on reference to Sir Geo. Hampson my surmise was confirmed. There is apparently no character by which the females of *sericea* and *tibialis* can be distinguished from each other. *L. sericea* proper (or at any rate the male of the species) appears to be extremely scarce. During twenty-six years' collecting in Ceylon I have taken only a single specimen, and that one was captured in Colombo. What I take to be *L. tibialis* is abundant at certain seasons in Kandy.

E. E. GREEN.

3. *Mr. Drieberg's Note on Crows* (*ibid*, *p.* 68).—It is possible that the fleshy grubs of a cockchafer were the object of the attention of the crows. These grubs are often found in localized areas of grass land, and are known to be preyed upon by crows and minahs. When grass has been attacked by the grubs, the roots are often so completely destroyed that the plants can be lifted with very little effort.

E. E. GREEN.

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4. *Note on the death of a Cooly from Snake-bite.*—The number of reported deaths from snake-bite is so great, and the cases in which the snake has been identified so few, that any authentic records are of especial value. Hearing of a recent fatality on an estate in the Gampola district, and learning that the snake had been killed and preserved, I applied for the loan of the specimen. It proved to be a male of the Ceylon krait or karawala (*Bungarus ceylonicus*), measuring without its head (which had been cut off) 25½ inches. The total length must have been about 27 inches. There were 22 white rings on the body, and the black areas were continued—as well-defined dark bands—across the under surface. It is noticeable that this dark banding of the under surface is found in all of our terrestrial Colubrine venomous snakes: the cobra, the karawala, and the scarce *Callophis*, and, as far as I know, in none of the harmless species.

The particulars of this case have been kindly supplied by the superintendent of the estate. It appears that the man went outside his lines at 4 A.M. and was bitten on the left foot. He went back to his room, brought a lamp and a stick, and killed the snake. He is said to have recognized the snake as a deadly one, but returned to his lines and discussed the matter with his relatives until about 5.30, when it was time to start for muster. The man at this time felt sleepy and did not attend muster. The drowsiness increased until 10 A.M., when the case was reported to the Superintendent, who immediately went down armed with a bottle of whisky. But the man was able to swallow very little and was sick after each dose, the vomit being of a yellow colour. The patient was walked about until his legs refused to move. He was very cold. Artificial respiration (as applied in cases of drowning) was kept up until the arrival of the medical officer. The doctor's treatment consisted of whisky and ammonia, every half hour. At 2 P.M. the man was very feverish and quite insensible. At 4 P.M. he was reported dead, exactly twelve hours after the occurrence of the bite.

E. E. GREEN.

5. *Another fatality from Snake-bite.*—A visitor to my laboratory, while handling one of my caged snakes, was bitten on the thumb by a small specimen of *Dipsas ceylonensis*. This is one of those interesting species that, while possessing grooved fangs, have apparently no poison gland in connection with them. The bite drew blood, but the patient suffered no subsequent inconvenience whatever. On the other hand, the snake was found dead next morning, without any signs of injury to account for its decease. To paraphrase the well-known rhyme, "The man recovered of his bite, the snake it was that died."

E. E. GREEN.

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6. *The Bite of the "Brahminy Lizard."*—Year by year the Registrar-General's annual mortality report includes one or more cases of "death from bite of the Brahminy lizard." The Brahminy lizard is the common skink (*Mabuia carinata*), the bite of which is firmly believed by the natives of the country to be of a most venomous character. Dissection reveals no poison glands. The teeth of the animal are not grooved, nor are they even sharply pointed, their crowns being obliquely truncate. I have however received at first hand particulars that seem to show that the bite of this lizard can be followed by slight symptoms of poisoning. A lady tells me that, happening to place her hand on the floor under a table, she felt a distinct bite on the finger, and one of these skinks ran out. The wound was scarcely appreciable and drew no blood; but in three hours' time that finger was very swollen and tense. There was some tenderness on pressure, but no general disturbance. The only remedy adopted was the dipping of the injured finger in raw whisky at intervals. The swelling gradually abated and had almost disappeared by the following morning.

It seems probable, therefore, that the ordinary saliva of this lizard has some poisonous quality, in which case it might be possible for a person in weak health to be so seriously affected as to succumb from the effects of the bite.

E. E. GREEN.

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7. *Vitality of Dragonfly Larvæ.*—I recently received by post a match box containing several specimens of the aquatic larvæ of a dragonfly (*Libellulid*). To my surprise the insects, though they must have been out of the water for nearly twenty-four hours, were alive and very active. When placed in their native element they were so dry and so full of air that they were quite unable to sink below the surface. One of them managed to crawl down a stick to the bottom of the vessel, but upon releasing its hold it promptly rose to the surface again.

The larva of the dragonfly is purely aquatic ; it breathes water, and never of its own free will leaves the water until it emerges in preparation for the final change into the winged insect. Under such circumstances it is astonishing that these larvæ were able to survive without apparent injury so prolonged an absence from their proper element. On dissection their tracheæ were found to be completely filled with air.

E. E. GREEN.

8. *Capture of a Butterfly by a Hunting Spider.*—While I was watching a small group of butterflies on a sandbank at Haragama, I was fortunate enough to see the capture of one of them by a large Lycosid spider.

The spider suddenly rushed out from some leaves, and seizing an outlying member of *Huphina remba* made for the water. Wishing to secure the specimens I netted them, or it would have been interesting to see whether the spider would actually have taken to the water. On examining the spider later it was found to be a female with a large number of young crowded on the back of its abdomen. The body of the spider measured approximately $\frac{3}{4}$ of an inch in length. While in captivity it finished its meal, completely dismembering the butterfly and entirely consuming only the softer parts of the body.

February, 1908. F. E. WEST.

9.—*Mosquitoes and Eyeflies.*—Have entomologists noticed how these pests seem to be getting prevalent at higher and higher elevations ? I remember when there were no mosquitoes at an estate in this neighbourhood about 4,500 feet elevation ; it was pleasant to be able to sleep without a mosquito curtain, now a necessity.

The eyefly is another pest that seems to be getting worse up-country, and I know of no really effective means of destroying them. I think there must be some particular tree or shrub that brings them, otherwise why is it that they are conspicuous by their absence in some bungalows and swarming in others, even though every attention is paid to clean surroundings in the latter ?

Perhaps Mr. Green could throw a light on the problem. If he could tell us how to get rid of them, he would earn the gratitude of many. As usual, Nature seems to be moving to the rescue, though somewhat slowly. One sees everywhere now a small green flycatcher, about the size of the "white-eye," a friendly little bird. He will sit on a bough quite close to you and suddenly

dart down on a fly a few inches away from one's face. It would be interesting to know the proper name for this little friend,* he certainly seems to keep down the eyeflies.

R. MACLURE.

Maskeliya, January 13, 1908.

10. *Mosquitoes and Eyeflies.*—The distribution of mosquitoes depends principally upon facilities for breeding. Most of the species are dependent upon stagnant or approximately still water. I have found certain species abundant at all elevations in the Island, though the bite of those frequenting the higher altitudes does not appear to be so virulent. I remember experiencing considerable trouble from mosquitoes in a bungalow in the Dikoya district at an elevation of over 4,000 feet in the year 1881. The greater frequency of mosquitoes on up-country estates in recent years may possibly be attributed to the greater attention now paid to horticulture. Small pieces of ornamental water are more common, and pits to catch water for irrigation purposes. The presence of large numbers of pot plants in a verandah is often a source of mosquitoes. If water is allowed to accumulate in the saucers of the pots, it will soon become infested with the small wriggling larvæ of several species of mosquito, particularly of the vicious little "tiger mosquito" (*Stegomyia scutellaris*).

The life-history of the so-called "eyefly" of Ceylon is still unknown, and I have so far been unable to obtain even its scientific name. Its greater abundance round up-country bungalows seems to be associated (whether coincidentally or otherwise) with the increase of ornamental trees, and I have thought that it may possibly breed amongst the accumulation of fallen and decaying leaves. But until the early stages of the insect have been discovered any explanation must be merely guesswork. Eyeflies can be excluded from a bungalow by keeping the premises darkened. Bamboo tats lined with green cloth will afford almost complete relief from this pest. They should be let down a little before midday and can be rolled up after 4 o'clock.

E. E. GREEN.

11. *Migration of Butterflies.*—While travelling from Sirigala in Uva to Liangolla in the Eastern Province for four days (October 18 to 21, 1907), I noticed large number of butterflies migrating towards the east.

* This will be the Gray-headed Flycatcher, *Culicicapa ceylonensis*.

Catopsilia crocale and *Papilio polytes* were very abundant, but amongst the captured were :—

Papilio nomius	Ergolis ariadne	Danais limniace
Papilio crino	Hebomoia australis	Danais aglea
Papilio demoleus	Appias paulina	Bindahara sugriva
Junonia iphita	Catopsilia pyranthe	Telchinia violæ
Junonia almana	Castalius rosimon	Euplœa asela

The migration was not noticed while travelling from Liangolla to Pottuvil.

JOSEPH A. DANIEL,
December 23, 1907. Assistant Mineral Surveyor.

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12. *A visit to the Nitre Cave ot Wellawaya, Uva.*—On September 12 last I visited the Nitre Cave at Wellawaya, mentioned by Dr. John Davy in his "Account of the Interior of Ceylon," pp. 429 *et seq.* (1821).

The surroundings of the cave are scarcely changed at all. The cave is in the heart of forest about 2½ miles from the Koslanda-Wellawaya road. We observed evidences of elephants visiting the vicinity of the cave. We struck the entrance into the cave after searching for some time.

The cave is situated on the side of a hill. It is formed in a band of limestone running across the hill in S.W. and N.E. direction. The limestone band dips about 45° to the west. The limestone collected from the sides of the cave is made up of fairly pure good-sized crystals of calcite. I am inclined to think that the cave is primarily formed by natural causes. The solvent action of waters and the decomposition of the rocks owing to chemical and physical actions are the chief agencies which wrought this cave. The limestone might have been subjected just at this place to unequal strain, which would then favour solubility. It is very probable that this cave was formed before the surface features of the surrounding district were fully developed.

The entrance into the cave was steep, and a loathsome smell emanated from it owing to damp, as we found later on owing to the excreta of bats. We lit our lanterns and candles and began to descend into the gloom of the cave. Then we heard a sound like that of gushing waters, and I thought there was a stream flowing through the cave. But this was a delusion, as I quickly discovered. We had already disturbed the bats, and they were flitting about like shadows in the gloomy cavern. The gushing sound was caused by the fluttering of thousands of bats.

After descending about thirty feet we found ourselves at the entrance of a huge hall. The sides were rugged, but the roof at this place had apparently a smooth surface. Where the bats had settled on the roof from time to time little white patches were left, which

gave one an impression of a curiously patterned ceiling. There were similar patches on the sides of the cave. The roof dipped towards the west, evidently along a certain weak foliation, or may be along the junction plane of limestone and gneiss, which I could not ascertain. Huge blocks of rock had fallen down and were scattered on the floor. At other places the roof was irregular and rugged, but covered with white patches. Fine blackish dust and bats' dung lay evenly over the blocks lying on the floor, so that we had to move very cautiously. The dust in several places I found more than 5 feet thick, and lying so loose that one might have sunk through it if one had walked unwarily. In some places it was thicker than 5 feet. It was easily disturbed, and our walking had raised quite a large amount ; but it was stifling when we started digging.

The number of bats here was enormous. Like a whirlwind they hovered round us. They constantly dashed against us, settling on us, one even clinging to the mouth of a cooly.

Very high in the roof of some parts of the cave were funnel-shaped openings communicating with the surface. Light streamed in and dimly lit up the rugged sides of these openings and the part of cave immediately below. It gave one an impression of a deep dark dungeon only lit up from a side window from a tower high above. This, with the bats flitting aimlessly in the sombre light, made a most melancholy and gloomy impression.

We crossed the hall, which I believe is more than 200 yards long and more than 150 yards broad, for the further end. Here we had to climb on all fours about 20 feet, when we found ourselves at the entrance of small tunnels which opened into chambers. These appear to have been worked by men.

Here the stench was overpowering. We worked up a small tunnel. It was very low and narrow, so that only one person can pass at a time in a stooping posture. The bats having perhaps no other egress from the passage dashed against us in a continuous stream. We dug in one of the chambers. By the time we finished it was simply stifling, also the heat was tremendous. So we returned to the entrance of the cave.

The economic value of the tons of manure found in this and several other caves is yet to be proved. Davy states that this cave was worked for many years for saltpetre by " natives, a party of whom, whose express occupation and duty it was, came annually from the neighbourhood of Passara for the purpose."

The formation of saltpetre in the cave is due to the decomposition of alkali-bearing silicates, such as the felspars, in contact with bats' dung. It does not occur in the bats' excreta.

Davy gives a very interesting account of the manufacture of saltpetre by the ancient Sinhalese in his book, pp. 265 *et seq.*, which should interest many a reader.

January 4, 1908. JOSEPH A. DANIEL.

Geocichla wardi (the male bird on the right). From Talawakele (J. Ryan, Coll.).

13. *Destruction of Deer.*—I desire to bring to the notice of all interested in sport and in the beautiful wild animals of Ceylon the heartless destruction of deer in the Island. Recently, when on an extended tour in the western part of the Island, I stopped at Wellawaya and Telulla for some time, and regretfully noticed the terrible slaughter of the deer at the time of close season for sport. Every cart coming from Hambantota way had deer skins, especially the spotted deer (*Cervus axis*), hanging out, and venison was usually procurable. Every night I heard the report of guns in the jungle close by, and knew too well that that usually meant a deer wounded or killed.

The villagers take advantage of the condition of the female deer during the close season to kill them. This fact can be borne out by a well-known sportsman who was staying at the resthouses mentioned above about the same time as myself. This gentleman, on tracking some villagers in the jungle, discovered the uterus of a deer containing a live fawn, which would probably have been born in a few days. A little further in the jungle he found bags of venison hidden away.

I noticed on several occasions during my tour in Uva in September male deer wandering alone, which to my mind tends to prove that a good many of the females with the young had fallen victims to the guns of the villagers. I may mention that it is a common sight to see villagers wandering with guns.

The game laws, I may mention, are practically a dead letter. The sportsman who probably would be content with the head of a male deer as a trophy is debarred from shooting during the close season, but villagers, actuated by commercial or selfish motives, shoot what they will with impunity, sparing neither male nor female, old or young.

I write purely in the interest of the Ceylon fauna, and trust this note may attract attention, and that greater vigilance may be ensured for the protection of the wild animals, and of deer in particular. I feel sure that unless the latter are protected they will not take long to be extinct.

December 16, 1907. JOSEPH A. DANIEL.

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14. *Further Note on the Birds of Dimbula.*—In sending in the original list I was a little doubtful about inserting Ward's Ground Thrush* (*Geocichla wardi*), but on January 17, 1908, I was able to shoot both male and female and to send the specimens in first class condition to the Museum (see figure).

* Jerdon called it Ward's Pied Blackbird.

I was able to observe the characteristic grounding habit of this bird in a ravine where a driblet of water was running over rock and sand. When shot its mouth was full of oose. *Cichla* is the Greek for a bird generally identified with the Ousel, and *Geò cichla* means Ground Ousel.

In the first list I unaccountably left out the up-country Minah, with his starling plumage and yellow ear lappets. They used to be quite common, nesting in the woodpecker holes and other hollows in the giant doon trees, which are now, alas ! of the past in Dimbula. They fed a good deal on the fruit of the wild nutmeg (Malaboda), and I have shot them with their crops full of the fruit—not a bad swallow for a bird not much bigger than a starling.

The scientific name of the hill Minah is an amusing example of the turgidity of the classic chamber-naturalist—literally translated *Eulabes ptilogenys* means the " cunning (fellow) with a feathery lower jaw."

À propos of the general ignorance on the subject of birds, one of our oldest planters recently made the statement to me that hardly any of the birds now visible were in Dimbula in the jungle days. It is seldom worth arguing out an abstract question like this verbally, but it is interesting to note that nearly every bird in my list had been identified fifty years ago by that keen observer Kelaart.

Very little has been added to our numbers since then, although the labours of Legge, Bligh, Layard, Lewis, and others have added much to our general knowledge of habits, nidification, &c.

Classical Nomenclature.—This is from either a naturalist's or a scholar's point of view rather a woful hash, but in the first place it is a mistake to call it classical; and in the second place to complain of it is merely to betray want of familiarity with the principles of zoological nomenclature. In many cases the literal translation of the Linnæan name leads to an absurdity. In rare instances it may be considered an improvement on the common name, as with the common Kestrel, *Tinnunculus alaudariu*, literally the lark-hunting kestrel.

Talawakele. JAMES RYAN.

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15. *The Purple-rumped Sunbird.*—Mr. Ernest Green has recently drawn attention to the well-known habit of this bird of fluttering continuously against window panes. Its scientific name being " Spiderhater " (*Arachnecthra*), I had the idea that possibly it came to window panes in search of spiders or the flies in their webs. As, however, they frequently allow an approach to within a few inches of the inner side of the glass, I am convinced that they are merely attacking their own reflection in the glass, and that therefore the advancing observer is hidden from them by reflection.

This window tapping habit is shared by the Gray Wagtail. By the way, I notice the Gray Wagtail is almost invariably solitary in his habits. However many one sees of a morning, they are always alone. So perhaps he is driving away an imaginary rival.

The Sunbird must be one of our lightest birds, as they may frequently be observed swinging on the stigma of the common *Abutilon* (Chinese Lantern flower) in search of insects, on which, in spite of their common name (*Nectarinidæ*), they mainly feed.

It may be worth noting that the Gray Wagtail came in this year to a day with the Autumn Equinox, but I fancy the phase of the moon coinciding had something to do with this. Most migratory birds prefer a full moon when not hustled by frost and consequent want of food. Then they fly at any time, but mostly by night—in the daytime so high as often to be invisible, except to highly posted observers.

A criticism has been recently made that I have confined my list of birds to those in my own neighbourhood. This is incorrect. Of 74 birds identified, 33 may be said to be found everywhere, 16 are only seen in jungle or on patana, paddy field, and marsh, while the remaining 25 are mainly based on single specimens shot or observed on six other estates covering an area of upwards of two miles square.

No bird has been put in unless shot or identified by a competent observer. Several specimens reported by witnesses of doubtful credibility, or not identifiable from the description given, have been kept out.

Talawakele. JAMES RYAN.

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16. *Binomial Nomenclature.*—This is the method of naming animals and plants by a Latin form of words, one for the genus and one for the species, which was introduced by Linnæus a century and a half ago. It is not a very good method, but it is the best that is known. In many instances a classical or a personal name is adopted for the genus, *e.g.*, Nereis, Argonauta, &c., while the specific term may indicate a character or the distribution, or may again commemorate the name of a person, as *Vesperugo tickelli*, commemorating Mr. Tickell. Often, however, the etymology of a name will not bear looking into, frank nonsense being sometimes employed. But it ceases to be nonsense as soon as it is used to designate a particular species of animals or of plants. It is commonly a mistake to read a meaning into an artificial term.

Very often the same species has been named twice by two different observers, and in such an event the name first given is that which stands by rule of priority. Frequently, alas, names which have been sanctioned by long usage of fifty or a hundred years are suddenly discovered by some too diligent inquirer to have no legal title, and

they are forthwith abolished by a stroke of the pen, or at least the stroke is not omitted. This rigorous application of an arbitrary rule, which allows no latitude, leads to pedantic discussions of the utmost triviality, and exposes systematic zoology to the suspicion of dilettantism. The effect of it is to close the door to many who might otherwise have been willing to enter; and the lesson which it teaches is that one should respect names, but use them as seldom as possible, and not pry too closely into their hidden meanings, confounding zoology with philology. It is quite possible to invent a better system of nomenclature, and this will probably be done in the course of another century, but it will be a laborious task, and moreover will not help us.

On this matter of nomenclature, it may be useful to repeat the words of Professor T. H. Huxley, one of the foremost British biologists of the nineteenth century. Speaking of the lobster and crayfish (neither of which occurs in this country), he notes that then (1880) "the recognized technical name of the crayfish is *Astacus fluviatilis*, that of the lobster is *Homarus vulgaris*. And as this nomenclature is generally received, it is desirable that it should not be altered. Science is cosmopolitan, and the difficulties of the study of zoology would be prodigiously increased if zoologists of different nationalities used different technical terms for the same thing. Thus, we have a nomenclature which is exceedingly simple in principle and free from confusion in practice. *And I may add that the less attention is paid to the original meaning of the substantive and adjective terms of this binomial nomenclature the better.* Very good reasons for using a term may exist when it is first invented, which lose their validity with the progress of knowledge. Thus, *Astacus fluviatilis* was a significant name so long as we knew of only one kind of crayfish; but now that we are acquainted with a number of kinds, all of which inhabit rivers, it is meaningless. Nevertheless, as changing it would involve endless confusion, and the object of nomenclature is simply to have a definite name for a definite thing, nobody dreams of proposing to alter it."

All the same the lobster and the crayfish do not carry the same technical names as they did in Professor Huxley's time.

Of course, as has been indicated above, all this trouble, which arises from a laudable attempt to control half a million natural species by half a dozen strictly logical rules, will amount to nothing in a hundred years' time.

Ed. "S. Z."

A NEW CEYLONESE TETTIGID (ORTHOPTERA) OF THE GENUS EURYMORPHOPUS.

By J. L. Hancock.

With one Figure.

THE following description of a new Tettigid is based on four specimens recently received from Mr. E. Ernest Green, Government Entomologist of Ceylon. These interesting little Orthoptera belong to the genus *Eurymorphopus*, which was first described by the author in Genera Insectorum.* Only one other species is known, namely, *E. cunctatus*, Bolivar, which is from the Island of New Caledonia. The latter species forms the type of the genus, and is like the present species in being small and apterous, but unlike it in several specific characters. Owing to these differences it may be necessary to modify the definition of the genus slightly to receive both species. Mr. Green informs the author that the new species, *E. latilobus*, here described, "frequents the surface of dry rocks in the shade of the jungle." They were taken at Undugoda in September, 1907.

In a previous work by the present author, on the "Tettigidæ of Ceylon," sixteen Ceylonese genera were recognized.† To this number the genus *Eurymorphopus*, Hancock, may now be added. It belongs in the third sub-tribe "Metrodorinæ" of my table there presented.

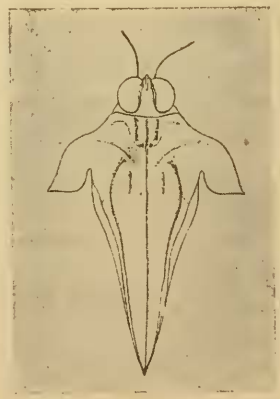
Eurymorphopus latilobus, sp. nov. (Fig. 1.)

Body small, apterous, depressed, conspersed with granulations, the lateral lobes very widely dilated; the hind femora proportionately stout; colour fuscous or fusco-ferrugineous variegated with light ochreous yellow, especially on the lateral lobes of pronotum and legs. Vertex barely produced beyond the eyes, viewed from above very narrow, strongly narrowed forward, tricarinate, subacuminate, and slightly longitudinally canaliculate on either side of the small, abbreviated, median carina; at the middle of vertex between the eyes the width scarcely more than one-half that of one of the eyes. Head but very slightly elevated above the dorsum of pronotum; eyes globose, the occiput behind only little exposed; face oblique, the frontal costa depressed and but little roundly elevated between the antennæ; posterior ocelli situated opposite the lower third of the eyes; antennæ short, filiform, not so long as the vertical facial diameter of the head, inserted little below the eyes. Pronotum

* 48th Fascicule, pp. 35–36, 1906. † *Spolia Zeylanica*, Vol. II., 1904.

depressed, granulate, truncate anteriorly, the apical process scarcely or not extended backward to the apices of the posterior femora, cuneate, backward toward the acute apex subemarginate and slightly turned downward ; dorsum somewhat bifossulate behind the shoulders on each side of the median carina ; between the shoulders provided with two short, abbreviated, supernumerary carinæ ; humeral angles wanting, the lateral carinæ inconspicuous and convex ; median carina more distinct, percurrent, subundulate in profile. Elytra and wings wanting ; lateral lobes of pronotum widely ampliate, the margins externally rounded, posteriorly distinctly truncate, and here the posterior angles formed in prominent subacute apices, not so acute in the female, the transverse diameter between the angles being the widest part of the body. Anterior femora compressed, above convexo-carinate, inferior carinæ lobate at the outer third ; middle femora compressed, the outer face carinate, inferior carinæ biundate, or lobate at the outer third part ; posterior femora stout, the longitudinal carinæ below the middle of the external pagina strongly expressed, viewed from above arcuate, entire, the oblique rugæ prominent ; the femoral and genicular spines of ordinary form and size ; posterior tibial margins minutely serrulate and spinose ; first and third articles of the posterior tarsi equal in length.

Length of body female (to end of ovipositor) 7 mm., pronotum 6 mm. ; post. fem. 4·5 mm. Male 6 mm. ; pronot. 5 mm. ; post. femora 4 mm. Two males and two females from Undugoda, Ceylon ; collected by E. Ernest Green.



Eurymorphopus latilobus, n. sp.

Dorsal view of pronotum and head.
Male, enlarged eight times.

HYMENOPTERA NEW TO CEYLON, WITH DESCRIPTIONS OF NEW SPECIES.

By O. S. Wickwar, F.E.S.

With Plate; and Appendix by Col. Bingham.

THESE notes will deal with the tribes and families described in Col. Bingham's work on the Hymenoptera of British India, Vols. I. and II. (Fauna of British India Series).

The following list, compiled from the volumes in question, gives four tribes with their respective families and relative number of species, showing a total of 193 species recorded from Ceylon, 59 of which are endemic, against a total of 30 species recorded in Sir Emerson Tennent's work on Ceylon about fifty years ago.

The fact that many of our commonest species are not recorded from Ceylon will show what little attention has hitherto been given by collectors to Ceylonese Hymenoptera.

I have to thank Dr. A. Willey, the Director of the Colombo Museum, who has kindly placed at my disposal the Museum collection. My thanks are also due to Messrs. E. E. Green, F. M. Mackwood, Col. N. Manders, R.A.M.C., and Mr. Thos. Bainbrigge Fletcher for the gift of several specimens. Above all, I am indebted to Col. C. T. Bingham for his generous assistance at all times, and for ready help proffered in verifying my identifications and checking several descriptions. It is proposed to continue these notes from time to time when sufficient information and material have accumulated.

The abbreviations "Col. Mus." mean in Colombo Museum.

Table of recorded Families and Species.

		Already recorded from Ceylon. Number of Species.	Endemic.	Now recorded for First Time.	New Species.
Tribe: Fossores :—					
Fam.	Mutillidæ	26	14	8	2
	Thynnidæ	1	1	—	—
	Scoliidæ	9	4	—	—
	Pompilidæ	30	15	9	—
	Sphegidæ	48	10	10	1
Tribe: Diploptera :—					
Fam.	Eumenidæ	15	5	5	4
	Vespidæ	6	1	—	—
Tribe: Anthophila :—					
Fam.	Colletidæ	1	1	—	—
	Apidæ	45	8	—	1
Tribe: Tubulifera :—					
Fam. Chrysididæ		—	—	—	1
Sub-Fam. Chrysidinæ		12	3	—	—
	Total	193	62	32	9

From the above table it will be seen that 32 species have been added to the number previously recorded from Ceylon (according to Bingham's latest work), and the short note on each in the following list is all the available information I can obtain up to the present. The new species, marked with an asterisk, are, so far as I know, described for the first time. To these must be added *Nomia basipicta*, n. sp., and *Chrysis spectrum*, n. sp.

List of Species now recorded for the First Time from Ceylon.

Mutillidæ.

Mutilla cicatricifera (André), Nos. 82, 83, 84, Col. Mus. Females, locality unknown.

Mutilla placida (Smith), No. 245, Col. Mus. ♀ taken in Northern Province, April, 1904.

Mutilla interrupta (Oliv.), No. 86, Col. Mus. ♀ from Matale.

Mutilla soror (Sauss.), Nos. 87, 90, Col. Mus.; No. 87 from Pundaluoya; No. 90, locality unknown.

Mutilla pulchriceps (Cam.), No. 91, Col. Mus. ♀, locality unknown.

Mutilla subanalis (Mayr.), No. 93, Col. Mus. ♂, locality unknown.

*Mutilla indostana (Sauss.), No. 96, Col. Mus. ♂ from Pomparippu, April, 1887. The ♀, which was previously unknown, is now described for the first time with the other new species.

Mutilla pilosella (Mayr.), No. 98, Col. Mus. ♀ from Kayts, Northern Province, August, 1903.

*Mutilla willeyi, n. sp.; ♀ No. 94, Col. Mus., from Delft.

Pompilidæ.

Salius.

Salius cæruleopennis (Sauss.), No. 38, Col. Mus. Locality unknown. Regarding this specimen Col. Bingham writes: "I have never seen this species before; answers the description, but is not of slender form, and the wings are lighter in colour." Although the difference is considerable, it would be premature to separate it until further local specimens are available and the difference found to be constant.

Salius nicevellii (Bing.), No. 39 ♀, No. 40 ♂, both in Col. Mus., from Balangoda.

Salius sericosoma (Smith), No. 47, in Col. Mus., from Matale.

Pompilus.

Macromeris violacea (Lepel), No. 2, Col. Mus. ♀ from Northern Province, July, 1887; another ♀ from Mamadu, Northern Province, April, 1904. A ♂ in Coll. O. S. W., from Habarana, North-Central Province, October, 1902. This very handsome species may be easily mistaken for *Salius madraspatanus*, the females especially closely resembling each other in size and colouration.

Pompilus unifasciatus (Smith), No. 29, ♀ Col. Mus., from Tissamaharama, February, 1903. Col. Bingham is now of opinion that *P. bioculatus* (Bing.) and *P. unifasciatus* are one and the same, the former being a variety of the latter. The specimen in question, No. 29, was examined by him, and has some of the characters of both. *P. bioculatus* will therefore be a synonym.

Pompilus acceptus (Bing.), No. 44, ♀ in Col. Mus. labelled "Ceylon."

Pompilus ilus (Bing.). ♀ in Coll. O. S. W. differs from Bingham's description in having the apical halves of the wings *purple effulgent*, as well as fuscous. Taken at Kandy, August, 1902.

Pompilus subsericeus (Sauss.), in Coll. O. S. W. from Colombo, April, 1903, a common species. I have often watched the females burrowing, generally in dry sandy places, but before descending any depth they would leave off and start again in another place.

Pompilus canifrons (Smith), No. 265, Col. Mus. ♀ from Nambapana, April, 1904.

Sphegidæ.

Tachytes sinensis (Smith), No. 128, ♀ Col. Mus., locality unknown.

Tachytes modesta (Smith), No. 129, Col. Mus. Common in Colombo, especially in May, June, and July. A very variable insect in size.

Larra fuscipennis (Cam.), No. 15, Col. Mus., from Deltota. Common in Colombo in March.

Liris nigripennis (Cam.), No. 60, Col. Mus., locality unknown.

Piagetia ruficornis (Cam.), No. 130 in Col. Mus., from Palatupana, January, 1902. This species has been common in Colombo in March for three successive years, but I have not observed it here during any other month. I have taken specimens at Ganawatta, north of Kurunegala, in April, 1904. Nothing is on record of its nesting habits. I have often watched it for a long time running about the walls of mud huts as though in search of prey. The only other species recorded from British India, *P. fasciatipennis*, has been recorded from Ceylon.

*Ammophila basalis (Smith), No. 73 ♂, No. 72 ♀, in Col. Mus. The former taken at Colombo in November, 1903, and the latter at Henegama (below Balangoda) in April, 1902. I have in my collection four males, two taken in Colombo in November, 1903, and two at Henegama in April, 1902, and two females from Henegama in April, 1902. It is interesting to note that the male of this species was previously unknown. It nearly answers the description of *A. atripes*, but is much smaller and slighter in build—length 15 to 18 mm., exp. 16 to 20 mm.—and is easily distinguished from *A. atripes* by the much lighter colour of the wings, which are very pale fusco-hyaline against the dark fuscous and purple effulgent wings of *A. atripes* ♂.

Sceliphron coromandelicum (Lepel), Nos. 147, 148, in Col. Mus., locality unknown. I have in my collection specimens from Henegama, Ganawatta, and Matale, and have seen it in Colombo.

Sphex splendidus (Fabr.), No. 24. ♀ in Col. Mus. taken at Kalpitiya. A very handsome species, probably confined to the dry hot districts.

Sphex ægyptus (Lepel), No. 54, in Col. Mus., from Puttalam.

Sphex xanthopterus (Cam.), Nos. 141, 142, in Col. Mus., from Colombo, January–February, 1902. Very common in Colombo I have watched a ♀ burrowing in the sand, but she did not complete the nest. It set to work at great speed, scraping with its fore legs and kicking back the sand for some distance behind with its hind legs.

EUMENIDÆ.

Montezumia impavida (Bing.), No. 260, ♀ in Col. Mus. (variety), ♀ from Nedunkerni, Northern Province, April, 1904. This is the only specimen I have seen.

*Montezumia rufipetiolata, n. sp. ♂ from Mamadu, Northern Province, in Col. Mus.

Eumenes edwardsii (Sauss.), No. 3, ♂ in Col. Mus., taken at Ritigala rock (2,500 ft.), North-Central Province, July, 1887. Another in Coll. O. S. W. from Madulsima, August, 1904. This last varies slightly, and I doubtfully identify it as *E. edwardsii*. Probably a local race.

Eumenes punctata (Sauss.), No. 52 (variety) in Col. Mus., from Matale, is the only specimen I have seen.

Eumenes esuriens (Fabr.), Nos. 158, 159, ♀ ♀ in Col. Mus., one from Delft island, June, 1903, and the other from Battulu-oya, October, 1902. These vary slightly with the descriptions of the Indian and Burmese forms, but are probably varieties, as the species is variable.

*Eumenes ichnogastroides, n. sp. ♀. Fig. 9. From Nedunkerni, April, 1904, in Col. Mus.

Rhynchium abdominale (Illig.), No. 21, ♀ in Col. Mus. from Puttalam, another from Nedunkerni, Northern Province, April, 1904, No. 267. A ♂ in Coll. O. S. W. from Ganewatta, April, 1903.

*Labus campanulatus ♀ n. sp. Figs. 10, 11, 12, 13, Col. Mus. No. 226.

*Odynerus subfistulosus, n. sp. Fig. 8, Col. Mus. No. 224.

Descriptions of New Species.

**Mutilla indostana* (Smith). Fig. 6. Col. Mus. No. 222.

♀ New. ♂ Known.

Taken in cop. with typical *M. indostana* ♂. (Second abdominal segment with two pubescent white spots.) Head and thorax very closely and coarsely punctured, coarser and deeper on the thorax

and running into furrows on median segment. Abdomen closely and finely punctured under the black velvety pubescence. Vertex cheeks and emargination of the thorax covered with recumbent, downy, silvery pile. The whole covered with sparse erect pubescence, thickest on the abdomen, median segment, and vertex. Head and thorax dark ferruginous red, merging into black on the lateral edges of thorax, pronotum, lower portion of face, and behind the eyes. Median segment has a prominent lateral tubercle—similar to male—black, shining, and inclined posteriorly. Abdomen above covered with black pubescence ; a large central spot at apex of first segment, two similar spots, one on each side of the centre of second segment, two quadrate spots—their lower corners converging towards the centre—on the third segment, silvery white. Apical segment and ventral portion of abdomen with long whitish pubescence. Length 13 mm. Described from one specimen caught at Nedunkerni, Northern Province, in Colombo Museum No. 222.

**Mutilla willeyi*, n. sp. ♀. Fig. 7. Col. Mus. No. 94.

Head, thorax, and abdomen very coarsely punctured and granular ; head a little narrower than the thorax, the last rather narrowed towards median segment, transverse in front. Black. The whole covered with close recumbent pile golden on the thorax (except the anterior margin, where it is black), first and basal two-thirds of second abdominal segment above. The head, anterior lateral angles of pronotum, lateral round spots on segments 2–5, and medial round spots on posterior margins of second, fourth, fifth segments, the legs, sides, and a thin medial line on first and second segments above—of glistening silvery pile. Profusely studded with long, stiff, erect hairs, which are black on the black and silvery portions, and brown on the golden portions. A prominent sharp keel, ending in a sharp tubercle, dividing the emargination of the sides, the keel fringed with long thin white hairs. Length 12 mm.

This gorgeous little Mutilla, the only one I have seen, was captured by Dr. Willey on the little island of Delft off the north-western coast of Ceylon.

**Eumenes ichnogastroides*, n. sp. Fig. 9. Col. Mus. No. 228.

Head and thorax closely and evenly punctured, finer on the clypeus ; petiole and basal segment smooth, polished, and shining ; the petiole as long as head and thorax united, gradually broadening towards the apex, a short transverse sulcation just before the apex of same, giving it a flattened appearance. Clypeus convex and widely emarginate. Thorax globular ; a fine central longitudinal carina the whole length of the mesonotum. The whole covered with short golden pubescence. Reddish brown. The mesonotum with a black patch anteriorly and a broad black semicircular band

interrupted above. Petiole above black with two rather indistinct yellow streaks on the sides and a yellowish band just before apex. Basal segment with two oval spots laterally and a broad sharply defined band along the basal portion yellow ; above this band the segment is black, merging into reddish brown towards petiole ; following segments reddish brown touched with yellow on the apical margins. Wings flavo-hyaline along the costal margins, the rest fusco-hyaline with a dark fuscous spot covering half the radial cell and extending down into the cubital cell.

This species may be easily mistaken for *Ichnogaster fraterna* (Bing.), which it resembles in form and especially colouration, but an examination will at once reveal the genus, and the intermediate legs will be found to bear only one tibial calcar, besides the claws of tarsi being dentate, which at once separates it from *Ichnogaster*. Length to anterior margin of basal segment 13 to 14 mm. Expanse 20 to 22 mm.

Nedunkerni, April, 1904.

**Montezumia rufipetiolata*, n. sp. ♂. Figs. 14, 15.
Col. Mus. No. 223.

Head, thorax, and abdomen smooth, shining, and punctured ; the punctures close and even on the front, thorax, basal, and anterior margins of segments 2 and 3 ; vertex and petiole shining, with few scattered shallow punctures. Median segment rounded and steeply sloped with a deep longitudinal groove ; petiole with two lateral blunt teeth about the middle. Clypeus convex and emarginate. Glossy black ; the clypeus, except the anterior margin narrowly, a line on the scape in front, a club-shaped mark between the antennæ, the sinus of the eye, a narrow spot behind it, a line along the anterior margin of the pronotum, interrupted in the middle, a marginal band on the basal segment—twice interrupted—and a central spot on margin of second segment, pale yellow. Legs testaceous red, touched with black on the femora. Basal two-thirds of petiole red, apical one-third black ; a shallow longitudinal groove on petiole above, rising about the middle and ending abruptly in a hollow, just before reaching the apex. Wings fusco-hyaline, hind wings paler. Length (to margin of first basal segment) 10 mm. Expanse 20 mm.

This species can at once be distinguished from its only ally *M. impavida* by the red on the petiole.

Taken at Mamadu, Ceylon, April, 1904.

* *Odynerus subfistulosus*, n. sp. Fig. 8. Col. Mus. No. 224.

This species differs structurally from typical *O. fistulosus* in the following important respects. The basal three segments as coarsely punctured as head and thorax, the apical two segments without punctures. Clypeus emarginate, scutellum without a furrow,

medium segment produced sharply into a waved ridge, the truncation shining and punctured, not striate. The yellow markings in the sinus of the eyes and behind the latter, the lines on the pronotum, tegulæ, mesopleuræ, the marginal lines of all segments except the second, and the lateral spots and markings on legs, median segment, and ventral segment *absent*. It appears to me that the above differences are sufficient to separate this from *O. fistulosus*.

**Labus campanulatus*. ♀ n. sp. Figs. 10, 11, 12, 13.
Col. Mus. No. 226.

This species may at once be distinguished from *L. humbertianus* by its larger and heavier build and by the much larger and distinct coarse punctures covering the whole.

Head, thorax, petiole, and basal segment of abdomen very coarsely and evenly punctured, the punctures on the head finer and closer. Clypeus convex deeply emarginate. The pronotum in front laterally toothed. Median segment deeply incised forming a hollow for the petiole, the lateral margins of the incision with two teeth. The petiole broad and heavy, abruptly truncate at its base with a raised ridge at the verge of the truncation above. Basal segment of the abdomen long and campanulate. Black and glossy; the head with obscure silvery pile. The anterior half of the clypeus, the mandibles, the scape beneath, a minute spot between the bases of the antennæ, the apical margins of the petiole and first segment, yellow.

**Chrysis spectrum*, n. sp., Fig. 3. Col. Mus. No. 227.

Division C, Bingham's Key A, b^1, b^2, a^5—close to *C. singalensis*.

Metallic green with golden effulgence. The region of the ocelli, the medial areas of the mesonotum, scutellum, first, second, and third segments of the abdomen above, and the bases of the last two, purplish blue. The blue markings on the head and thorax centrally touched with black. Sides of the mesonotum golden red with fine longitudinal carinæ. First, second, and third segments of the abdomen, laterally, with bright cupreous golden spots extending in a band along the posterior margins of the second segment; the spot on this segment largest and brightest and of deep ruby red. Pronotum touched with golden red. Antennæ black, about as long as pro- and mesonotum united, first two joints of the flagellum touched with golden brown above; the scape in front, and legs more golden than green; the tarsi brown. Pilosity, short, erect, and whitish, fairly abundant; facial hollow finely transversely striate, with rather long whitish recumbent hairs on the sides; head, thorax, and abdomen densely and somewhat evenly punctured, finer and closer on the second and third segments. Head, from the front, about twice as broad as long, widely emarginate posteriorly; eyes large, prominent; clypeus broad, very narrow. sub-porrect and emarginate in the

middle. Anterior ocellus enclosed in a curved indistinct carina, the two ends of which terminate at the verge of the facial hollow. Thorax and medial area rectangular, the anterior lateral angles prominent. Median segment vertical, almost hidden, its posterior lateral angles produced and toothed. Wings hyaline, nervures dark brown, tegulæ dark blue. Abdomen, medially distinctly carinate; the first segment with a medial short broad groove at base with a slight hollow on each side; the third segment with the medial and lateral angles dentate, the margins between the teeth straight, not sinuate, an antiapical series of six foveae on each side of the medial tooth. A magnificently marked species possessing every colour of the rainbow, which its name indicates. Length 7 mm. Expanse 10 to 11 mm. (Four specimens, Colombo.)

**Nomia basipicta*, n. sp. Figs. 1, 2. Col. Mus. No. 225.

I would place this species in Bingham's Key Class B, Division *b*, a^1, and close to his description of *N. pilipes*, from which it differs in the following respects. Vertex, front, mesonotum, and scutellum without pubescence. Abdomen very finely and closely punctured throughout, the punctures coarser on the margins of the segments. The enclosed space at base of median segment longitudinally rùgose. Black, the basal segment red with a dark brownish patch in the centre reaching the margin and a deep V-shaped hollow at base, which is smooth and shining; remaining segments dark brown merging into black on the last three. Post-scutellum and margins of second to fifth abdominal segments thickly covered with very fine white plumose pile having a waxy appearance. Legs dull ferruginous brown; posterior femora with a tubercle beneath. Clypeus and front, from just above bases of antennæ, cheeks, sides of thorax, median segment (except the enclosed space at base), and legs covered with long silvery pubescence. A variety of the above has the whole abdomen brownish black, no red on basal segment. Abundant at Colombo. Length 10 to 12 mm. Expanse 13 to 14 mm.

Appendix to Mr. Wickwar's Paper by Col. C. T. Bingham.

Podalirius wickwari, form. nov.

♂ Head thorax, and abdomen very dark brown, almost black; legs dark castaneous brown, a narrow transverse band on the anterior margin of the clypeus and the tegulæ of the wings dull yellowish white, the apical margins of the segments of the abdomen very narrowly testaceous. Head clothed with white pubescence, which is long and comparatively dense on the front, on the occiput, behind

the eyes and on the under parts of the head, while on the clypeus at the sides and front and on the labrum it forms a thin fringe. Thorax covered somewhat densely with long brown hairs above, on the sides below extending on to the sides and posterior face of the median segment. Legs almost bare, the tibiæ and tarsi clothed and outwardly fringed with long whitish hairs; tibial calcaria yellowish white, preceded on the inner side of the tibiæ of the anterior and intermediate legs by a yellowish white curved robust hook and on the tibiæ of the posterior legs by a similar larger brown process or hook. There is a further armature on the inner side of the femora at base of a short thick blunt tooth. Claws bifid. Wings hyaline, nervures dark brown. Abdomen in the two males before me almost bare of pubescence, only the basal face of the abdomen, the sides, and apical margins of all the segments above and below fringed with brownish hairs. This absence of pubescence is evidently due to attrition; in fresh specimens the pubescence is probably fairly abundant. The whole head, thorax, legs, and abdomen beneath the covering of hair very minutely and closely punctured.

Length ♂ 10; exp. 19 mm. Habitat, Colombo, Ceylon.

This is a very distinct form, not closely allied to any Indian *Podalirius* known to me. It more nearly resembles the European *P. senescens* (Lepel) in general appearance, but the armature of the legs distinguishes it at once from any form known to me.

Oryssus (*Mocsarya*) *metallicus*, Mocsary.

Oryssus metallicus, Mocsary, Termesz. Fuzetek, XIX., 1896, pl. 1, fig. 2 ♀.

Mocsarya metallica, Konow, Termesz. Fuzetek, XX., 1897, p. 608 ♀.

It seems strange that this beautiful insect, described from the Sunda Islands by Mocsary, should occur also in Ceylon, but a Ceylon specimen of an Oryssus kindly submitted to me for examination by Mr. O. S. Wickwar corresponds so closely to Mocsary's description of *O. metallicus* that without an actual comparison with Mocsary's type I do not like to describe it as new.

So far as I can make out from Mocsary's description and plate, the Ceylon insect differs only as follows:—

Forewing: the fuscous cloud much paler, without purple reflections and limited to the apex of the wing extending into the apex of the radial cell, but not into the cubital cells. Legs nearly black, tarsi of all the legs bright orange red, posterior femora and tibiæ dull dark, not bright, red.

Professor Konow has split up Latreille's genus *Oryssus* into four genera, making *O. metallicus* the type of his new genus *Mocsarya*.

Explanation of Plate.

Fig. 1.—Nomia basipicta.

Fig. 2.—Nomia basipicta, showing tubercle on posterior femora.

Fig. 3.—Chrysis spectrum.

Fig. 4.—Oryssus metallicus (Mocs.).

Fig. 5.—Oryssus metallicus, front view of head.

Fig. 6.—Mutilla indostana (Sauss.), ♀ new.

Fig. 7.—Mutilla willeyi.

Fig. 8.—Odynerus subfistulosus.

Fig. 9.—Eumenes ichnogastroides.

Fig. 10.—Labus campanulatus.

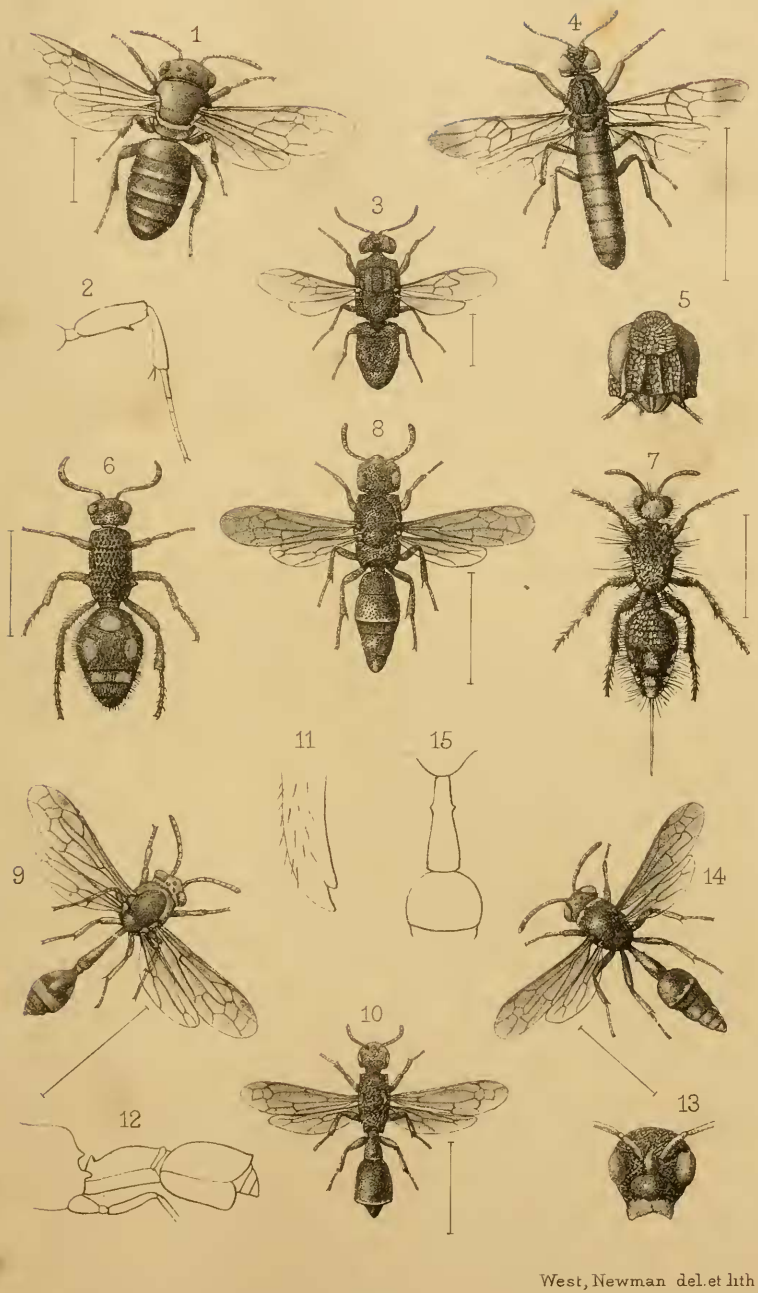
Fig. 11.—Labus campanulatus, mandible.

Fig. 12.—Labus campanulatus, showing median segment in profile.

Fig. 13.—Labus campanulatus, front view of head.

Fig. 14.—Montezumia rufipetiolata.

Fig. 15.—Montezumia rufipetiolata, enlarged view of petiole, seen from above.



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WICKWAR. ACULEATE HYMENOPTERA.

Fig.4. Oryssus metallicus *(Bingham.)*

THRESHING-FLOOR CEREMONIES IN UVA.

By James Parsons.

CERTAIN protective offerings were found buried in the threshing-floor of a paddy field in the village of Dehiwinna, Yatipalata division, Uva, a week or two after the *yala** threshing and winnowing had taken place. The stone or *arak-gala* covering the offerings was found concealed beneath some straw.

From below upwards, *i.e.*, in the order in which they were placed in the hole or *arak-wala*, the following were noted :—

(1) Two stalks of *iluk* grass (*Imperata arundinacea*).
(2) Two leaves of *tolambo* (*Crinum asiaticum*).
(3) Seven *bó* leaves (*Ficus religiosa*).
(4) A piece of *rambuk* stalk (*Saccharum arundinaceum*).
(5) Two stalks of *iluk* grass.
(6) A piece of the creeper *maduwela* (*Ipomœa obscura*).
(7) Five stalks of paddy with the ears.

The *iluk*, *maduwela*, and paddy were tied into rough rings about 10 cm. in diameter. Resting on the offerings and half projecting from the ground was the *arak-gala*, a roughly ellipsoidal stone of quartz rock measuring about 18, 12, and 10 cm. along its axes, obviously shaped by natural agencies and probably obtained from the nearest stream.

It is interesting to compare this list of offerings with those that should, at least theoretically, be placed in the threshing-floor according to the threshing-floor song translated by Dr. Coomaraswamy in his paper on "Paddy Cultivation Ceremonies in the Ratnapura District."†

Here seven *pilila* (*i.e.*, the parasitic plants) from different sorts of trees or plants are recommended. It was suggested to me that one at least of the *iluk* offerings was intended to be *iluk pilila*, a plant which is said to be exceedingly rare, and would appear to share the sanctity attached to parasitic plants in most primitive religions. The parasitic plants of the genus Loanthus are known as *pilila*, but as these plants are shrub-like and have woody stems, the *iluk pilila*, supposing it actually exists, can hardly belong to this genus. Assuming that the *iluk* represents its *pilila*, the reasons for the use of the other ingredients of the offering are fairly obvious.

* The second paddy harvest of the year, or autumn crop.
† Journal R.A.S., C.B., Vol. XVIII., 1905.

The blossom of the *tolambo* has a sweet smell; the *bó* leaves have evident religious value, and it is interesting to note that *seven* leaves were used, that ever-recurring number in Oriental mysticism.

The piece of *rambuk* stalk may have been placed as a substitute for sugar-cane, and *maduwela* is used in Sinhalese medicine. The paddy ears are the first that are gathered in the field after the threshing-floor has been reaped and the sheaves piled on the sides of the floor. It thus constitutes a sort of first fruit. It is, however, the paddy cut from the threshing-floor* which is the first to be threshed.

Certain objects are placed on the floor, but not in it at the time of threshing, viz., a shell, presumably the *arak-bellá* mentioned by Dr. Coomaraswamy, a piece of gold, iron, or other metal, and a piece of *kohomba* wood (*Azadirachta indica*). Also, if it can be obtained, the *góróchanna*, or hair ball (= the *gore* of Dr. Coomaraswamy) of a buffalo. According to the Ratnapura threshing-floor song seven *góróchannas* should be used.

These objects are kept in the paddy while it is being trodden and removed when the threshing is finished. They therefore seem to be simply talismans, while the leaves, &c., from the fact that they are buried and allowed to remain in the ground, would rather lead one to consider them as propitiatory offerings to evil spirits.

The word *arak*, or in its Sanskrit form *áraksha*, means preservation or protection.

A distinct set of offerings is made to the gods (*déwas*). These, consisting of betel leaves and various flowers, are placed in a *malpela* or rude shrine erected on the margin of the floor, and usually made of cadjan, but in this case of *rambuk*, on account of the scarcity of coconut trees in the neighbourhood.

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* It is to be noted, according to the Ratnapura threshing-floor song, that, in addition to the paddy *pilila*, paddy from the last year's crop should be placed in the hole.

THE KANDYAN DOOR.

By J. P. Lewis, Government Agent, Kandy.

THE Kandyan door is of a much more massive character than the modern *quasi*-European construction that is everywhere supplanting it, and in a short time the old Kandyan pattern of door and doorway will probably have ceased to be copied. The latest example of it is one that has just been constructed for the Kandyan Art Museum building, which also contains five old doorways of excellent workmanship *in situ*.

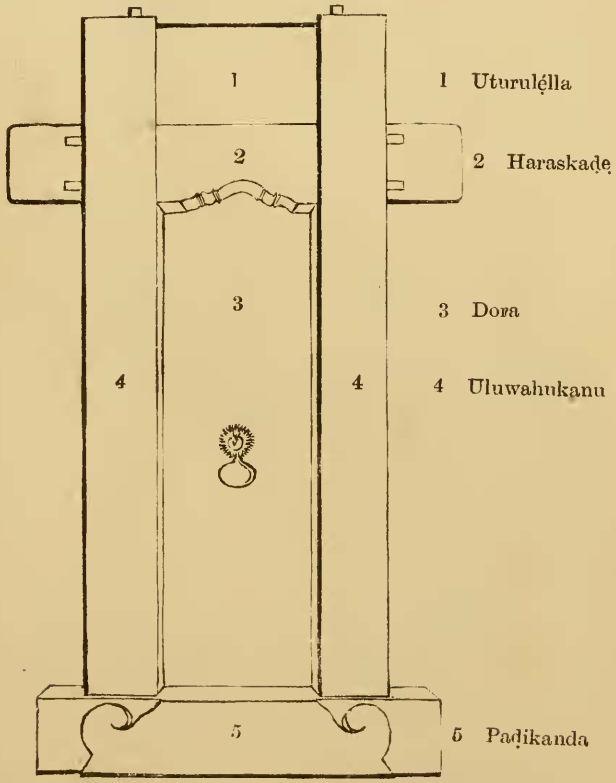


Plate I.—Exterior view of Kandyan door (the projecting ends must be imagined as hidden by the wall)

The same pattern of door frame and door is always followed, so that it may be said to have become stereotyped. Doors are of two kinds, single (*tani-doruwa*) and double (*depiyan-doruwa*). I send herewith a very accurate model of a single door and door frame, which will help to explain its design and construction.

The chief peculiarity of a Kandyan door is that it has no hinges. One might say of the Kandyan what Browning says of Sordello's builders (who are referred to I have been unable to fathom), that he

> "dreams and shapes
> His dream into a door post, just escapes
> The mystery of hinges."

Instead of hinges, the door, which is very thick, is rounded off on the side where, if there were hinges, the hinges would be, and the ends of this rounded portion project slightly at top and bottom and fit into holes, so that the door swings on these ends. These rounded ends are called *waṭaw* (singular *waṭawwa*, not in Clough).

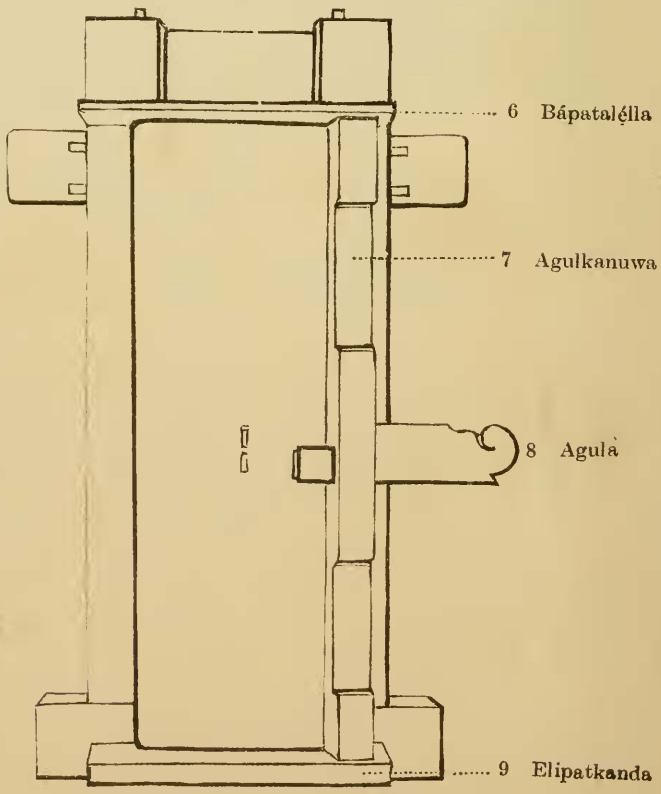


PLATE II.—Interior view.

A single door with its door frame consists of nine parts, which are indicated in the accompanying diagrams showing the door from the exterior and interior.

The whole door frame is called *uluwassa.* The two perpendicular posts are the *uluwahukanu.* The *agulkanuwa* is the post on the inside into which the big wooden bolt (*agula*) fits. There is sometimes an ornamental border round the door frame on the outside. This is called *lissara* or *lissarapati.* The lintel (*haraskade*), which is

usually of the pattern shown above (though sometimes it is more elaborate or has a double arch), is also called *udilipatkanda*. These Kandyan terms, however, are beginning to be forgotten, and the ordinary low-country word *rámuwa* to take their place.

The door handle is called *kayipudiwalalu*, which by the way is a Tamil word. The circular metal plate round it is called *bókkálé* (a word which does not occur in Clough) ; the key is *yaturumudda ;* the key plate *múnattahaḷuwa* (in Clough), and the iron bolt on the outside, which has a lion's head, *narissayatura* or *nárassara*. It is unnecessary to enlarge on the artistic character of this metal work, as everybody is familiar with it.

The inner bolt is *agula*, and the iron rod used to move it from outside *agultattuwa*. The hole through which this is inserted is *káppakaṭa*, which is not in Clough and sounds like Tamil.

The only difference between this door and a double door (*depiyandoruwa*) is that the latter is divided down the middle, and therefore is rounded at the two sides and requires two sets of *waḷaw*. The bolt is also, of course, different ; it is a double bolt in the centre of the door, and keeps the two halves together (see Plate III.). Both single and double bolts and the *kanuwa* into which the former is set are usually artistic in design.

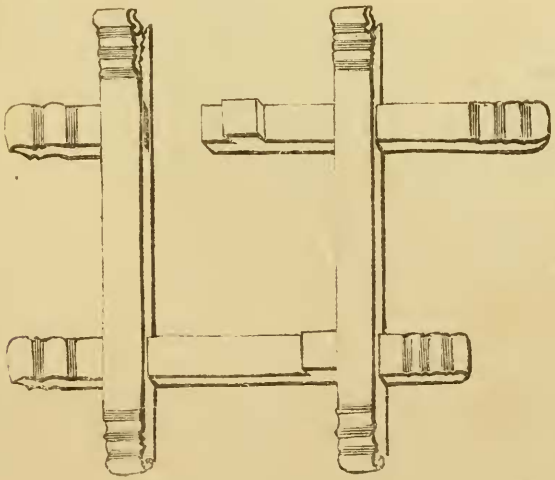


PLATE III.—Bolt of double door. The upper bolt is shown open, and the lower closed. One opens in one direction, and the other in the opposite.

In a Kandyan building the horizontal beam that supports the roof is called *deṷa* (in Clough), and the carved end of it (it always has a carved end) *dewasuliya*. The transverse beams that rest on these under the edge of the rough are called *waḷimbu* (in Clough).

PLACUNA FISHERY: INSPECTION OF MARCH, 1908.

By A. Willey.

I.—Ovulation and Maturation of Placuna.

THE Tamblegam pearl fishery, which has recently come to an end, has been conducted by contractors under a lease from Government, and was the second out of a series of five annual fisheries contemplated by the terms of a quinquennial lease. Indiscriminate fishing is reported to have occurred during the years 1905–1906; this ceased when the lease came into force at the beginning of 1907.

It was naturally supposed that the oyster beds would be automatically re-stocked at least once a year during the course of the lease; but this expectation has not been fulfilled, since *the oysters which have been taken this year belonged to the same generation as those of last year*, so that the end of the fishery means the end for industrial purposes of that generation. It is fortunately impossible, with the best efforts, to collect all the oysters; some few are certain to escape the vigilance of the divers; and these are the sole hope of the future, unless measures are taken, as they have been, to keep a special stock of oysters in reserve for breeding.

During my first inspection of the beds in June, 1907, I was unable to determine the sexes of any of the oysters examined fresh, owing to the immaturity of the gonads; and upon my second visit in October, 1907, I was not able to gather much further information on this matter for the same reason, even the largest specimens measuring more than seven inches in long diameter and more than six inches in height, being quite immature. I was able to detect the presence of occasional nests of developing ova amidst an abundant stroma; but this was not sufficient to determine whether the sexes were distinct, or whether the individuals were hermaphrodites; it was enough, however, to establish the fact of the commencement of ovulation. In some preparations there appeared an ovarian reticulum associated with an aggregation of the brown pigment, which is more or less diffused throughout the substance of the gonad. The alcoholic extract of the gonads has a clear yellow colour like a solution of picric acid.

At the same time (October) I examined the gonads of other Lamellibranchiate Molluscs, *e.g.*, *Venus*, &c., and found them to be perfectly mature, male and female in separate individuals, the

ovaries packed full of microscopic eggs, each in its own follicle, to the wall of which it was attached by a stalk. I looked in vain for this condition in *Placuna* in June and October (1907), *but found it prevailing on all the beds in March (1908)*. Male and female gonads are in separate individuals, as they are in the Mannar pearl oyster (*Margaritifera*),* and are either quite mature or submature in this month of March.

I am not aware that there exists any previous statement regarding the periodicity of the maturation of the gonads in the window-pane oyster, so that this definite observation may be regarded as a significant contribution to our knowledge of the natural history of this species; and, moreover, it yields information which will relieve future fisheries from arbitrary restrictions, affording a biological basis for whatever regulations may be drafted. The fact that the largest oysters examined in October last were immature (this does not mean that they were spent) was somewhat surprising, and seems to indicate that *Placuna* does not produce an annual brood, but that one generation succeeds another at intervals longer than one year, the exact period remaining for future discovery; and that sexual maturity is only attained after the completion of the superficial growth of the shell.

In the specimens examined in October I noted evidence of new growth at the shell-margin, chiefly in the form of a delicate lace-like fringe on the left valve. This was not conspicuous in March, and although the cessation of peripheral growth of the shell cannot be timed exactly, yet it would appear, from the evidence at hand, to coincide with the period of sexual maturity. In this respect, therefore, *Placuna* offers a striking contrast to the true pearl oyster, which attains sexual maturity at a very early age.†

The gonad of *Placuna* is a single organ chiefly connected with the right half of the mantle, and, contrary to what is observed in the common pelecypod (axe-footed) lamellibranchs, is mainly independent of the foot, which, in *Placuna*, has an acetabular structure at the end, is very protrusible, and remarkably like a proboscis in position and superficial appearance. Its action is probably like that of a contractile muscular proboscis when the animal imbeds itself in the mud; but I have not observed this directly. In the fresh condition the colour of the gonad varies commonly from a very pale, almost whitish yellow, to rich orange, the average colour being a creamy yellow. The differences in colour are not related

* W. A. Herdman. Observations and Experiments on the Life-history and Habits of the Pearl Oyster; in Herdman, "Ceylon Pearl Fisheries," Part I., p. 125, 1903.

† J. Hornell. Biological Results of the Ceylon Pearl Fishery of 1904; in Reports from the Ceylon Mar. Biol. Lab., No. 1, p. 8, 1905. Also printed in Sessional Paper XIII. of 1904.

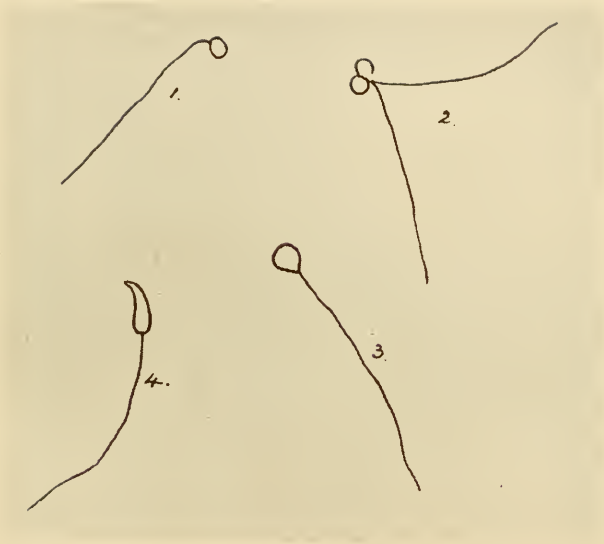
to distinctions of sex, but are to some extent correlated with individual variations in the black pigmentation of the mantle. In some cases the mantle round the adductor muscle up to the apex of the median hinge lobe is intensely black, the free peripheral portion being destitute of the black pigment, unless there happens to be a peripheral mantle pearl present, in which case, after removal of the pearl, the pigmented sac in which it was contained shows up clearly in the middle of the colourless tract. The dwarfed oysters of Kakkaimunai were noted in general to be pale throughout, often very little pigment being present in the mantle. Occasionally the gonad has a dark smoky brown tint; this was first observed in March in an individual which proved to be a female.

In both sexes the gonad is smooth externally, but internally a fine sacculation may be seen with a lens. Frequently, when the sacculation is coarse and even visible without a lens, the individual turns out to be a male: when the sacculation is so fine as to give a minutely spotted appearance when viewed with a lens, the individual may be a female; but this distinction is not absolute, and the only ultimate criterion is afforded by microscopic examination. Out of twenty individuals thus examined in March (1908), nine were male, eleven female. One of the Kakkaimunai oysters, though of small size, $4\frac{5}{8}$ by $4\frac{1}{8}$ inches, gave an impression of being old, and was in fact a mature female.

If an incision be made into the gonad of a mature female, a quantity of minute brown-coloured ova will stream out; but in a mature or submature male the contents are viscid.

The spermatozoa, as they appeared at this time, had round heads and very delicate tails (fig. 1). They moved, on the addition of sea water, in a jerky, spasmodic manner. The morulæ, from which they originated, had in very many instances not yet become dissociated, and in these cases the long tails could be seen, under high magnification, radiating on all sides from a mass of heads. Often two or several spermatozoa were seen with heads still agglutinated together (fig. 2). By way of comparison the ripe spermatozoa of a species of *Cardium*, common at Niroddumunai (where it is called "pakku maddi," this term being differently applied at Koddiyar), were sketched. These have elongate heads with hooked extremity and broad base, from which the tail proceeds (fig. 4). I have not yet had an opportunity to study the finer structure of the reproductive organs by means of sections.

The observations described above lead to the conclusion that the window-pane oysters living in lake Tamblegam in the first quarter of 1908 displayed synchronous maturation of the gonads; and that *Placuna* is a periodic spawner, or at any rate does not become continuously reproductive until a late age, in contrast with the chronic maturity of other burrowing bivalves, such as *Venus*, *Cardium*, and *Arca*.



Figs. 1–3, Spermatozoa of *Placuna*.
Fig. 4, Spermatozoon of *Cardium*.

II.—Age of the Oysters.

I take it that my inspection of the Tamblegam beds in June and October, 1907, allows me to assert positively that there was no effective fall of spat in that year; and I found no evidence of any having taken place in 1906. In June I did find yearling oysters in the Sambore river, but not in lake Tamblegam.*

The following tables show the growth of the oysters on the various beds since Mr. Hornell's inspection of 1905.† The term "plants" is applied to those oysters which I placed in an enclosure in Nachchikkuda in October, 1907, as will be mentioned later. Oysters taken from their natural positions on the beds are distinguished, when necessary, as "topotypes":—

Table I.—Nachchikkuda.

The dimensions given in this and subsequent tables are the averages of numbers of individuals, the numbers in each case being stated for the sake of completeness, although the actual number makes no appreciable difference to the average in a normal series. The standard height is 5½ inches or 139 mm. In the measurements given below the length precedes the height.

Date.	Observations.
May, 1905 (Hornell) ..	The bed "consists of very young individuals, none exceeding the size of a crown piece," *i.e.*, 1¾ to 2 inches in diameter, or about 50 mm.
June, 1907 ..	Average of 44 specimens: 159 by 147 mm., decimal points being omitted.
October, 1907 ..	Average of 66 specimens: 168 by 154 mm.
March, 1908 ..	Average of 9 "plants": 173 by 163 mm.
Do. ..	Average of 15 topotypes: 171 by 162 mm.

The averages taken in March of this year show that the transplanted oysters behaved normally.

Table II.—Kapalturai.

May, 1905 (Hornell) ..	"The bed off Kapalturai is also composed of young individuals, older by some three months than those of Nachchikkuda. The average size is 3·33 inches by 2·92 inches (83·25 by 73 mm.), and over the greater part of the bed they lie in great profusion, from 10 to 22 being commonly brought up at one dive." These may be estimated at not less than one year old.
June, 1907 ..	Average of 16 specimens: 6·6 by 6·1 inches, or 165 by 152 mm. These would be three years old.
October, 1907 ..	Average of 15: 169 by 153 mm. This is nearly the same as the June average, and just double the 1905 average; about 3½ years old.

* A. Willey. Report on the Window-pane Oysters (June, 1907). *Spolia Zeylanica*, Vol. V., November, 1907, p. 38.

† J. Hornell. Report on the *Placuna placenta* Pearl Fishery of lake Tampalakamam (May, 1905). Ceylon Mar. Biol. Lab. Rep., Part II., June, 1906.

Date.	Observations.
March, 1908 ..	Average of 22 : 181 by 165 mm. These are large scattered individuals living under conditions favourable to growth ; and the apparent average increase of size since October may depend as much upon individual variation as upon the general growth of the colony ; about 4 years old.

Table III.—Kakkaimunai.

The Kakkaimunai oysters are in general dwarfed and of unequal growth, hence the averages are only approximately comparable. The observations indicate that this bed is a favourable spot for the settlement and rapid, though limited and stunted, growth of *Placuna*. The oysters are crowded side by side, thus prejudicing their bodily growth, and perhaps also their total pearl productivity, but not affecting their sexual maturity; hence the Kakkaimunai bed acts as a natural reserve.

May, 1905 (Hornell) ..	Of two samples, one estimated at $1\frac{1}{2}$ year old gave an average size of 111·4 by 102 mm. ; the other estimated at $1\frac{3}{4}$ year old gave an average of 125·2 by 114·96 mm. Combining these two sets we obtain an average of 118·3 by 108·48 mm.
June, 1907 ..	Average of 12 specimens : 119·3 by 111 mm. It seems certain that these oysters belong to the same generation as those seen by Mr. Hornell in 1905. It would follow, therefore, that there had been practically no growth in superficial area, but only in the thickness of the shell.
October, 1907 ..	Average of first sample of 30 (October 17), 131·5 by 123·5 mm. A total of 79 oysters was measured on this date : the smallest 106·25 by 92·75 mm.; the largest 159·4 by 146·9 mm. This is an extreme variation tending to vitiate the average. Second sample of 30 (October 22) : 135 by 124·25 mm.
March, 1908 ..	Average of 16 topotypes : 129·2 by 122·1 mm. This is nearly identical with the average of the October topotypes.
Do. ..	Average of 16 plants (*i.e.*, oysters transplanted in October, 1907, from Kakkaimunai to Nachchikkuda) : 141·8 by 130·1 mm.

Table IV.—Sembian-aar.

It will be noticed that while the oysters on this bed show a larger growth than those on the Kakkaimunai bed, yet they resemble the latter in having made little increase in size since 1905.

May, 1905 (Hornell) ..	This bed "was particularly prolific in fine, well-grown oysters from 10 to 16 to a dive." Average size : 155 by 142·25 mm. ($6\frac{1}{8}$ by $5\frac{5}{8}$ inches) ; "probably over 2 years old."

Date.	Observations.
June, 1907 ..	Average of 12: 150·5 by 142·5 mm. The difference in average long diameter between this and the 1905 sample is negligible and the height is the same. I assume that they belonged to the same generation, and were therefore more than 4 years old.
October, 1907 ..	Average of 20: 154 by 149 mm.
March, 1908 ..	Average of 20: 166·4 by 154·75 mm. Shells very old, heavy, and mostly worn at the edges; some blackened ("micaceous") about the hinge area.

Table V.—Polokarai-aru.

This bed lies rather near the shore, between Sembian-aar and Kakkaimunai.

October, 1907 ..	Oysters scattered like those of Sembian-aar. Average of 18: 154·7 by 149·6 mm.

Table VI.—Uppu-aru.

I inspected this bed in March, 1908, with an entirely negative result, apparently due to an excessive deposition of mud during the recent rains. This backwater is a simple estuary, whereas the Tamblegam lake is to a great extent an arm of the sea.

III.—The Fishery of 1908.

The measurements tabulated above show that the oysters living in the lake at the time of the 1908 fishery were to all intents and purposes of the same age. There was not one too young to be taken by the divers, no fall of spat being known since 1904–1905. It follows from the facts which have been brought forward that the fishery of this year has not been an independent fishery like the annual Mannar fisheries, but it has been the conclusion of the industrial collection of one growth, or, to use an agricultural expression, one crop of *Placuna*.

The fishery commenced on February 3 and ended on March 17. Although short it went briskly, being better organized than in the previous year; and it gave better results in consequence of this fact, and also because of the increased average size of the pearls.

Arrangements had been made for the filling in of forms of daily return signed by the manager of the fishery on behalf of the lessees. These offered no difficulty of any kind and yielded just the information that was wanted and would otherwise have been lacking. Their use should be made an indispensable condition of future fisheries.

The total number of oysters recorded as having been taken in 1907 was 1,255,344. Of these, one-half belonged to the lessees, the other half to the divers; and the half share of pearls secured by the former amounted to the weight of 46 rupees, valued by weight

at Rs. 690. But many of the pearls have a definite qualitative value in native jewellery, so that the weight gives no reliable indication of the true worth of the pearl-yield.

The numbers of oysters entered on the schedules represent half the total quantity taken on each day. The half share of the entire catch this year aggregated 130,568 oysters, the number actually taken being therefore twice this amount, namely, 261,136.

The total number of days occupied by the fishery was 38, no diving being undertaken on Fridays, in accordance with Muhammadan custom.

Daily Returns of February, 1908.

Date.	Boats.	Divers.	Oysters.	Place.
3	15	58	15,100	Kakkaimunai
4	26	91	31,463	do.
5	32	95	27,009	do.
6	39	99	28,015	do.
8	37	99	2,313	do.
9	40	109	2,846	do.
10	18	48	1,289	Saliyatuwai
11	12	33	630	do.
12	14	40	767	do.
13	14	37	679	do.
15	6	17	360	do.
16	7	20	536	Mukkikallu
17	14	60	1,060	do.
18	23	74	592	do.
19	28	86	1,115	do.
20	8	25	205	do.
22	17	61	545	Nachchikkuda
23	12	49	681	do.
24	4	11	62	do.
25	19	63	1,114	Saliyatuwai and Nachchikkuda
26	22	70	891	Sembian-aar
27	15	64	1,096	do.
29	21	80	2,159	Polokarai-aru

March, 1908.

1	13	51	984	Polokarai-aru
2	12	56	1,130	Polokarai and Setukuda
3	17	67	1,540	Setukuda
4	20	75	1,655	do.
5	13	29	250	do.
7	15	50	435	do.
8	11	40	494	do.
9	14	45	672	do.
10	10	29	853	Sembian-aar
11	11	32	536	Nachchikkuda
12	9	25	360	do.
14	3	10	201	do.
15	5	15	375	Polokarai-aru
16	3	10	207	Saliyatuwai
17	5	15	349	do.
			130,568	

IV.—Pearl-yield.

During the course of the 1908 fishery it became clear that the crop of pearls was a great deal better than that of last year, and the actual figures show a disproportionate increase. For, whereas in 1908 the lessees' half share of oysters numbered only 130,568, or a little more than one-fifth of their share (627,672) in 1907, the weight of pearls secured in 1908 is returned at 92 rupees, double the quantity recorded in the preceding year.* This result is somewhat surprising, and can only be attributed to the continued growth of the pearls. After a pearl has reached a certain size, its further growth by the apposition of fresh layers of nacre must add greatly to its volume and value as compared with the earlier stages in its formation.

As this is the first occasion on which a comparison of the pearl-yield in successive years has been possible, it may be tabulated as under:—

Date.	Lessees' Share of Oysters.	Rupee Weight of Pearls.
1907 ..	627,672 ..	46
1908 ..	130,568 ..	92

The practical conclusion to be drawn is that in the case of *Placuna* the maximum pearl-yield coincides with the period of sexual maturity. If subsequent observations should confirm this conclusion, it will become an economic fact of controlling importance.

From what has been said it will be clear that a short lease is a pitfall, fatal to the spawning oysters. It is not to the interest of contractors holding a lease of only five years' duration to spare the spawners, but, on the contrary, it is their business to take as many as they can get, to which in fact they are legally entitled.

Moreover, seeing that superficial dimensions give no safe index to the state of maturity of the oysters, it follows that the provision as to size limit can only be a very crude approximation, especially when it is considered that size depends upon a dozen environmental conditions. The three-year theory of the longevity of *Placuna* seems to be based at least, in part, upon the length of life permitted by boring whelks, sponges, and human enterprise. When dead shells are brought to the surface with the two valves still adhering together, it is generally found that one of the valves, usually the convex valve near to the cardinal teeth, has been perforated by some enemy; and I attribute the mortality on the Nachchikkuda bed chiefly to the whelks, whose erect, subcylindrical egg-capsules are attached in dense clusters to dead valves of *Placuna* lying upon the bottom of the lake; each capsule contains a multitude of embryos, and oviposition appears to be chronic.

V.—Rainfall.

In my former report I urged the desirability of noting the rainfall in connection with the annual condition of the *Placuna* beds. In

* *Cf.* my June report, *op. cit.*, 1907, p. 40.

the Sambore river, the Uppu-aru, and the Palampat-aar the freshening of the water appears to have a direct and injurious effect upon the health of the oysters. The greater portion of the Tamblegam lake seems to be much more independent of the rainfall than the localities named, and successfully withstood the last rainy season.

The following table, kindly prepared at my request by Mr. H. O. Barnard, F.R.A.S., F.R.Met.S., Superintendent of the Meteorological Branch, shows the frequency of the rainfall in the Trincomalee District during the months October, 1907, to March, 1908, inclusive :—

Rainfall at Trincomalee.

1907.	Inches.	Days.
October	13·57 ..	20
November	22·13 ..	17
December	6·07 ..	13
1908.		
January	4·99 ..	11
February	6·85 ..	5
March	2·06 ..	6

VI.—Placuniculture.

It is only necessary to state here that the first steps have been taken towards placing the *Placuna* beds of the Tamblegam lake under conditions of culture. In October, 1907, a limited number (about 450) of oysters was transplanted by hand from the natural beds to a reserved enclosure marked off by stakes in Nachchikkuda. In March, 1908, these "plants" were found to be in good condition, and to have achieved their maturation in a normal manner.

There is a strong theoretical reason in favour of planting the oysters close together in a confined space. The effect of a fishery is necessarily to thin out the beds, so that the few surviving individuals become isolated and more or less widely separated. As the sexes are distinct the chances of fertilization are correspondingly reduced after a fishery, and transplantation may therefore be supposed to counteract the effects of depletion.

In March, 1908, a further experiment was set on foot. Twelve baskets of special construction were suspended from crossed poles in mid-water and stocked with mature oysters. It is hoped that some result will manifest itself before the end of the year.

Finally, one of the most necessary precautions in cultural operations, namely, the surveillance of the protected areas, has not been neglected. Three watchers have been appointed by the Assistant Government Agent at Trincomalee to look after the beds until the next fishery takes place.

Samples of the Plankton (floating micro-organisms) were collected and preserved in October and March, chiefly with the object of overtaking the free-swimming embryos of *Placuna;* so far, however, without success in this respect. Observations on other animals associated with *Placuna* have been made, but these do not at present affect the practical issues.

MOONSTONE FROM HANGURANKETA.

From a photograph taken by Mr. J. H. de Saram, C.M.G.

NOTES.

1. *Hanguranketa Moonstone.*—Readers of Fergusson's History of Eastern Architecture will not need to be told that the ornate semi-circular threshold stones, commonly known as moonstones, which occur at the bases of flights of steps leading into the pansalas and viharas of Ceylon, are an exclusive character of the ancient architecture of this Island, and are not found in India nor elsewhere on the Asiatic continent. Crossing the threshold must have formed a solemn part of the daily routine in the old days of militant Buddhism.

The stone here portrayed has been lying at the Museum for many years (see *Spolia Zeylanica*, III., p. 26, "Floral Moonstone"), but it has never been illustrated before. It is unique of its kind, and the extremely conventionalized nature of the decorative scrolls may point to the fact that it belongs to a somewhat later period than the zoophorous or processional moonstones (with representations of animals in procession).

The disc, which might serve equally well as a lotus emblem or as a sun emblem, is framed within a succession of what may either be flower vases or water pots, terminating on each side in the sign of the blessed footprints of Buddha. Outside these there is a complicated terminal scroll, which appears to be a makara derivative; and behind these scrolls there is an actual makara with open mouth, from which a minor scroll issues surmounted by a small uplifted trunk; behind the head the legs are seen, and the body ends in a coiled tail.

It has been said that when an object expressive of an artistic conception and having the character of a sacred emblem is removed from its original environment and brought to a Museum it loses all its significance. Such a reproach, however, only proceeds from one point of view, since, in addition to the original motive of the design, which nothing can alter, it acquires a new meaning. The conversion of a *res sacra*, even though it may have become obsolete, into a Museum specimen may seem a cruel turn of fortune's wheel, but it may be urged that its ethnographic value becomes accentuated.

This moonstone is said to have belonged to the palace of a Kandyan king at Hanguranketa. It is a great slab of gneiss with roughly dressed edges and finely sculptured upper surface, measuring 7 feet across the straight border, about 4 feet 8 inches from the middle of the latter to the middle of the convex border; the

diameter of the disc is 2 feet 8 inches, and the thickness of the slab about 8 inches. It is lying flat upon the ground, and is not easy to photograph, but Mr. J. H. de Saram, C.M.G., whose effort is here reproduced, succeeded admirably.

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2. *Stone Pillar from Gampola.*—A handsome stone pillar has been recently unearthed and presented to the Colombo Museum by Mr. T. B. Yatawara, Ratemahatmaya. It is carved differently on the four sides. The shaft of the pillar is octagonal, the base and capital square. The basal carvings represent a trisul ornament, a tom-tom beater, a flower vase, and a sedent lion ; at the top there are dancing figures and a peacock.

The following further information has been kindly supplied by Mr. J. P. Lewis, Government Agent of the Central Province, who was instrumental in securing the presentation :—

"One tradition is that Bhuvaneka Bahu V. transferred the seat of government to Kotte (1410), leaving the other members of the royal family at Gampola; and Raja Sinha I. of Nilambe, when on his way to Sabaragamuwa from Nilambe, received information of the sojourn at Gampola of these royal people, and fearing that they might kill him and take the kingdom had them killed. But one of them, Konnappu Bandara, escaped death, and remained at Gampola disguised as a Buddhist priest, and started to build a palace on a hill at Tiyambara-ambe, commanding a view of the low-country as well as the hill country. Whilst he was building it the king heard of it, and sent ministers to inquire into the matter. Konappu in consequence fled to Colombo, and from thence to Goa. He returned after the death of Raja Sinha, and became king under the title of Wimala Dharmasuriya I. (1592).

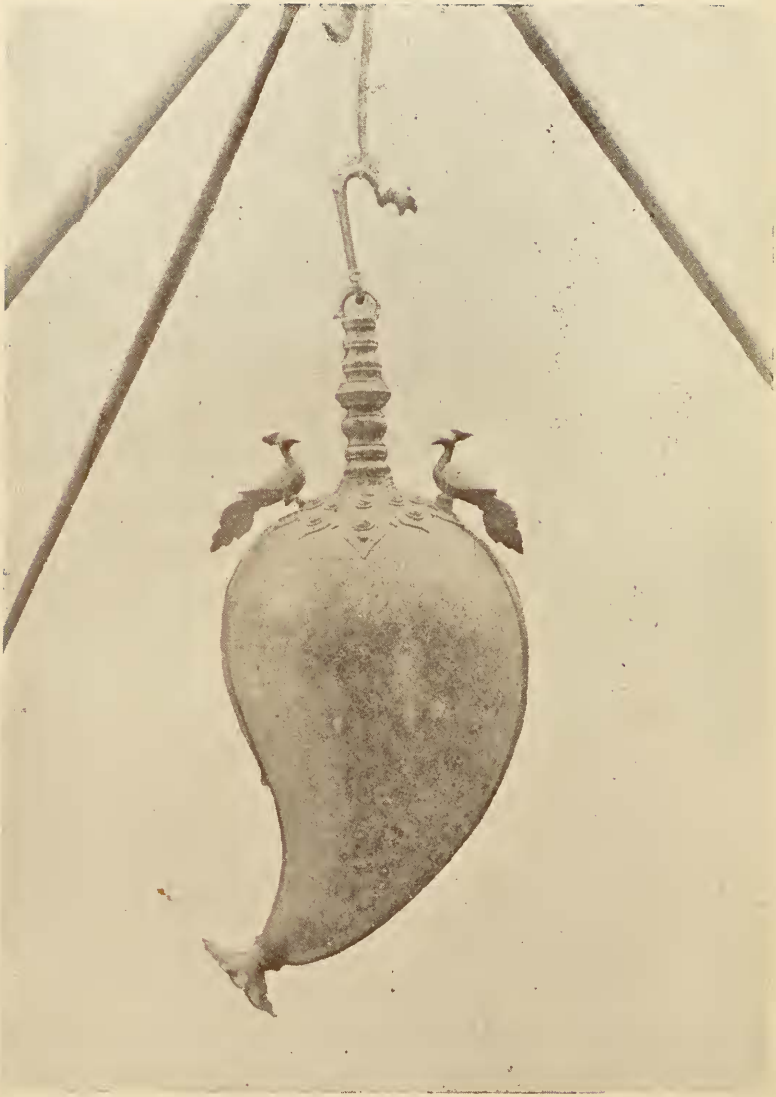
"Another tradition is that a prince of Gampola, who was occupying the palace at Sinhapitiya, found that Raja Sinha's visits to Gampola were too frequent for his safety, and, fearing death, started to build a palace at a spot not easily accessible. For this he chose the hill Eraminiyagammana at Tiyambara-ambe, and removed thither the materials of the old palace ; and when the king heard of it he sent emissaries to kill him. The prince was warned of this by somebody, and he fled from the place. The king's men pulled down what was erected and went away.

"This pillar is one of the four that have been found at the spot.

"Tiyambara-ambe is a village situated 9 miles from Gampola on the Gampola-Kurunduwatta road in Gangaihala korale."

TWO VIEWS OF THE GAMPOLA PILLAR.

From photographs taken by Mr. J. H. de Saram, C.M.G.



CEREMONIAL MANGO.

Lent to the Colombo Museum by Mr. Paul Pieris.

3. *Ceremonial Mango.*—A fine example of a large brazen mango has recently been deposited in this Museum on loan by Mr. P. E. Pieris, M.A., C.C.S. It is made with a pale alloy crowned by a mounting of yellow brass bedecked with crystals and terminated by a high knob carrying a hook. On each side there is a figure of a mythical bird called Garuda, and below these an incised Bo leaf design. The mango ends in a lotus flower with crystal (glass) centre. It is hollow and contains loose metal pellets, which rattle when carried about. Along the lower concave border there is a cleft, as in the Pattini bangles, armlets, and anklets, through which the pellets can be seen.

The following is the story of Pattini devi or the birth of the goddess Pattini out of a mango :—

"In the garden of the King of Pandya was a well-grown mango tree which bore a remarkable mango, out of which Pattini devi was born.

"This mango was more beautiful and larger than the other mangoes on the tree. It was arranged to pluck this mango by arrow shots. Headed by the King of Pandya, all the archers of the place tried in vain to shoot it down. Seeing this the god Sakra in the form of an old man with an arrow in his hand came to the spot. The King of Pandya said: 'Oh! old man, how can you shoot this mango after all these renowned archers, including myself, have failed?' The old man replied: 'Although I am old, there is no one among you who can lift my arrow.' Thereupon, knowing his power, the king asked him to shoot the fruit, so that the mango should not fall to the ground. A cloth being held up, the old man taking aim shot the mango. The fruit, separated from the stalk, began to fly round in the air. Whilst beholding this wonder, a drop of sap from the fruit fell into the eye of the king and blinded it. Thenceforth, the king being afraid to keep the wonderful mango in his country or to harm or eat it, ordered his people to put it into a pot, place the pot in a small boat on the water, and let it drift away. The boat was found by a Moorish queen, who carried off the pot with the green mango to her palace. A few days afterwards Sakra, chief of the seven heavens, came as an old beggar asking alms. The queen remembered the mango, and thinking to give a part of it to the old man looked in the pot. There she saw instead of the mango a female infant, more beautiful than a golden image, sucking her fingers. Sakra then disappeared.

"This strange infant, born from the mango, was named Pattini devi. Having grown up, she is said to have performed various marvels and supernatural acts. The story of the miracles she wrought is fully told in the Ambawidamana, Walalukathawa Salambasantiya, Wesamedima, and Ankeliupata."

The total length of the mango image and hook is about 22 inches, the mango alone measuring about one foot in length. It is said to

have come from the Seven Korales, and to have been used at the Pattini dewales, being carried in procession by the Kapuralas or Pattini Hamis in a lacquered box. At dewal maduwas they still perform the ceremony of shooting the mango.

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4. *A Note on Kallima philarchus.*—Whilst on a visit to an estate in the Uda Pussellawa district (5,200 feet) I had a good opportunity of watching the habits of *Kallima philarchus*. This interesting "Oakleaf" butterfly is one of those remarkable instances of colour protection, for, although the prevailing colour of the wings above is a brilliant blue, the under parts resemble a dead leaf, so that when the butterfly has settled with closed wings it is extremely difficult to distinguish it from a dead leaf. For two days a butterfly frequented a certain spot on the trunk of a tree quite close to a footpath, and thus I was able to watch it at close quarters. I noticed with much curiosity that as soon as the butterfly settled, which it did in the usual way, it immediately turned round so that its head pointed downwards. I was much puzzled over this proceeding, which occurred every time the butterfly settled, until I discovered the reason. The butterfly turned round so that the "tail" of its two hind wings would almost come into contact with the trunk of the tree, thus representing a stalk, and the apparently dead leaf would hang in a perfectly natural way, drooping downwards, or, as Mr. Green remarks (*Spolia Zeylanica*, Vol. V., Part XVIII., p. 89), "it might be mistaken very easily for a detached leaf, that in its fall has hitched up in a cobweb....."

W. A. CAVE.

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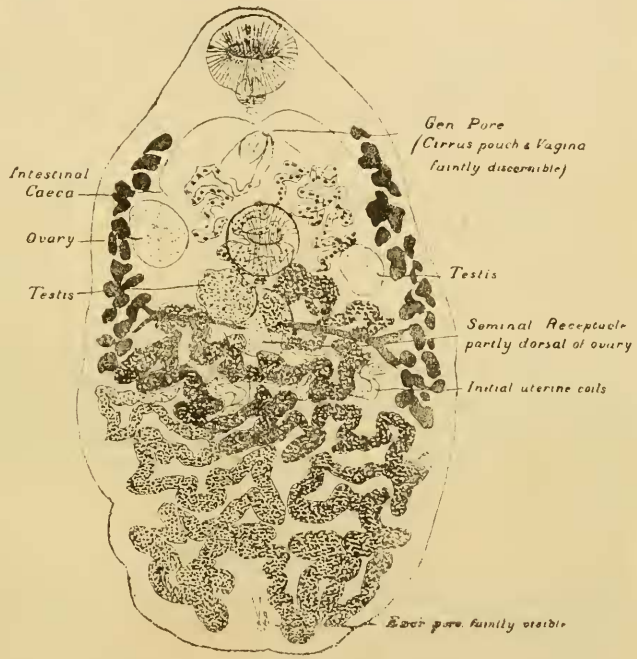
5. *Parasite from the Gall-bladder of Ceratophora.*—Whilst dissecting a specimen of the Unicorn Lizard (*Ceratophora stoddarti*) from Nuwara Eliya in April, 1905, a parasitic flat worm was found in the gall-bladder. It was forwarded through Mr. A. E. Shipley to Professor A. Looss at the School of Medicine, Cairo, who kindly furnished the following provisional report. A second specimen was taken from the same species at Hakgala in January, 1906. The lizard is one of those which are peculiar to Ceylon, occurring at the highest elevations, and the occasional presence of a fluke in its gall-bladder is rather an interesting case of parasitism to put on record.

Dr. Looss's report :—

"I have examined your specimen, and am herewith sending you a sketch of what I have been able to make out (see text-figure). The worm is a Distome, as I had surmised, but its organization rather differs from what I believed to see in your sketches (made in Ceylon). There is as yet no genus established for this structural

type, but *Distomum mutabile*, Molin, from the gall-bladder of *Lacerta muralis*, so closely resembles your form that there can be no doubt that both forms are congeneric. The most recent description of *D. mutabile* is given by Lühe in Centrbl. Bakt., &c., XXVIII., 1900, p. 563. A comparison of that description with my sketch will show you this resemblance, which extends also to the habitat (*i.e.*, the gall-bladder). You might therefore safely establish a new genus for your parasite. I should not, however, advise you to do so, since the state of preservation of the specimen does not admit of giving a full diagnosis of the genus.



Distomid parasite from gall-bladder of Ceratophora.

"The details in the organization of the worm which I have not succeeded in settling are the following :—(1) The length of the intestinal cœca : they disappear from view at the anterior border of the testicles, but apparently do not terminate there. (2) The structure of the copulatory organs : they are present, but so faintly outlined that nothing more is visible. (3) The shape and extent of the excretory vesicle, the pore being alone discernible. (4) Finally, the skin has fallen off, and the question whether it is or is not armed with spines remains an open one. These four points ought to be mentioned in the diagnosis of the new genus (speaking from a strictly scientific point of view) ; but practically it will be recognizable without them."

School of Medicine, A. Looss.
Cairo, December 14, 1905.

6. *The Lula's Enemy and the Adventurous Squirrel.*—I was out at Horana last week and noticed a black and white snake about two feet long and as thick as a man's thumb holding a lula in its mouth sideways by its back. The fish was about eight inches long, and twice the thickness of the snake. It was bleeding freely where the snake had hold of it with widely distended jaws. I got the fish away and put it back in a part about 10 feet off, when it immediately dived beneath the mud. The snake remained stationary, even refusing to move on being pushed with a stick, and seemed either exhausted or stupefied.

Another rather curious incident occurred in a bungalow I was staying at. There is a stuffed crocodile in the verandah, with its mouth wide open. It lies well inside the house. A squirrel came in and walked up to the crocodile, looked inside its distended jaws, and then bolted. It seemed fully to realize that the beast was stuffed.

Colombo, April 14, 1908. A. L. HINE-HAYCOCK.

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7. *Fishery Observations.*—A knowledge of the breeding and swarming habits and periods of marine, estuarine, and fresh water fishes must form the basis of intelligent action in regard to fish preservation and culture, and it is from this point of view that the following notes are offered.

I.—Shoal of Plotosus Fry.

Plotosus is a genus of Siluroid fishes (sometimes called Cat-fishes) represented in Ceylon waters by two species, *P. canius*, which may be the same as "Kalapu-anguluwa," although I am not certain about this; and *P. arab*, which has been called "Mudu-hunga." The respective Tamil names for these species are given by Mr. A. Haly in his list of fishes likely to be found on the coasts of Ceylon (Colombo, 1890) as "Kelura" and "Kadalsungen."* The former is an estuarine fish not found in the Red Sea; the latter ranges from the Red Sea to Japan and Polynesia.

Whilst I was inspecting the Tamblegam window-pane oyster beds on June 24, 1907, and passing a point called Peyaddumunai, near the mouth of the Periya Palampat-aar, I noticed, at a distance, a dense black mass floating close to the surface, which looked like drifting seaweed, and was actually pronounced to be "pasi" by the boatmen. Upon approaching it, however, it resolved itself into a

* At Niroddumunai the general term for these fishes is "kelethi," and they distinguish between Nāgalam or Māmpalam kelethi and Muttei or Arthu kelethi, the latter being a species of *Macrones* (*M. gulio*).

vast multitude of small tadpole-like fishes, moving in unison, each one characterized by two longitudinal white stripes commencing from the head between the eyes and converging backwards to either side of the dorsal fin. A diver jumped overboard and secured a quantity of them in a bucket. Subsequent examination proved them to be the fry of *Plotosus*, by reason of their many-rayed ventral fins and confluent second dorsal, caudal, and anal fins.

At first I concluded from their habitat that they were the fry of *P. canius*, but the proportions of the eyes and of the eight barbels to the length of the head afterwards led me to assign them to *P. arab.*

Their size varied very slightly from about 18 to 19·5 mm. in extreme length from the snout to the tip of the rounded tail fin. Just in front of the origin of the anal fin and behind the vent there is a pair of disc-like organs with sinuous margins. Between them occurs the urogenital papilla. The character which would seem to clinch their specific identification, namely, the total number of rays in the conjoined vertical fins, was not available, inasmuch as the anterior portion of the second dorsal fin membrane is destitute of rays at this early stage.

I do not know of any previous records of the pelagic swarming habit of the fry of *Plotosus*. They formed, in the mass, a conspicuous object, and might easily have been passed by as seaweed had not curiosity prompted nearer acquaintance. Whether or not this casual resemblance can really afford them an effective screen from their enemies seems questionable.

II.—Lula Fry.

The lula (*Ophiocephalus striatus*) is the most important fresh water food fish of Ceylon, both as regards quality and quantity. It is also known by its Hindustani name "murral," according to Mr. H. S. Thomas's latest spelling of the word, and by its Tamil name "viral." The Hindustani name is the one most currently employed outside Ceylon.

It is what Dr. Day calls a compound breather, being more essentially an air-breathing fish. The Ophiocephali "never obtain oxygen for any length of time from the air in solution in the surrounding water, but inspire it direct from the atmosphere, no matter how cool and charged with air the water may be"; and they "expire in a longer or shorter interval if unable to reach the atmospheric air." They are thus independent of the state of the water in which they are living, and "in carrying live specimens from the plains to the Nilgiri hills, this was most successfully accomplished in water largely mixed with mud."*

* Day, F. Report on the Fresh Water Fish and Fisheries of India and Burma. Calcutta, 1873, p. 25.

The adult lula feeds upon smaller fishes and frogs. In Ceylon it is known to be particularly partial to a near relative, the "pandaral kanaya" (*Ophiocephalus gachua*), whose recognition marks are the barred yellow and black pectoral fins and the tubular nostrils; it also likes "issu" (fresh water prawns) and "dandiya" (the Ceylon minnow, *Rasbora daniconius*).

Mr. H. S. Thomas (Rod in India, 3rd edit., 1897, p. 234) says that "murral are the easiest of all Indian fish to introduce"; they will "thrive in ponds and at various altitudes, so you can easily stock a pond if you desire, but they will speedily depopulate it of other sorts of fish.* The natives frequently put them into their wells, from which they can take them fresh as they want them." This last practice does not seem to be common in Ceylon, but is occasionally met with, as in the resthouse well at Alut-oya in the Tamankaduwa district, North-Central Province. They are kept here, however, merely for show, being fed artificially once or twice a week with small fish.

Dr. Theodore Gill notes that the Ophiocephalids are in prime condition when perfeetly fresh and throbbing. It would appear that they cannot be salted or dried successfully, and therefore that, however plentiful they may be, they cannot compete with the customary dried fish in curry.

The habit of brood-nursing or parental care of the eggs and young has been often described, as, for example, by Day, Thomas, and others, and more recently, from a comparative standpoint, by Gill.† In Mysore it was observed by Colonel Puckle (quoted by Day) that *O. striatus* breeds twice a year, in June and December, the males constructing their nests amongst the vegetation at the edges of the tanks. In South Canara it is said to breed in December and January.

Although I have not yet had an opportunity of witnessing the nidification and brood-nursing of the lula, I have on two occasions secured samples of the fry. Part of a swarm was taken from the Galelawala, Barawe, near Hanwella, in the late afternoon on February 19, 1908. The total length (from snout to tip of caudal fin) varied from 32 to 37 mm.‡ The ground colour, especially at the sides of the body, was pellucid red, and the upper half of the eyes was bright red. The general shape was that of a tadpole, and there is reason to think that this is a fundamental form.

They were poured into a bath, where they were kept over night, restored to the chatty next day, and brought to Colombo (18 miles) by bullock coach arriving at 1 P.M. All except one or two were alive on arrival; many dead "kuni," small fresh water shrimp-like

* See below.

† Gill, Th. Parental care among Fresh Water Fishes. Ann. Rep. (1905), Smithsonian Inst., Washington, 1906, p. 492.

‡ About $1\frac{1}{4}$ to $1\frac{1}{2}$ inch.

crustacea belonging to the genus *Caridina*, were in the chatty with them, which they were not eating. These "kuni" thrive equally well in running water, as low-country rivers and mountain streams, where they retreat under stones, &c., and in still water, as tanks and ponds, where they flourish among the vegetation near the edge. In some places they occur in such quantity as to make it worth while to dry them for use in curry. Their presence in water is a good sign, and they constitute an important source of fish food. Those which had been put into the chatty with the lula fry were perhaps too large. I was unable to keep a running supply of live "kuni," and did not succeed in finding out definitely the best food for the young fishes, but I kept some of them alive in an aquarium for more than 5 months, during which time I put in various nutrient substances, water plants, chironomus larvæ (*i.e.*, lake-fly larvæ), roast gram, rice, chopped hard-boiled egg-yolk, &c., the principal pabulum being gram and yolk.

These substances promoted a luxuriant multiplication of micro-organisms, more especially ciliate infusoria of the genera *Stentor*, *Paramœcium*, *Blepharisma* (with hook-shaped rostrum), and *Spirostomum*.* The water became absolutely milky with *Spirostomum*, a protozoan animalcule, which is easily visible to the unaided eye, and is in fact the longest of the Ciliata. Gram which had been placed over night in the aquarium sometimes appeared like large flakes of snow in the morning, owing to the enormous aggregation of Spirostoma about the grains. I cannot say whether the young lulu fed upon the protozoa, but those which survived were vigorous to the end. They were actually seen to nibble at the particles of yolk, but the truth is that to this day I do not know precisely what is the best vehicle of nutrition for lula fry when kept in close confinement under artificial conditions not even approximating to nature. The experiment, however, is useful in so far as it demonstrates their great viability.

The water supplied to the tank was well-water, and it was kept at a depth of $1\frac{1}{2}$ to 3 inches. At the outset a great many died owing to the too abrupt change. After the initial mortality more deaths occurred from time to time for which I was unable to account, except on the supposition that they were starving. On March 25, however, more than a month since the beginning of the experiment, I noticed one floundering helplessly amongst the floating weeds on the surface. It presented a meagre, starved appearance, but on opening it a prominent white fat-like mass was found in the body cavity partially concealing the viscera. This turned out to consist of two soft writhing *Cestode* worms (possibly *Schistocephalus* larvæ). Exploring farther forwards in the body cavity, I found another worm of the

* On April 11 a pair of *Stentor* was seen in conjugation. On April 19 *Paramœcium* was noted as conjugating, *Blepharisma* dividing.

same kind encysted; this also writhed inside its envelope. Other fry, which had died previously and had been preserved, were then examined and found to be similarly infected.

The body of the parasitic worm is shortly segmented, and the elongate head or scolex has a groove along each side and a terminal exserted sucker or rostellum. The integument contains numerous scattered oval calcareous corpuscles. Larval cestodes which are found in young fishes usually achieve maturity in the intestine of fish-eating birds.

On April 19 a vigorous young lula was caught and measured. It had distinctly grown both in bulk and in length. The eyes reflected a delicate red flush from the lens; iris pale golden; a slight reddish tinge was still apparent along the sides of the caudal region; the definite markings had commenced to appear as about nine short black vertical demi-stripes on either side of the dorsal fin. It was very strong, active, and erect, not easily put on one side. The total length was 41·5 mm.; body length (excluding the tail fin) 34·5 mm. At this time the aquarium contained, besides the protozoa named above, some Rotifers and some Naiid worms.

Two dead lulu removed from the aquarium on May 21 and 22 measured 43 and 40 mm. respectively. Another in full vigour, with the definitive body-markings well indicated, was taken from the aquarium on June 1; it measured no more than 38 mm. in total length; body length (excluding tail fin) 32 mm.; diameter across the branchial region 6·5 mm., across the projecting eyes 7 mm. At first I missed the red flush of the eyes which is so characteristic of young lulu, particularly after they have attained a length of 4 or 5 inches, but upon placing the specimen in dilute alcohol the red colour developed. On July 8 seven of the healthy young fishes were caught, measured, and returned to the tank; their total lengths (including the tail fin) were 42·5, 44, 44·5, 45, 46, 47, and 48 mm.

Another sample of lula fry of the same age, or rather younger than those taken in February, was brought from Hanwella on May 22. They measured 30 to 31 mm. in length, and showed the same sub-translucent reddish or golden red colour throughout when seen from above. The sides of the body were of a pure roseate hue, the uppermost dorsal region being darkened in varying degree according to circumstances by the presence of scattered chromatophores capable of expansion and contraction, producing a more or less smoky appearance.

The occurrence of this second brood indicates an extended period of spawning during the first few months of the year, both before and after the rains. The first brood was taken towards the end of a period of drought, the second after heavy floods.

The predaceous habits of the adult lula, which seem to debar it from association with other fishes in stock ponds, do not apply in the same degree to the fry, nor to the adolescent stages up to a

minimum length of 6 inches, and it would be possible, sooner or later, to establish reserves for rearing the young in places where the supply shows signs of diminution.

The laboratory experiment described above shows that the transition from a late postlarval stage (without any trace of the definitive body-markings) to an early adolescent stage takes place slowly, and that during this transition period they are exposed not only to the rapacity of avowed enemies, but also to the more insidious attacks of internal parasites.

III.—Fry of Mada-karaya.

Madaya or mada-karaya (*Ophiocephalus punctatus*) is a near relative of the lula, from which it differs in colour, scale-rows, fin-rays, and in habits. A young lula compared with a madaya of approximately the same length (5–6 inches) had 46 dorsal fin-rays, as against 31 in the latter; the lateral line dipped down two rows of scales below the twelfth dorsal ray in the lula, whereas it dipped to the next row only in madaya; anal fin of lula with 28 rays, of madaya 22; about 57 scales along the lateral line in lula, about 40 in madaya; ventral fins of lula below the pectorals, in madaya nearly reaching the vent.

The madaya is a mud-burrowing fish, extensively eaten, and also used as live bait for "moda" (*Lates calcarifer*) and other large river fish, which are caught with a special bamboo rod supported over crossed sticks from the bank after sundown, for example, in the Kalu-ganga at Tebuwana.

On April 15, 1908, during rainy weather with intervals of sunshine, I observed a couple of mada-karaya in a clear shallow "wala" in the paddy fields at Bellana on the Matugama-Badureliya road in Pasdun Korale East. They were guarding a small brood of very young fry, a sample of which I secured with the assistance of Mr. John Dassenaike of Bellana, who accompanied me. One of the elders, rather smaller than the other (estimated about 6 inches long) and more brightly spotted, was probably the male. They were frightened away at our approach, but returned to the brood, which was advancing slowly in unison.

The young fry were all of one age, and measured only 6 millimetres in total length. They present (after preservation) three longitudinal white bands, namely, one median dorsal band with two spindle-shaped enlargements in front (see figure) and a pair of broad lateral bands commencing from the eyes.

They were moving about freely exposed in very shallow water under bright sunlight, in contrast with the usual habits of the adults, which are intensely cryptozoic. My sample consisted of upwards of 130 individuals, perhaps about one-tenth of the entire brood.

Some much older madaya fry were brought from Hanwella on May 22 in company with the second lot of lula mentioned above, and

some very young kavaiya (*Anabas scandens*, the climbing perch). They evidently did not belong to one brood, since they varied in length from 21 to 39 mm. One of about 32 mm., which may be selected for description, showed only a faint indication of a median dorsal golden line in front of the dorsal fin ; this, however, is more distinct at a younger stage (21–26 mm.), where both the lateral and dorsal bands have a brilliant greenish golden tinge. A bright golden band commences from the snout, passes through the upper part of the eye and above the pectoral fin to the tail fin. The rest of the back is dark, the ground colour being resolved into about five close-set dark stripes on each side between the dorsal fin and the lateral golden band, and three or four similar stripes below the latter. The ventral surface in front of the anal fin is whitish, as it is also in lula fry. At the age represented by a length of 36–39 mm. the dorsal band has gone and the lateral bands have faded, merging into the ground colour and losing the golden sheen. The general arrangement of pigment in longitudinal stripes shows up very clearly after preservation. The madaya fry seemed to be rather less hardy than the lula fry.

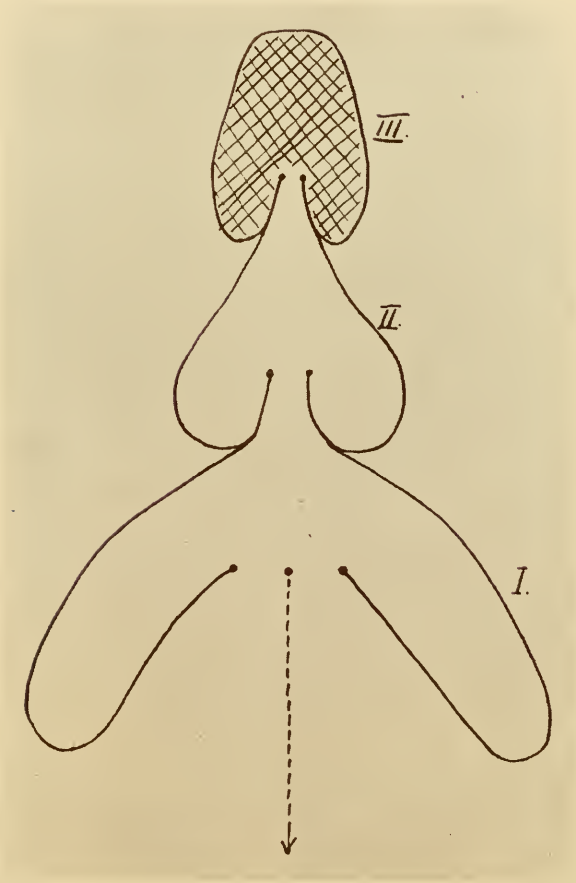
IV.—The Jakotuwa Fishery in the Panadure River.

When crossing the bridge on the coast railway over the Panadure river one may notice that the river is traversed as far as the eye can reach by a series of fences, which stretch a short distance from the shore, or half-way across the river, or right across with but slight interruption. It is to be feared that the interruption in an otherwise continuous fence barricading the river is not made primarily in the interests of the migrating fishes, for a net is often bent across it, as will be seen later. Connected with each fence and forming part of its construction is an elaborate fish-trap ; sometimes several traps are intercalated in the course of a single fence. The whole is called a jakotuwa, or fish-weir.

A typical jakotuwa consists of a wattle fence of split bamboo (batta-li) extending nearly half-way across the river from one side, and a similar fence on the opposite side, leaving a passage between them guarded by high bamboo scaffolding, which serves as watch towers. At the shore end on each side of the river there is another passage with coir ropes stretched across it under water, between the strands of which the bleached leaflets of the coconut palm are looped, forming a white fringe in the water, called "pan-rena" or "pan-adinawa."* This is said to direct the fish alongside the fence

* In Clough's Sinhalese Dictionary "pan-adinawa" is defined as the operation of drawing an extended rope on the water on which white strips of coconut leaflets are suspended for the purpose of driving fish into nets. It is thus employed as an aid to netting in the Kuda-ganga, a tributary of the Kalu-ganga.

Fry of *Ophiocephalus punctatus*, seen from above.
× about 5.



PLAN OF A JAKOTUWA FISH-TRAP.

The dotted line represents the fence, and the arrow points to the shore. I., II., and III. are the successive chambers of the trap, the last covered with coir netting.

towards the mouths of the traps. The latter have two entrances, one on either side of the fence, as shown in the diagram.

In each half fence of the typical jakotuwa which I have selected for description three traps are inserted at intervals. Each trap consists of an ingenious triple cone-in-cone arrangement rising from the bottom and projecting above the surface of the water, strengthened by upright poles and horizontal bars. The trap acts as a maze, and the fish which penetrate into the terminal chamber (III.) find themselves in a blind alley, from which there is practically no escape. In order to remove them a man climbs over the top and drops into the water in the middle compartment (II.), from whence he lets himself into the end chamber under water ; this chamber is covered over by coarse coir-netting to prevent the fish from leaping out. Another man in a boat stands by with a hand net called "atanguwa," by which the diver catches the entrapped fishes. This being done, the opening into the inner chamber is made secure, and the diver, having first returned to the middle chamber, re-enters the boat.

The apices of the cones point towards mid-stream. At the central end of the fence on the north side there was another trace of coconut leaves before the bamboo watch tower of that side. Between the two watch towers (guarding the central channel) was stretched a large net called "atoniya," held up-stream by the two watchers, the corners of the net being attached on each side of the passage to a long pointed pole driven into the bottom ; the opposite or sea end of the net was held above water by two men in a boat ; the up-stream border of the net is below water ; it is a plain net, not a bag. As soon as the watchers see fish passing over the line of demarcation they quickly raise the poles, thus lifting the forward leach of the net out of water, and so the fish are netted. The boatmen then haul in the net and secure the fish, of which I saw only three or four caught at a time, half-sized gray mullet. The jakotuwa is what is termed a "fixed engine" ; the atoniya was at work at dawn, early afternoon, and again towards sundown.

The fish which were taken out of a jakotuwa in my presence in December last included marine, estuarine, and fresh water forms, *e.g.*, "eliyalu" (*Platycephalus*), "kalanda" (*Sillago*), "parattiya" (*Caranx*), "anguluwa" (*Arius*), "koraliya" (*Etroplus*), "godaya" (*Mugil*).

The jakotuwas are lighted up at the mid-river end of each fence by a lantern at night; this burns all night, and the netting and diving operations are repeated at about 5 A.M. on the following morning.

A small or single jakotuwa consists of a single cone-in-cone trap at the end of a fence projecting a longer or shorter distance into the river from the shore, always with the guiding trace of coconut leaves at the shore end. In this case there is often an arrangement with rope attachment permitting the entire terminal chamber to be raised

up bodily. The movable cages of the single jakotuwas were in fact raised in the early morning and appeared like huge funnels or chimneys; at night a lamp is suspended inside these cages, on the principle of the moth trap.

Sometimes the shoreward coconut traces are made fast to a "polkotuwa" for soaking coconut husks. A great quantity of coir yarn is required in the making of the fences for binding the horizontal slips to the upright poles.

The jakotuwas are numerous, extending far up the river, being very thick about the Gorakapola ferry, beyond the 16th milestone from Colombo; about the 14th milestone they become rarer, and are usually only single, on account of the width of the river here. Not many were visible from the Moratuwa bridge near the 12th milestone in December, but when crossing the bridge again at the end of May I saw a large one above the bridge close to the spot, where there is a permanent wooden hut for fish watchers in the river.

The jakotuwa system is the chief method of fishery in the Panadure river, and constitutes a remarkably brisk industry. Even the stretching of the "atoniya" across the central channel need not be objected to, so long as men are in attendance; but nothing should be allowed to block this channel when fishermen are not standing by. The Panadure river, together with the Bolgoda lake, is a great tidal backwater, sometimes nearly fresh, sometimes brackish, without any direct mountain source. It is connected by canals with the Kelani-ganga to the north and the Kalu-ganga to the south. The Lunawa lake, between Colombo and Panadure, which joins the sea (during the north-east season) at Angulana, is a separate sheet of water, and is also the seat of a jakotuwa fishery.

Colombo Museum, A. WILLEY.
July 20, 1908.

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8. *A Cobra on the Threshing-floor.*—On February 27 last while watching the threshing of paddy in a field near Rayigama, not far from Horana, a cobra of immense proportions formed one of the party, gliding about near the threshing-floor quite calmly, in spite of the presence of over a dozen persons and the usual clamour that accompanies the operation of threshing in this country. As the reptile moved about it passed between the legs of one of the men, who stood his ground as unconcernedly as the Colossus at Rhodes. I endeavoured to convince the company of the unwisdom of allowing the reptile to go free, but no one was enthusiastic about a hunt and slaughter. Their attitude was said to have arisen from a belief that the snake was an incarnation of a deceased owner of, or claimant to, the field, and that so far from doing it injury it was their duty to welcome the visitor and take advantage of the opportunity offered

of propitiating it. The more reasonable, if unromantic, explanation would seem to be that the cobra was after field rats which frequent the neighbourhood of threshing-floors.

March 7, 1908. C. DRIEBERG.

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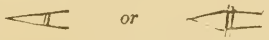
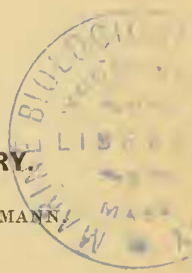
9. *The Moorman's Dagger* (see *Spolia Zeylanica*, Vol. III., p. 213).—The dagger or "kathar" is undoubtedly the same as is used by Charans and Bhats in Gujarat, Kathiawad, and Rajputana. By them it is commonly used for purposes of suicide, to which they resort when they have stood surety for a chief and the chief breaks his word. It also always accompanies their signature on documents as a mark, usually drawn as under :—



A note on it will be found in Forbes's Rasmala. There is a very well-known Gujarat (Kathiawad) tradition of voyages to Ceylon, especially from Saurashtra, *i.e.*, the modern Junagahd, &c. Java is definitely stated by all Gujarat tradition to have been colonized from there by a cadet of one of the Rajput houses. Query :—Can this dagger have thus been acclimatized in Ceylon, and is it known in Java ?

December, 1907. OTTO ROTHFELD, I.C.S.



AN ITINERARY OF THE VEDDÁ COUNTRY.

By C. G. Seligmann, M.D., and Brenda Z. Seligmann.

BEFORE describing the route followed and some of the incidents that occurred during a recent sojourn in the Veḍḍá country, it is perhaps worth while to refer, for the benefit of others who may be engaged in similar work in the East (*e.g.*, in the Malay Peninsula), to the great assistance derived from a preliminary survey of the country conducted from a motor car and without going further on foot from the main road than ten miles. Opinions at Colombo and Kandy varied greatly as to the prospect of successful work among the Veḍḍás ; two views were generally held : the first asserted that there were no genuine Veḍḍás left—half-breeds and Village Veḍḍás there were, and with these it would no doubt be possible to make friends ; the other view referred to the extreme shyness of the hosts of Veḍḍás who, clad only in leaves, still roamed about the wilder parts of the Island. It was pointed out that not only should we be unable to find these, but that this was really as well, for should we chance to surprise them we might expect to be riddled with arrows. As might have been anticipated, the truth as to the existence of "wild" Veḍḍás lay between these two extremes, and it was by quickly visiting a number of settled Veḍḍás by means of a motor car, and ascertaining the direction from which they had come, that a route was plotted which enabled the greater number of existing Veḍḍá groups to be visited, and ultimately led to satisfactory intercourse with a number of the few Veḍḍás uncontaminated by recent Siṇhalese or Tamil influence.

After leaving Baṇḍárawela the first halt was made at Bibile, where, among a number of coins and pebbles collected by the rest-house keeper and brought by him for sale, there was noted a moderately good example of the type of quartz implement discovered by Messrs. Green and Pole. An early start the next morning permitted of an interview with a number of the Veḍḍás and half-breeds settled on the big chena at Rerenkada in the neighbourhood of Kallodi ; of fifteen folk seen here only one man and woman appeared to be even moderately pure-blooded Veḍḍás : the woman was only 53½ inches tall, while the man measured 63 inches. The next stop was made a few miles further on at Maha-oya, and the afternoon was spent in talking to three Veḍḍás from Omuni ; these men were too poor to pay the tax of a rupee and a half due from each of them, and had

just been brought down to spend a week working on the road in lieu of their tax. They were not pure-blooded Veḍḍás. In spite of this, their thin hungry appearance pointed to the truth of their story that they were really short of food, and that if they were kept from home for a week their wives and families would be reduced to a condition of starvation. Luckily Mr. G. W. Woodhouse, the District Judge, believed their story and sent them back to their village, for when we visited Omuni about a week later, although we were met with the customary gift of honey, to which were added a few berries, it was obvious that even the small number of folk left in the settlement were really short of food, and this in spite of a number of families having left some time before to wander into Tamankaḍuwa, where they hoped to get yams, and perhaps some game. Indeed, so short of food were these people that, in spite of the interest one of us (B. Z. S.) inspired, a number of women left the village immediately after our arrival, explaining that if they did not go and find some yams they and their children would get nothing to eat that night.

The folk of Omuni share with the people of Mudugala, now living at Unuwatura Bubule, about four miles from Maha-oya, the possession of some most interesting beads, the like of which we did not see elsewhere among the Veḍḍás. At Omuni they are worn by the women and regarded as heirlooms, and descend from grandmother to granddaughter; or, when a woman dies before a granddaughter is born, from mother to daughter; and it appears to be usual for a grandmother to give a number of her beads to a granddaughter soon after the latter's birth, and again at her marriage. At Unuwatura Bubule these beads are not worn, as they are regarded as too precious—indeed they are considered *quasi*-sacred, at least as the property of the *yakku*, and are used in the ceremonial dances in which the *yakku* are invoked. The beads themselves, which are much worn, are of glass, generally red or green, and have been identified at the British Museum as Venetian beads of the sixteenth or seventeenth century—indeed most of the actual patterns are identical with the beads in a traveller's sample book preserved in the Museum.

From Maha-oya our route lay to Batticaloa, where, after a delay to pick up an interpreter kindly put at our disposal by Mr. Freeman, we went on to Kalkudah in order to visit the coast Veḍḍás to the north of Batticaloa. Although these coast Veḍḍás, or Veṛdás as they call themselves, have intermarried with the Tamils and have adopted many Tamil customs, they still have remains of the old clan system of the Veḍḍás, and although they usually speak Tamil, the majority of them say they have a language of their own which they consider to be the old Veḍḍá language, and which was found to be Siṇhalese. They have roughly built temples, and we were told independently in two settlements that the chief agency worshipped was called Kapalpé or Kabalpé, *i.e.*, "ship spirit." At first we

feared some misunderstanding, but when one of us was shown within one of their temples, into which after some trouble he was allowed to penetrate, a small model of a ship partly square rigged was seen, and it was stated that at a special ceremony this was hoisted to the top of a pole some thirty feet tall which stood outside the temple; it appeared that there was no reason to doubt the substantial accuracy of the information given, and the matter is brought forward here in the hope that some of the readers of *Spolia* may be able and willing to give some details of this worship, and perhaps trace its origin. On the way back from Batticaloa we stopped at Kallodi, and here, from the remains of the folk of Unapane and Idipola we obtained the first hint of the possible existence of the remains of a hunting language, for an informant, of whom we asked the words for bear and deer, showed considerable hesitation before he would give these words.

We reached Bandárawela with some hours to spare, which were spent on the patanas quite close to the town, where we were delighted to find a number of flakes and worked fragments of quartz.

We returned to Colombo, and after a certain amount of delay, caused, first, by the necessity of overhauling gear and going through the collections in the Colombo and Kandy Museums, and subsequently by the wet weather, work was begun with Bibile as base. Through lack of appreciation of the amount of fresh food that was always obtainable in the jungle, we were unduly hampered at the outset by the amount of tinned food and biscuit that we carried, and the number of our *tavalam* bulls was unnecessarily great. The first day's march was to the Public Works Department bungalow at Nilgala, where, owing to the unexpectedly wet weather, several days were spent. On the way to Nilgala we passed a number of graves of the village Siṇhalese, usually occurring in groups of two or three; the litter, ornamented with red and white, on which the body is carried to the grave, being left to decay by the side of the burial mound. Mr. Bibile, who had been attached to us as interpreter and assistant, told us that usually each family had its own burial area. In spite of the wet the time spent at Nilgala bungalow was not wasted, for we were kept busy making colour and other tests upon the local Siṇhalese for comparison with the results which we hoped later to obtain from the Veddás. A number of optical illusions were also shown these people, who were most interested, and saw nearly all the illusions well, afterwards explaining the reason of parallel line illusions to each other with much excitement and illustrating their reasoning on their fingers.

On the first fine morning we started early for the Danigala Veddás, about eighteen of whom are all that remain of the Nilgala Veddás, who in 1858 numbered 72 souls.* The road was interesting, for it

* J. Bailey: "Wild Tribes of the Veddás of Ceylon." Trans. Ethn. Soc., 1863, p. 28.

soon crossed the Kalugalbemma, with its extraordinary surface of rounded and spherical masses of stone. This is figured on the maps and usually described as an old road leading from Anurádhapura eastwards, but, as pointed out by Mr. James Parsons, the Chief Mineral Surveyor, this alleged road is a natural dyke of dolerite which extends for many miles across the country. About six miles from Nilgala we reached the site of one of the camps of the Drs. Sarasin, and we soon plunged down the face of a wooded rocky hill, descending some 450 feet in twenty minutes. Then, crossing a small *talawa* and a stream our way led up a similar but loftier hill, till at a height of about 1,200 feet we came on a rounded shoulder of rock, on which stood the skeleton hut of the Danigala Veddás, built on the pattern of the ordinary village Veddá habitation, but entirely lacking the slats of bark which make the sides of these moderately weather-proof. By its side there was an even rougher shelter consisting of a large bough with the smaller branches overlaid with banana leaves. Near the hut were the "patriarch" Kaira and three other men; there were also present three women and a boy of about twelve and two much younger children, and although both of the latter had many teeth they suckled persistently.

Kaira, who is the *vidáné* of the group, has a number of swellings on the abdomen which are adherent to the skin and firm to the touch; the largest is hemispherical and as big as half an orange. He attributes these to stings of *bambara*, the rock bee, but since we saw no similar masses subsequently, although we met many Veddás who must have been frequently stung while honey-taking, this does not seem very likely, and these masses are almost certainly fatty tumours.

We did not get much information from the Danigala Veddás, who were, however, perfectly ready to be photographed and to discuss generalities, but who did not speak unless addressed. We put this down to shyness, and so, after a short visit, returned to the bungalow, having, after obtaining permission to do so from Kaira, determined to make our first camp at the foot of the hill on which the hut was perched. Accordingly on our next visit a small camp was made, and the next morning we reached the top of the hill in good time, and found the same folk there, but after a little talk we discovered that it was not possible to learn anything of their customs from them, for they lied freely in answer to all genealogical questions, maintaining that there were no more members of their group. We then proposed that we should go and see their other houses on a *chena*, said to be less than an hour's walk from their look-out hut. This request was met with a blank refusal, and Mr. Bibile explained that the old man asked him not to tell the white folk about their affairs, and the cultivation they did, and the grain they had stored; in fact, from what we learnt on that morning and subsequently from peasant Sinhalese of the neighbourhood, it is clear that the Danigala community have adopted the *rôle* of professional

primitive men. Quite a number of the village Siṇhalese have dealings with these folk, who herd their cattle, the Veddás receiving in return every fifth calf that is born. Synthesising what we heard, it appears that in the ordinary course of events the Nilgala headman sends word when strangers are expected; then the folk we saw repair to their very striking hut on the rock dome and post a look-out on a big rock about half way up, and on our second visit the leading man of our party who was carrying the camera stated that he saw a Veddá bolting from this rock as we came up. These folk, who, when we saw them, wore their Veddá loin-cloths and were smeared with ashes, are reported to wear ordinary Siṇhalese clothes when not in their professional pose, and Mr. Bibile, who has himself seen one or more of them in sarongs, points out that the imposture is kept up for two main reasons: firstly, they fear that their cultivation might be stopped (evidently an echo of the *chena* difficulty of the Eastern Province), or that they might be taxed if they did not appear to be poor fellows living on hardly-won jungle produce; and secondly, their pose of poverty interests strangers and procures them visitors, whose generosity varies directly as the degree of primitiveness with which appeal is made to them.

Under these circumstances, it did not take long for us to decide to move to Ambilinne, whence we should be able to reach the Henebedda and Kolombedda Veddás. These folk occupy the land immediately to the east of the Danigala rock *massif*, but as it was quite impossible to get our baggage across the hills, it was thought best to return to Nilgala and thence follow the track to the Public Works Department bungalow at Ambilinne. Here we had the opportunity of getting to know four of the younger men of the Henebedda community. We gave them rice and curry materials, and it was interesting to find how extremely pungent they made their curry, which suggests that they have long been acquainted with Siṇhalese cookery, for previous experience in the Pacific and in Borneo had seemed to show that folk unaccustomed to hot and spicy food considered even a slight amount of pungency most objectionable. They passed the night on sacking on our verandah and were immensely interested in everything that went on, being especially pleased with a little boxwood top which they learned to spin immediately. About nine they quite spontaneously began to sing and dance, the rhythm being supplied by their song and the slapping of their hands on their chests and flanks; but beyond this there was very little regularity in the performance. In one figure, in which an arrow was struck in the ground, the performers began to move round it clockwise with their right hands inwards, but very soon one dancer was circling in the opposite direction between the other two, who were still moving clockwise. The two performers who had not struck their arrows into the ground held these in front of them in their hands, which were separated by the length of the shaft, while their

bodies were somewhat bent forward over the arrows, which were moved from side to side as they danced. The steps were taken with the legs tolerably wide apart, the weight of the body being supported on one leg while the other was scraped along the ground by somewhat tilting the pelvis. This movement took place on the two legs alternately, a double step (somewhat as in polka) being sometimes substituted for the scrape. After a little time, when the circling movement had been entirely broken up, and all three men were dancing more or less independently, they shouted Ah-h, and pointing their arrows at the sky, waved them furiously before suddenly falling supine in a condition of pretended exhaustion and unconsciousness. The fallen men were at once lifted up and supported by a number of Siṇhalese, who had by this time been attracted to the bungalow, and the Veḍḍás then came to us and promised game in abundance, giving, as we subsequently discovered, a remarkably good imitation of the ritual of their shaman when he is possessed by the *yakku*.

When they were shown the phonograph, comparatively little persuasion was required to get them to sing into it, though some of the English songs which we gave them impressed them not at all; but when the song was reproduced which one of them, Sitawanniya by name, had sung into the machine, they were greatly amazed, though they were neither so scared nor so shy as a Papuan would have been. Their astonishment was expressed by placing one hand over the mouth and chin with its palmar surface towards the face, the fingers spread on either side of the nose and mouth so as to cover the more or less nervous grin which was to be seen on all their faces.

At the time of our visit the Henebeḍda and Kolombeḍda Veḍḍás were gathered in two caves, or more properly shallow rock shelters, called Bendiagalgé, in that portion of the jungle known as Henebeḍda, and our camp was formed about 200 yards from these caves. We stayed in this camp for some time and found the Veḍḍás excellent informants, the only difficulty we experienced being to prevent them wandering away when the novelty of our visit had worn off after the first two or three days. This was overcome partly by small presents, but more we think by making them free of our camp—a freedom which they never abused—and by keeping a constant supply of chewing materials (arecanut, betel, tobacco, and lime) at their disposal. It was, of course, necessary to feed our informants, who had no store of food to fall back upon, and as we had not expected to meet so many folk, a part of the *tavalam* was sent back to Bibile to fetch an extra supply of kurakkan (millet), which, with smaller amounts of coconut and rice, kept them reasonably contented. It may be well to record, for the possible benefit of others, that an effort which had been made to retain a small number of the best informants in our camp and to allow the others to go did not succeed. The less desirable, because less knowledgeable, individuals would return to the caves and the camp after short absences to see how we

Fig. 1.—Bendiagalgé (page 161).

were getting on, and it was soon obvious that these also must be fed if any regular work was to be done. The extreme courtesy and consideration of these somewhat sophisticated Veddás, although not so great as that of the wilder groups we were to meet later, made all our dealings, including the serving out of supplies, easy, slight awkwardnesses or mistakes being often hailed with roars of almost childish merriment. We record these facts deliberately, as they are contrary to the statements that have so often been made concerning the Veddás, and we may point out that all the Veddás we met, although somewhat shy, were merry, courteous, kindly, generous, and truthful folk, the only exceptions being found among the members of communities such as Danigala and Dambani, who are accustomed to pose to visitors as primitive Veddás.

It is not the purpose of this slight sketch to describe our work or the results we obtained, but in view of the recent discussion on quartz implements discovered by Messrs. Green and Pole, and lately described in the *Ceylon Observer* and in this journal by the Drs. Sarasin, we give here a short account of the results of our exploration of the Bendiagalgé caves. These consist of two rock shelters formed by a single mass of rock, broadly speaking rectangular in shape, with its long axis running roughly in a N.-S. direction. The rock mass is somewhat tilted, so that its southern edge is high above the *talawa*, towards which its northern extremity slopes, and the whole rock somewhat resembles an immense wedge. Its eastern face has weathered so as to form two rock shelters; each of these has a well-cut drip ledge in no respect differing from those admittedly cut by the Siṇhalese about the time that Buddhism was introduced to the Island, and the lower cave has in addition two square sockets cut in its roof resembling those discovered by Mr. F. Lewis at Nuwaragala and figured by him, and such as we afterwards saw at Mullegamagalgé. Further, there are three steps cut in the solid rock between the two rock shelters and other smaller steps, and signs of ancient working are to be found about the rock mass. Figure 1 is a photograph of the upper of the two caves showing the drip ledge; the figure also shows two sets of steps hewn from the rock. There is no inscription on the rocks of either of these caves, but below the drip ledge of a rock shelter used by the same community of Veddás, and not more than an hour's walk from Bendiagalgé, there is an inscription, of which Mr. H. C. P. Bell says:—"The Brâhmi (characters) are of the oldest type, therefore B.C." This inscription has been read by the same authority, to whom my best thanks are due, as "(cave of) the chief.....son of the chief Vela." There is thus reason to suppose that the Bendiagalgé caves were used by the Siṇhalese some 2,000 years ago, and this together with the present occupancy by the Veddás makes it worth while to record the results of our excavation, although we had not time to make it complete.

The nature of its bottom made the lower cave the easier to examine, and so a longitudinal trench was dug in the longer axis of the cave. The results of the excavation of the first two feet may at present be ignored ; massive rock, which was taken to be the bed rock of the cave, was reached at about 2½ feet, and the interest of the excavation centres in the lowest few inches immediately above the cave floor under a deposit roughly 2 feet in thickness. In this zone just above the bed rock there were found many fragments of quartz, some milky, some ice-clear, some faintly opalescent, some smoky, and some amethystine. A few of these were as big as hen's eggs, the majority varied from the size of an apricot to a haricot bean, some were even smaller. From the larger number of pieces of quartz—nearly 300—collected at the depth mentioned from this trench, and a small trench driven at right angles to it, as well as the absence of pieces of country rock, there can be no doubt that these pieces of quartz were brought to the site in which they were found by man. They were not waterworn, and the variety of colour and opacity they presented make it certain that they had not weathered out *in situ*, in spite of the fact that quartz (but not as far as we could determine ice-clear quartz) occurs in segregation masses in the gneissic rock of the neighbourhood. When all the fragments were carefully washed and examined it was found that some 3 per cent. of the pieces of quartz obtained from this cave showed signs of working. They are in fact implements similar to those shown me by Messrs. Green and Pole.

Additional proof that the fragments of quartz had been brought by man to the site on which they were found, was afforded by some irregular digging done in the upper cave formed by the same rock mass as the lower cave, and separated from it only by a few feet. The floor of this cave was so rocky that a regular trench could not be dug, but a number of holes—the largest perhaps 6 feet by 4 feet—were dug down to what was apparently the country rock at the bottom of the cave. Fragments of pottery and the bones of animals were found in plenty in these holes, but altogether they yielded only four pieces of quartz, namely, two waterworn pebbles and two broken pieces of clear glassy quartz.

A well-marked bulb of percussion is present in a number of the quartz implements ; this applies both to those in Mr. Pole's collection and to those we collected : some are worked on both edges, others on one side only. In the majority the working is somewhat rough, though this is not to be wondered at considering the refractory nature of the material, but a few of the best in the Pole collection would be considered pretty specimens had they been produced in soft stone.

As regards the type of these quartz implements, there seems no good reason to consider them other than neolithic ; and except for the material of which they are composed, many of the specimens

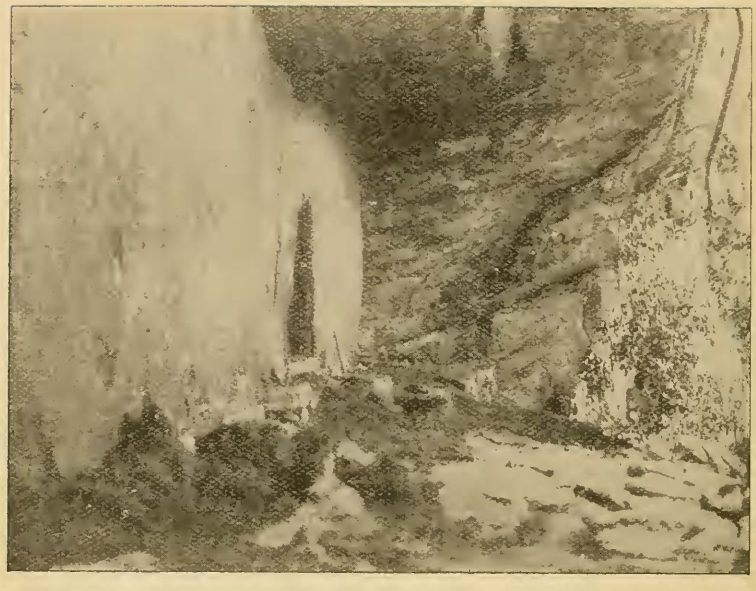


FIG. 2.—Mullegamagalgé, showing the arch leading into the hall of the cave (page 163).

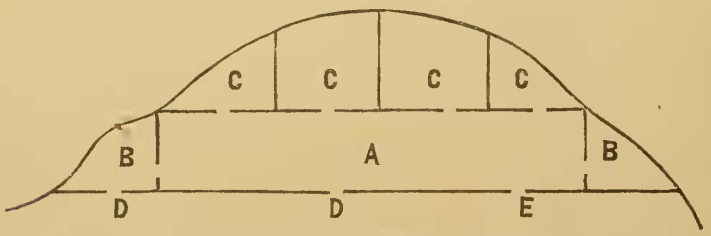
FIG. 3.—Mullegamagalgé: the under surface of the overhang (page 163).

differ in no respect from implements of the neolithic age found in Europe.

Although the folk of Bendiagalgé have bows, they do not seem to use them very much. Some of the younger men are certainly accustomed to guns, and as their stalking is magnificent they kill a good deal of game when they have a gun of their own or can borrow one from the Siṅhalese. But in spite of the little use of the bow, the arrow is still their almost universal tool, and as there was no knife in the community we had the opportunity of seeing the remarkable skill with which a deer was skinned and cut up with an arrow. The Veḍdás certainly desired no better tool, and when we pressed a butcher's knife on one of them in order to see how he would handle the unaccustomed tool, it was interesting to note how slowly he worked and how poor the result was compared with that he obtained with the arrow, which he held just above the blade somewhat as a European holds a penholder. No less astonishing was the skill employed in removing the skull cap with a few strokes of the axe: not only was the brain lifted out entire, but it was removed so neatly and cleanly that the result was more suggestive of an anatomical preparation than a piece of butcher's work.

On our return to Ambilinne a day was devoted to a visit to a big cave, Mullegamagalgé, which lies less than a mile to the north of the Ambilinne-Namal-oya road. The character of the scenery changes some 3½ miles from Ambilinne, the open park country giving place to thicker jungle. About four or perhaps five miles from Ambilinne we left the track and worked our way through jungle uphill for about three quarters of a mile until we reached the cave situated on a rock ledge. The front of the cave had been closed by a brick wall about 2½ feet thick and about 25 yards long, the bricks being covered with a stucco-like casing, apparently of rough plaster. There are two doors in the wall with hard wood frames, which have been attacked by wood-boring bees, and there is also an open arch with no evidence of a door having been fitted to it which opens into the cave (figure 2). The inclined rock which forms the roof of the cave overhangs the wall by 10 feet or more, and a drip-ledge is cut out in this which at one end is continuous with a second drip-ledge cut almost vertically down the face of the cliff, the two forming a system admirably arranged so as to carry off to one end of the ledge the water, which, even when we visited the cave after a few days of dry weather, dropped continuously from the rock forming its roof. The under surface of the highest part of the overhang of the rock is shown in figure 3, but we do not feel capable of pronouncing whether the step-like arrangement of the rock is due to natural planes of fission or whether the rock has in part been worked smooth. A number of square holes, judged to be some 9 inches deep, had been cut into the solid rock of the overhang about 3 feet above the junction of the wall and the rock; three of these can be seen dimly in figure 3.

On entering the cave we disturbed an immense number of bats who had taken it for their own. The whole place literally swarmed with them, and as the floor had a covering of two or three inches of their dung, the odour was most oppressive. Entering by the arch we found ourselves in a hall about 14 yards long by about 8 broad, the back of which, consisting of a brick wall, is pierced by four doors, each leading into a separate cell, the sloping roof of the cave forming the back walls of them all, as well as the outer side walls of the two outer cells. The partition walls between the cells are made of brick covered with a layer of mud or plaster. The two ends of the cave are separated from the main hall by low mud walls, which do not reach to the top of the cave; both present a rectangular gap through which the hall communicates with the small antechamber which these walls cut off, one of which has a door communicating with the exterior. On a " table " built up of bricks and mud in the hall there is a large flat stone with a circular excavation on its upper surface about 2 feet in diameter and half an inch deep. A similar stone was found lying on the floor in that antechamber which communicates with the outside of the cave. Figure 4, reproduced from a flashlight photograph, shows a number of these features. It was taken with the camera pointed obliquely down the length of the hall, and shows the inner wall and the doorway leading into one of the cells. The stone with the circular depression is also shown against this wall, while the low wall with its rectangular opening leading into one of the small end chambers, into which daylight streams through a gap in the outer wall of the cave, occupies the background of the photograph. The subjoined plan will make clear the arrangement of the chambers of this cave.



Plan, not to Scale, of Mullegamagalgé.
A, main hall; B, antechambers; C, cells; D, doors; E, arch.

At one end of the wall closing in the front of the cave, where some bricks had worked loose, it could be seen that the lowest tier of bricks was laid on the face of the rock separated only by a layer of cement, formed of crushed pieces of quartz set in some adhesive substance, and part of the floor of the central and largest chamber of the cave seemed to be covered with the same substance. The local ideas concerning this cave are, that long ago it was the habitation of Veddá chiefs, and that it was used again in 1818 by refugees during the Rebellion, to whom the bricked-in front and the brick walls of the cells within the cave are attributed.

FIG. 4.—Mullegamagalgé: view inside the hall of the cave, showing the stone with circular depression on a brick table against the wall (page 164).

FIG. 5.—Hemberawa. A buffalo skull is seen at the base of a betel vine (page 169).

Our next camp was formed at Koṭalinda in the Eastern Province, beyond Namal-oya. On our way there we met a community of gypsies. These folk travel with large herds of cattle and goats, and appear to subsist by doing a trade in these, and by begging, snake-charming, thieving, and blackmailing. Their camp consisted of a number of scattered shelters, more or less circular in outline and formed of leaves of the talipot palm. Many of the men have medium brown or hazel coloured eyes and are very good-looking, some having distinctly aquiline noses. The women, who are less good-looking, would pass as Tamils, but were immediately differentiated from all the Tamil women we had seen by the masses of ornaments they wore, many of them being literally covered with bangles and necklaces, the former made of silver, brass, and some silver-like alloy, and the necklaces composed of glass or shell beads. They were said to speak a dialect of Telegu, and they told us that their ancestors had come from the neighbourhood of Madras, though the members of the community we saw had all been born in Ceylon. They say they worship and dance the god at Kataragam, whom they call *Yelnoth*, identifying him with the Tamil's *Kanda Sámi*. The fore-arms of the majority of the women were tattooed, the patterns looking as though they might have been flower derivatives; there were also small tattoo marks on the foreheads and temples of most of the women.

We were detained in the neighbourhood of Koṭalinda for some days, partly owing to wet weather, but more to the determination of the villagers to assist us as little and as slowly as possible in clearing away the trees that had fallen across the track during the cyclone of the year before, so that they might make us believe that there was a great deal to do and be paid accordingly. It was not till a week after we had left Namal-oya that we reached Baṇḍáradúwa, where there was a large Siṇhalese *chena* settlement with two Veḍḍá houses on it. These Baṇḍáradúwa folk and a few scattered families living in the neighbourhood are all that remain of the Kóvil Vanamai Veḍḍás, a group of whom we had heard a good deal, and who twenty years ago appear to have been very much in the condition of the present Henebeḍḍa Veḍḍás, that is to say, a community making rough chenas and building good chena huts, but still passing part of their time in caves and living to a certain extent on game and honey. It was, however, immediately clear that these Veḍḍás had much foreign blood in their veins, for all the men were over five feet high.

The day after our arrival a Veḍḍá called Kaira came to our camp sobbing and shaking, and protested that he could not stay with us as his brother was dead. He seemed deeply affected, though another brother, Kaurála, who was with him, appeared quite calm, which led us to suspect that his uncontrollable agitation was due to something more than mere affection for the dead man, and we soon discovered that his brother had died in his hut, and it was

therefore his duty to make an offering to the Buddhist priest and to provide the necessities for a dance to the *Ne Yaká*, and that he had not the wherewithal to fulfil these duties. If these matters were neglected the spirit of the dead man would be angry, and after seven days, when the spirit had become a *yaka*, would cause sickness, and probably kill him. His manifest relief when we offered him the money needed to purchase the offerings, showed that his sorrow for the loss of his brother was the least of his troubles, and he was quite gay when he started on his twenty-mile walk to the nearest boutique with Rs. 3·50 in his betel pouch, and readily assented to our condition that he must return and perform the *Ne Yaku* dance near our camp. He declared that the place of the dance was immaterial, but that it must occur on the seventh day after death, because on the third day the spirit visited the Kataragam god, who, on the seventh day, gave it permission to receive offerings and to exercise power for good or evil over its living relatives.

The things which it was necessary to present to the Buddhist priest and their price in cents at the native boutique were :—Three measures of rice, 60 ; two coconuts, 20 ; five balls of jaggery, 15 ; twenty-five arecanuts, 6 ; five tobacco leaves, 12 ; 100 betel leaves, 18 ; one plate, 30 ; one cup, 25 ; one mat, 25 ; one handkerchief, 36 ; half bottle of coconut oil, 50 ; total, Rs. 2·97. On the other hand, the offering to the *Ne Yaku* consisting of rice, betelnuts, and a coconut, costing less than 50 cents. Notwithstanding this unpromising beginning the *Ne Yaku* dance they performed seemed to be entirely Veḍḍá in purpose and feeling, agreeing closely with that seen later among the " wild " Veḍḍás near Nuwaragala, the chief feature of both dances being that the dancer possessed by the spirit of the dead man, on seeing the good things provided by his relatives, showed his lovingkindness to them by feeding them with part of the offering and promising them protection and good hunting.

While at Baṇḍáradúwa we also had the opportunity of seeing a Siṇhalese " devil " ceremony at the village of Gonagola, some four miles from Baṇḍáradúwa. The ceremony was got up to cure a woman and child of what seemed to be chronic malaria, though the woman also had a number of chronic sores which suggested multiple granulomata. The ceremony, which began about 2.30 P.M., lasted about six hours, the *kaṭṭadirála* being possessed by a number of demons in turn, to all of whom offerings of various foods were made. A living fowl was offered to one of the demons, *Riṛi Yaká* by name, but no masks were worn, and the ceremony could not begin until fresh blood, other than the blood of a fowl, of which there were many running about the village, had been obtained. To this end the villagers borrowed a gun from a member of our party, and although nominal Buddhists, having shot a monkey but not quite killed it, they could not be persuaded to kill it until the rice with which the blood was to be mixed was cooked, since the fresher its blood the more pleasing it would be to the spirits invoked.

From Bandáradúwa a long day's walk brought us to Uniche, where we arrived tired and in advance of our carriers, to be most hospitably entertained by the Engineer in charge of the construction of the bund of the big new tank. After sleeping that night in unwonted luxury in the Irrigation bungalow, we went on to Tumpalamcholai, and from there to Maha-oya, whence, with the resthouse as our base, we made a number of trips to the Veddá communities in the neighbourhood. The most interesting of these was a visit to four families that lived in the wild country to the south of Nuwaragala. These folk make no *chena* and have no huts, but live a wandering existence, spending their time in caves and rock shelters and living entirely on game, yams, and honey. We had heard vaguely of this group of Veddás for some time past, and had tried to reach them from the neighbourhood of Bandáradúwa, as, if this had been possible, it would have saved us the long and wearisome tramp to Tumpalamcholai, but there had been illicit *chena* making in the neighbourhood, and every effort had been made to lead us off by the local *árachchi*, and it was only after the matter had been taken up by Mr. G. D. Templer of the Forest Department that we were able to reach them. Among the most interesting things we saw among these people were the rough drawings of men, dogs, elephants, and leopards with which the walls of their caves were decorated. These drawings are made by moistening wood-ash with saliva, and drawing on the walls of the cave with the finger dipped in the paste thus produced; the spots of the leopards being indicated by dots of black made by working up charcoal with a little saliva. These drawings were extremely crude and rougher than the Australian cave drawings, which have been described by many observers, though they did not compare unfavourably in artistic skill with some of the rock drawings of the North Queensland aborigines, of which, indeed, one of us was strongly reminded.

There are a number of other small Veddá communities within a few miles of Maha-oya, who, though more sophisticated than the Nuwaragala community, well repaid visiting. Those of Mudugala, now settled at the hot water springs (Unuwatura-bubule) within a couple of miles of Maha-oya, although socially much influenced by the surrounding Sinhalese, must be regarded as tolerably pure blooded, for they are all extremely short men—the shortest member of this community being only 53½ inches—while two other men who seemed about the average height of the people were 56 and 56¾ inches respectively.

From Maha-oya we went on to Kallodi, where we were detained for a couple of days by the temporary loss of three of our bulls, that were finally caught some ten miles from where they had got away from our *tavalam* leader. Part of this time was spent in the partial excavation of a cave on the slopes of Kokagala hill. The roof of this cave was horizontal, the shelter having been formed by the wearing away of a soft horizontal stratum. A trench, some 12 feet

long, was first cut; immediately under the superficial soil were two layers of bricks, directly below which there lay a flat worked stone with a flange cut on one surface of it. The stone itself was nearly 3 feet long by some 15 inches broad and about 5 inches thick. So far no bone or fragments of pottery had been found, and it was not until a depth of about 30 inches was reached that fragments of pottery appeared. Nearly a foot lower we found a considerable quantity of coral, some bones, a couple of pieces of very poor iron ore or very rich slag, fragments of pots, and a number of badly preserved pieces of wood charcoal. Below this there was a fine gray layer of ashes about six inches thick, resting upon what appeared to be the bedrock floor of the cave. Only a very few pieces of quartz, and these such as might easily have got there without human assistance, were found, so that there was nothing to show that this cave was ever inhabited by the same folk who at one time occupied the Bendiagalgé caves and left their worked quartz implements behind them. A good drip-ledge is cut on the rock above the mouth of the cave, on the roof of which, some 5 or 6 feet above the present floor level, there are a few traces of a whitish substance which may be the remains of rotten plaster.

From Maha-oya we walked to Alutnuwara, stopping on the way at several settlements of Village Veḍḍás. These are the people visited and so well described by Deschamps, and we are able to confirm all he says as to their unpleasant behaviour. They live in well-built huts and have good chenas, and do a considerable traffic with Siṅhalese hawkers, a couple of whom were staying in the village of Dambani at the time of our visit. These folk have been utterly spoilt by being sent for to dance and make sport for visitors, generally more or less distinguished. They ask for presents every five minutes, and when one man is given a present for any assistance rendered, every member of the village clamours to receive the same. They have preserved a number of words, which are not obviously Siṅhalese, or are Siṅhalese periphrases, and speak in a loud, harsh tone; this being very largely a matter of pose got up to impress the visitors, though the singularly helpful and kindly Árachchi of Beligala seems unintentionally to have fostered the habit. He is the usual guide to visitors who come to see these Veḍḍás, having, as he says, known them well for thirty years, and he always speaks to them in the same harsh tone of voice.

We slept a night at Dambani, and early the next morning started the phonograph, against which even these disagreeable people were not proof, and with its aid were able to collect a good deal of information about the *yaku* and obtain a number of their songs and incantations. Warned by our experience at Dambani we did not visit the other big Village Veḍḍá settlement of Bulugahalandéna, but sent for some of these men to visit us at Beligala, where for a couple of days we made a most comfortable camp in the outhouses belonging to the Gamarála, whose courtesy was very marked. From here,

after a brief visit to the *chena* settlement of Welanpelle, which was certainly not worth the detour we made to reach it, we went on to Alutnuwara, where we found the main part of our baggage which had been sent on by the good track from Kallodi.

The Siṇhalese new year now made it necessary to give our men a holiday, so, after a couple of days of quiet spent in working up notes, we crossed the Mahaweli-gaṇga and walked to Madugoḍa, climbing *en route* the Gallepadahulla, or pass of one thousand steps, the old pilgrim route to Alutnuwara. A zig-zag road up the hill, which is practicable for bulls, has been made, but in spite of this and the disrepair into which the stone steps of the pass have fallen, we met a fair number of pilgrims, and, tiring though the climb was, the view from the top of the pass over Uva and the valley of the Mahaweli-gaṇga was certainly worth the effort. After a pleasant week spent at Kandy we returned by the same route to Alutnuwara, where we encountered considerable trouble in obtaining coolies, which would have been really serious if it had not been for the kindness of Mr. C. Herft, District Engineer, who lent us a batch of road Tamils. From here we started to walk down the valley of the Mahaweli-gaṇga to visit the Veḍḍá communities which were said to exist stretching northwards and eastwards into Tamankaḍuwa. Although we expected to find these Veḍḍás had come much under Siṇhalese and Tamil influence, it was necessary to do this in order to obtain a full list of the Veḍḍá clans (*warge*), for there were a number of clans of which we had obtained the names without being able to verify the existence. Our first halt was made at Hemberawa, about eighteen miles from Alutnuwara, a compact village of potters who are considered of so low a caste that the *Árachchi*, who is theoretically in charge of them, lives at or in the neighbourhood of Alutnuwara, one of their own men being appointed Vidáné, and making an extremely efficient village headman. This man told us that he and his people were the descendants of Veḍḍás; whether this accounts for the greater energy than usual displayed by the villagers seems doubtful, but we had little difficulty in persuading this man and a number of his villagers to act as guides and carriers to Polonnaruwa in place of the Alutnuwara men, who were already clamouring to be sent back. The houses of the village of Hemberawa are rather unusually closely crowded together; very many of them have a potter's wheel in front of them under a lightly built thatch, and between the houses there are many fragments of broken pots, some of them of extremely good design and evidently portions of vessels of unusual dimensions. There were a number of young betel vines growing about the village, and one of these was protected from the evil eye in an interesting and, as we believe, infrequent manner. Instead of the usual blackened inverted pot with white designs on it, the skull of a buffalo was carefully placed at the foot of the prop up which the vine was climbing, in order, as we were assured, to exert the protective influence already alluded to (figure 5).

As the folk of Girandura, the nearest Veddá settlement, were hopelessly sophisticated and entirely resembled the local Siṇhalese, we walked on next day to Elakoṭaliya, where it had been alleged that there were true wild Veddás, but as we did not think this likely we were not disappointed when the Elakoṭaliya folk turned out to be a small group of pleasant, well-nourished people, living on a good *chena*, who remembered only a few of their Veddá customs. Passing the night at Elakoṭaliya we started in the dusk of the dawn next morning for Yakure, leaving ourselves time and opportunity to spend whatever time was desirable at Kalukalaeba, where there is a Veddá *chena*. These folk still remember the *warge* to which they belonged, but have adopted a Siṇhalese mode of life ; so, after a few hours we went on to Yakure, a large and populous village doing a big cattle breeding trade and inhabited by folk resembling Tamils and worshipping Hindú gods, but who still call themselves Veddás and are of the Veddá clans and observe clan exogamy.

These folk told us that there were Veddás less sophisticated than themselves at Ulpota and Kohombane, some ten or twelve miles distant, so we sent for some of these. The headman of these people knew a few words of the " Veddá " or " jungle " dialect which has been already referred to, but when asked on what occasions he used these, replied : " When sent for by visitors and Government officers." He, however, confirmed the information concerning the clans that we had already obtained from the folk at Yakure. The next morning we walked to Poḷonnaruwa, where we heard of a group of descendants of Veddás living at a place called Roṭáwęwa, who make rice fields in the same way as do their admittedly Siṇhalese neighbours, and a small community who at one time lived near Sígiri. It appeared that these were the people who have been spoken of as Poḷonnaruwa Veddás, but we did not visit their village. After a couple of days at Poḷonnaruwa we went on to Sígiri, where we were for the first time able to approach near enough to a colony of *bambara* to obtain good photographs. There ended our journey in the Veddá country, a journey leaving, amidst many pleasant recollections, two dominant remembrances—the extraordinary beauty of the park country and the charming courtesy of the still unsophisticated remnants of its inhabitants.

THE MODES OF OCCURRENCE OF QUARTZ IN CEYLON.

By James Parsons, B.Sc., F.G.S.

IN view of the attention which has recently been directed to the occurrence of ancient quartz implements in Ceylon, it may be of interest to indicate the nature of the varieties of quartz which have been found in the Island, and the special physical characteristics of these varieties with reference to their mode of origin.

Quartz may be defined as silica or silicon oxide crystallizing in the trapezohedral group of the hexagonal system. Its specific gravity is 2·65 ; its hardness on Mohs' scale 7, thus easily scratching ordinary window glass. It melts at a temperature of over 1,400° C., but in igneous rocks it is, as a rule, the last constituent to solidify, being moulded by and filling the interstices between other minerals which in the laboratory have been shown to melt at lowert emperatures. This reduction of the fusion point is probably due to the presence of water vapour under great pressure.

Quartz when quite pure is colourless and transparent, but when impure may be found of all colours from white to black, and be translucent or opaque.*

The white colour is due, as a rule, to minute inclusion of gas or liquid. Shades of green, yellow, red, and blue are due to traces of metallic oxides, and when dark brown or black it has been shown that it often contains organic compounds.

When in the form of crystals, these commonly appear as hexagonal prisms with pointed terminations, which approximate to hexagonal pyramids. There are usually transverse striations on the prism faces. The conchoidal nature of its fracture may be well seen in any artificially chipped piece of crystalline quartz or flint, when it gives rise to what is known as the " bulb of percussion." It has practically no crystal cleavage, *i.e.*, shows no disposition to split along any definite plane in relation to its crystal outline.†

The term quartz will be here taken to include the vitreous or phenocrystalline forms, to which it is popularly and perhaps correctly confined, as well as the cryptocrystalline or chalcedonic forms, including chalcedony and impure forms, such as flint, chert, and jasper. There is some question whether the cryptocrystalline form should be considered hexagonal, part at least of the silica in chalcedony appearing to be triclinic.

* Clear quartz is known in Sinhalese as *palinguwa* and the white translucent variety as *tiruwana*.

† As shown later a schistosity or slaty cleavage may be developed in quartz masses.

Opal is an amorphous, hydrous form of silica. It occurs in Ceylon in some cherts, and occasionally forms independent masses. Precious opal is not known to occur in the Island.

Quartz is the most abundant mineral in Ceylon, as indeed it is in the whole crust of the earth. Taking first the vitreous varieties known to occur, these have a wide distribution in the series of crystalline schists or gneiss, of which practically the whole of Ceylon is composed. In the majority of these it forms an essential constituent, and may even be present as an accessory in the crystalline limestones which occur interfoliated with the gneiss. In the gneiss it occurs usually in irregular grains moulded by the other rock constituents and interlocked with them. It may also be intergrown with the felspar in micropegmatitic fashion or extended in parallel rods. The characteristic colour of charnockite is largely due to the dark quartz, which is an important constituent of the rock, but the cause of this colour in the quartz is obscure. The different divisions of the gneiss have very varying quartz contents, and bands may be found ranging from almost quartz-free rocks through types containing only isolated grains of felspar and garnet to rocks entirely composed of quartz. These granular quartz rocks attain considerable development over the central part of the Island, forming bands which may have a thickness of several yards. It is important to note that the quartz rocks are simply highly siliceous foliæ of the gneiss, and not quartz veins. Casual gold prospectors in Ceylon have often referred to them as "lode quartz," and many assays have been made of the rock, which has only ocasionally shown traces of gold, due probably to the introduction of the metal by infiltration along cracks.

When unaffected by earth movements, the rock is more or less friable, and consists of interlocking grains of white quartz, sometimes with occasional grains of kaolinized felspar and garnet. Recent observations have, however, shown that this granular white quartz is the source of the greater part of the glass clear quartz and quartz crystals which are common, but not often observed *in situ*. It is the clear quartz derived from the granular quartz which probably forms the greater part of the material from which the ancient implements have been made. The rock is more readily than any other in Ceylon affected by comparatively slight earth movements. The earliest stage in this dynamo-metamorphism is to shatter the rock, rendering it exceedingly friable. This may be seen on a considerable scale in the mountain ridges dividing Uva from the Central Province, where the friable character of the quartz caused some difficulty in tunnelling operations during the construction of the Nanu-oya-Bandarawela section of the railway. It may also be seen about Passara and several other localities. The next stage is the development of a regular cleavage, which was first observed by me near the Badulla-Passara road on the flanks of Namunakulakanda. The

most beautiful and striking case, however, has been lately noted at Crystal Hill estate near Matale. In one place where the quartz rock has been thrown into a small low anticline, a regular fine cleavage has been set up radially to the fold, and the quartz has been entirely re-crystallized, becoming glass-clear, and, in places, hypidiomorphic crystals of quartz have been developed, irregularly intergrown with their long axes parallel to the cleavage. This longitudinal intergrowth of the crystals sometimes produces forms approaching "sceptre quartz," *i.e.*, long crystals bearing at one end a stumpy crystal. A good example of "sceptre quartz" may be seen in the mineral gallery of the Colombo Museum, though the origin of that actual specimen is not known. In the clear quartz are discontinuous faint milky lines at right angles to the cleavage, which represent the partings of the original foliation. I would not suggest that all the idiomorphic and hypidiomorphic quartz crystals found in river gravels, especially in the Ratnapura District, originate from the metamorphism of quartz rock, but it is certainly a mode of origin which has previously been overlooked.

The passage of granular quartz into homogeneous transparent quartz may also be well observed on the Passara-Madulsima road, where the rocks are thrown into undulations at right angles to the general foliation strike. Here it is the pink or rose quartz that is developed. In places the rock is full of iron ore, probably ilmenite. On examination of a hand specimen with a lens abundant grains of garnets are seen. These show no crystal outline, but appear as pale pink blotches, fading almost insensibly into the surrounding pink quartz. Under the microscope these garnets are seen to be elliptical in section, with their long axes parallel. They show obvious signs of crushing. The quartz is traversed by faint parallel lines or cracks, also parallel to the long axes of the garnets and marked by some pale green decomposition product. These cracks appear to indicate the original grains. Between crossed nicols the whole of the quartz in the slide, except one grain, extinguishes parallel to these cracks and to the garnets, indicating that the quartz has been re-crystallized and oriented in this direction, which would be the direction normal to that in which the metamorphosing strain occurred. The one grain which is not parallel to the others extinguishes at an angle of 45° with the general direction.

Under a high power, especially by oblique substage illumination, the quartz is seen to be crowded with rutile needles, of which a large number are parallel, arranged at right angles to the garnet axes. One or two beautifully developed little idiomorphic crystals of rutile are also seen. The colour of rose quartz is usually attributed to the presence of titanium dioxide, and the abundant presence of rutile would confirm the supposition in this case.

Rose quartz is fairly common in the Island, but seldom seen *in situ*. When in uncracked pieces of sufficient size it may be cut *en cabochon*

as a gem and used for decorative purposes. A good example, showing a star by reflected light, similar to a star sapphire, may be seen in the mineral collection of the Colombo Museum, to which it was presented by Mr. W. C. Wild. Cleaved transparent quartz is found *in situ* in several places (*e.g.*, near Morawaka) besides the Matale District, forming knots in the granular quartz. Its comparative scarcity, however, *in situ* may be attributed to the fact that the surrounding granular quartz disintegrates readily, the homogeneous transparent portion being left intact.

It is of course possible that cleaved quartz may sometimes arise from the dynamo-metamorphism of pegmatite or infiltration veins, but I have seen no example of this ; the effect of earth movements on small masses of quartz being rather to shatter the mineral than effect any re-arrangement of its particles. Since writing the above I have observed near Naula, 18 miles north of Matale, an occurrence of idiomorphic and hypidiomorphic transparent quartz associated with a pegmatite (graphic granite). The crystals were intergrown, and faces were found as much as 2 ft. long. They were not actually *in situ*, but the quartz was undoubtedly that of the pegmatite. I am inclined to think that their origin was due to re-crystallization, as near the locality cleaved granular quartz was found, and other rocks near showed clear signs of strong earth movements.

The series of crystalline schists or gneiss is invaded by intrusive pegmatites, in which the quartz is often intergrown with orthoclase and microperthite, forming graphic granite. The quartz in coarse varieties of these pegmatites may sometimes form masses of considerable size. It is, as a rule, translucent, and is fairly homogeneous in structure.

Fine quartz veins also occur filling fissures in the gneiss. These in many cases can be shown to be genetically related to the pegmatites. That they were sometimes injected at a considerable temperature is seen by the metamorphism they occasionally produce in the gneiss, invading it, silicifying it, and giving rise to the formation of iron ores (*e.g.*, at Morahela near Balangoda). The quartz of these veins is, as a rule, white, and has a loosely crystalline structure. It often bears hornblende (*e.g.*, at Rambuke near Rakwana), iron ores, especially ilmenite, also tourmaline, which occurs in needles, or is sometimes seen intergrown with the quartz in graphic fashion. A fine example of this curious rock is exhibited in the Mineral Gallery. To be distinguished from these quartz veins, which are magmatic, or at least solfataric in origin, are the later infiltrations of silica, following rock decomposition, filling fissures and cavities. The quartz may crystallize in idiomorphic forms, and in one observed case, near Rakwana, was amethystine.

Veins of quartz are often seen associated with basic lenticles in the gneiss. These veins often appear to be the result of crush due to

earth movements, and follow lines of thrust and faulting. The basic lenticles and pinched bands with associated quartz segregations, in my experience, only occur in regions affected by earth movements, and may result from later metamorphism rather than original magmatic segregation. In some cases the veins resemble pegmatite intrusions. The quartz weathers out in small fragments, which may be opaque or transparent.

Quartz of all varieties in more or less rounded shapes naturally forms the bulk of the river gravels. Granular quartz pebbles are most common, and transparent cleaved quartz can with some certainty be referred to the same rock which has been subjected to dynamo-metamorphism. The transparent crystals in the river gravels sometimes attain a considerable size, and may be colourless, yellow, or brown. Such crystals are occasionally sold in the Ratnapura District to Chinese merchants, and fetch a rupee or seventy-five cents a pound. The coloured varieties are also cut as gems, when the stone may be described as citrine or cairngorm, good specimens of which when well cut show a beautiful transparency and depth of colour.

Crystals of amethystine quartz are often found when gemming. The colour, which is due to traces of manganese, is not, as a rule, evenly distributed throughout the crystal, but confined to the central portion. Hence almost all cut gems of Ceylon amethyst are parti-coloured, but on account of their fine deep purple are highly esteemed, indeed the only other important locality for amethyst is Brazil, since the supply at Oberstein is exhausted. Brazil crystal of all colours is, however, cut at Oberstein.

Clear quartz containing needles of rutile or tourmaline is known as sagenitic quartz. It is sometimes found in gravels, and may be cut *en cabochon* to form ornaments that are more curious than beautiful.

Mention should be made of the quartz cat's-eye or "tiger's-eye," which contains numbers of minute fibres of asbestos or siliceous pseudomorphs after that mineral, showing when cut *en cabochon* a ray of light similar, though inferior, to that of the true cat's-eye, which is a variety of chrysoberyl. Ceylon is referred to in text books as a locality for the stone, and examples may sometimes be seen in local jewellers' shops. I have however never seen it in the field.

Recent sandstones and pits of quartz grains with quartz cement occur near the sea coast at Puttalam, Negombo, and other places.

Coming now to the cryptocrystalline varieties of quartz, excellent examples of chalcedony are sometimes found in the river gravels, doubtless washed from the cavities in decomposed gneiss where they were formed. It also occurs, but rarely, as a thin coating on the joint faces of rocks (Nildandahena).

Of special interest with relation to stone implements are the cherts. Chert is an impure siliceous rock containing chalcedony and sometimes opaline silica stained with iron oxides. As a rule, the silica of

cherts is derived from an organic source, such as sponge spicules and the tests of radiolaria and diatoms. The Ceylon cherts, however, are entirely inorganic in origin, and may be described as silicified rocks. Dr. A. K. Coomaraswamy* has shown that the original rock was, in all the cases he investigated, crystalline limestone, in which the carbonates have been replaced by silica introduced in solution by percolating water. Thin sections of the rock, which commonly occurs in the neighbourhood of crystalline limestone, when examined under the microscope, show that it consists of spherulitic aggregates of chalcedony or structureless opal, or both, which may enclose individuals of phlogopite, graphite, and spinel, characteristic minerals in crystalline limestones. In one case corroded dolomite crystals were observed. It was doubtful at the time of Dr. Coomaraswamy's observations if these silicified rocks could originate except from limestones, but since then similar rocks have been found (*e.g.*, near Dodanduwa) which are far from any exposures of limestone, and bear unmistakable evidence in the form of decomposed felspar individuals of their origin from some siliceous rock by decomposition and silicification. The cherts are most commonly shades of brown and red, but are also white and green. The green varieties consist principally of opal, and are softer than the brown. Brown chert was formerly worked for gun flints and strike-a-lights, and is known in Siṇhalese as *gonapitta* or *ginigala*.

Pebbles stained brown with iron oxide, and wholly or partly siliceous, are often dredged up in gemming operations from the beds of rivers, and are known as *kahánda*. They appear to be water-worn pieces of orthoclase or micropegmatite which have been decomposed and silicified.

It is hoped that these notes on the different forms of quartz in Ceylon, and their modes of origin, may be some guide to local collectors of stone implements in forming an opinion as to the nature and probable source of the material used for implements or brought from rock or stream for purposes of ornament.

Implements of white quartz have been found in South Africa and elsewhere, but those of clear vitreous quartz are of extreme rarity in all other parts of the world, except Ceylon, where it was the chief material used, and where implements of that material are found in abundance in certain localities.

For the manufacture of implements the transparent cleaved quartz, which has been shown to be of metamorphic origin, was admirably adapted, as it split naturally into more or less flat flakes which could be easily worked to an edge. Implements showing a cleavage face or fractures are common. Crystals were also worked. The white translucent forms of quartz do not appear to have found so much favour among the ancient artificers in Ceylon, but this may

* Geological Magazine, Decade V., Vol. I., 1904, pp. 16–19.

be more apparent than actual, as the somewhat hackly fracture of this variety cannot so indubitably show signs of work as the glass-clear quartz.

In the case of the finds at Maskeliya, Bandarawela, and in certain caves, the material used was often obtained from derived pebbles, which must have been carefully searched for, as pebbles of clear quartz are certainly not common in the neighbouring streams.

Only a few implements formed of chert have hitherto been found in Ceylon, and as the clear quartz cannot be said to be distributed in great abundance in the localities where the implements have been found, and could then only be obtained in comparatively small unfractured pieces, it is somewhat remarkable that chert was not more widely employed, but still more so that one of the compact siliceous varieties of gneiss, such as the common charnockite rock, was not fashioned to form the larger and ruder tools.

A PRELIMINARY NOTE ON HÆMATOZOA FROM SOME CEYLON REPTILES.

By Muriel Robertson.

With Plate.

DURING a recent visit to Ceylon I had the opportunity of coming across a number of blood-inhabiting protozoa. I chiefly confined my attention to the examination of the blood of reptiles, and obtained a number of positive results. The following paper gives a very brief preliminary account of the infections met with.

It gives me much pleasure to have this opportunity of expressing my recognition of Dr. Willey's kindness in forwarding the work in every possible way.

I propose for the present to treat the parasites according to their occurrence in the vertebrate host, rather than according to their classification in the Protozoon System.

The two common tortoises in Ceylon are the lake tortoise—*Nicoria trijuga*, and the milk tortoise or kiri-ibba—*Emyda vittata*.

Nicoria trijuga is very generally infected with *Hæmogregarina nicoriæ*, described in 1905 by Dr. Castellani and Dr. Willey. This particular tortoise has two habits ; it either lives in ponds or lakes, and these individuals, in even such different parts of the Island as Colombo, Kandy, and Trincomalee, are almost always infected by the same parasite ; or it lives an almost dry land existence in ditches. Generally speaking, the dry-land tortoises are not infected. I have often found ticks upon these last, but they never showed any sign of protozoon life.

The water-living tortoise carries a little water leech, an apparently undescribed species of *Branchellion*. The leech lives on the tortoise and lays its eggs on the carapace in large numbers, and although the leech takes up its abode on its host in a much more permanent way than is the case with most of its kind, it nevertheless will wander off it at apparently very slight provocation. This Branchellion appears to me to be the transmitting host for the Hæmogregarine in the blood of the Nicoria.

The Hæmogregarine is of a very ordinary type ; it shows multiplication in the vertebrate host, but the details of the process have not yet been quite made out. It also shows the two endocorpuscular types of Hæmogregarines—one a broad type with a large nucleus, the other a slender recurved type with a dense nucleus. In the

alimentary tract of the leech the Hæmogregarine is easily to be distinguished; it becomes motile in the intestine, and at a later stage the parasites disappear. They may perhaps pierce through the intestinal wall as described by Siegel, but I am not as yet at all certain upon the point.

The other tortoise, *Emyda vittata*, is a true aquatic creature; it harbours in its blood both a Trypanosome and an interesting Hæmogregarine—I propose to call these provisionally *Trypanosoma vittatæ* and *Hæmogregarina vittatæ*, as this confuses their ultimate classification less than any other method of nomenclature.

The Trypanosome is a large creature, rather reminiscent of *Trypanosoma raiæ* in its general appearance. The kinetonucleus is rod-shaped, and lies at a considerable distance from the non-flagellate tip of the animal; there is a very well developed frilled membrane. The trophonucleus generally lies rather near to the kinetonucleus, but in some specimens is much further forward. The myonemata of this species are to be seen with remarkable clearness, particularly in the live state during certain phases. The analysis of its various methods of locomotion is interesting, but I do not propose to go into it just now; suffice it to say that it shows at times a very characteristic spiral movement. In fact, although this is a distinctly massive trypanosome, it frequently executes the corkscrew figure backwards and forwards, so characteristic of such a spirochæt as, for instance, *Spirochæta anodontæ*, only, of course, the movement is much slower. If a slide with infected blood is sealed and kept for from 12 to 24 hours, small chrythidial flagellates are seen to appear. The first time I came upon these I was much surprised, and hoped not unnaturally that they had arisen from the many hæmogregarines which were also present in the blood. The conditions were repeated, and I was able to follow on the live specimens the development of these small forms from the large trypanosome.*

I can only, in a paper of this type, give the barest sketch of the process. The trypanosome rolls itself up and the flagellum breaks free, but generally still remains attached at the kinetonucleus end. The flagellum is motile for a long time, but finally comes to rest, lying often in an untidy tangle round the creature. The trypanosome divides into two, the daughter individuals generally remaining more or less in contact; a further division into two occurs; the divisions in every case involve both the tropho and the kinetonucleus.

The result of these divisions is a group of four often very irregular little creatures. They become pear-shaped, and put out each

* A somewhat similar multiplication of trypanosomes has been already observed by França (Bull. Soc. Port. Sciences Nat.) and by Dutton, Todd, and Tobey, Ann. of Trop. Med. and Parasit. 1, No. 3, 1907. Both these cases deal with the trypanosomes of frogs, but I have not as yet had the opportunity of seeing the original papers.

a flagellum from their blunt ends. I have over and over again watched this part of the development under an immersion lens, and all that I can say is that a little blunt stiff process simply appears. This gradually lengthens and becomes motile, but at first it is quite unable to move the body of the creature. Finally, it can be observed that the attachment of the flagellum is no longer quite at the blunt end, but has shifted slightly to one side, and a small protoplasmic ridge, which I take to be the first sign of the membrane, is to be detected. The four little flagellates separate and move actively about. This short description does not take into account the considerable variation in detail which occurs. This trypanosome is true to the versatile traditions of the genus, and many slight differences, especially in the relative times at which the processes occur, are to be observed.

The intermediate host for this species is another little water leech. The trypanosome undergoes the above development at once upon being taken into the crop of the leech, and further divisions after the two mentioned seem to occur. The creature finally develops into a slender trypanosome of very varying size with a narrow membrane and a short flagellum ; the kinetonucleus very generally lies very close and just anterior to the trophonucleus. It is, I think, important to note that they are to be found in large numbers in infected leeches at the close of digestion, when there is no blood left in the alimentary tract.

Many interesting experiments were tried with the big horse leech, but I have not space to describe them here. The horse leech, by the way, has distinctly catholic tastes, as one specimen started to feed eagerly upon my own hand, and upon being persuaded to desist, took equally kindly to the tortoise. In the blood of the *Emyda vittata*, the trypanosome infection is almost invariably associated with a hæmogregarine infection.

The hæmogregarine shows two distinct types—a long slender recurved individual with pale faintly reticulate protoplasm and a dense nucleus ; and a broad type with deep blue staining protoplasm and a very characteristic loose meshed nucleus. This nucleus is not like that of any other hæmogregarine that I have ever seen, and is much more suggestive of the nucleus of a large resting trypanosome, not that I wish to imply that there is a connection between the two infections.

These broad hæmogregarines show a very interesting feature, namely, two large oval bodies which stain from a pale pink to a deep slightly brown red with Giemsa's stain. They are not present in all the broad specimens, especially not in the smaller ones, but they are a very characteristic feature of the larger broad forms. At first they were very suggestive of structures with kinetonuclear affinities, but from their highly refractive appearance in the live state and the variability in their staining properties, I am rather

inclined to consider them as of the nature of plastids. However, I do not wish to make any very definite statement just at present. Besides these "red bodies," as I have called them, there may be many staining granules present in certain cases.

The slender recurved type is much less numerous in the blood than the broad type. It is tempting to consider the recurved type with the pale protoplasm and the dense nucleus as a male gametocyte, and the broad form as the female gametocyte, but I do not at present see any very striking evidence to support such a view.

Multiplication occurs in the spleen and to a lesser extent in the liver, the parent organism giving rise to eight reproductive bodies. These, it is interesting to note, are found to lie in pairs, each pair being enclosed in a delicate boat-shaped capsule. This is very well seen in the live specimen.

In the alimentary canal of the little water leech both the endocorpuscular forms become motile, but I have not as yet got the details of their further development.

The Ceylon lizards do not seem to harbour protozoon parasites to any great extent—a circumstance contrasting with the conditions obtaining in other countries. Thus the common Calotes and the beautiful Brahminy lizard, which the ancient Siṇhalese naturalists firmly believed to be hatched out of cobra eggs, and the skink and the horned up-country lizard were all negative, so also the common little house gecko who lives on the walls and eats flies.

Two species of forest gecko, however—*Hemidactylus triedrus* and *Hemidactylus leschenaultii*—certainly made up for the deficiencies of the other members of the group. These geckoes, by the way, come from the Trincomalee side of the Island ; it is all very jungly country with very little cultivation of any kind.

Hemidactylus triedrus harbours a large hæmogregarine with a double capsule. I have called this *Hæmogregarina triedri*. Associated with it in one case was a very delicate trypanosome with a compact circular nucleus ; the small kinetonucleus lies immediately behind the trophonucleus, and the body extends for some distance behind the two nuclei. This trypanosome has a very characteristic appearance. I propose to call it *Trypanosoma pertenue ;* it is found curiously enough in both *Hemidactylus triedrus* and *Hemidactylus leschenaultii*.

Hemidactylus leschenaultii shows, besides this last-mentioned trypanosome, three other protozoon parasites, which may be found singly or in any combination. The first of these is the Hæmocystidium described in 1905 by Drs. Castellani and Willey. This is a pigmented organism showing a very marked differentiation into a pale form and a deep form ; the nucleus is a very delicate structure,

rather difficult to demonstrate satisfactorily. There is little doubt that in this case the differentiation marks off the male and female gametes or gametocytes.

The second parasite is a Hæmogregarine (*Hæmogregarina leschenaultii*).—This creature has two free motile forms always present in the blood and two endocorpuscular forms. The one free form is a slender creature with the power of carrying out a truly amazing set of gregarine movements; it is also able to bend double and to execute swimming or gliding movements. This creature has a dense nucleus and pale protoplasm without granules; it has an exactly corresponding endocorpuscular form, which lies with one end slightly curled up.

The other motile form is massive and granular. This creature moves much less actively than the slender form, and its periods of rest alternate with periods of movements something after the fashion of *Coccidium Schubergi*, Schaudinn.

There is a massive endocorpuscular form which is always rather scarce; I think it corresponds to the broad free form, but the nucleus differs slightly.

The third parasite of this gecko is a trypanosome (*Trypanosoma leschenaultii*).—This trypanosome differs very markedly from *Trypanosoma pertenue*; I never found them together in one individual. *Cf.* figs. 8, 9, and 13.

All these gecko parasites were first sent me from Niroddumunai, near Trincomalee, by Dr. Willey. Later on, when I went over to Trincomalee myself, I had the opportunity of studying them all in the live state. The transmitting hosts were not discovered.

Among the snakes only hæmogregarines were found. *Zamenis mucosus*, the common rat snake, which lives on the roofs of houses, and *Chrysopelea ornata* both showed a species with a very marked capsule thickened at both ends. The hæmogregarine lies in the capsule, and often shows a deep red staining area at either end; the nucleus is rather delicate.

Fig. 12.—I have not named this, as I notice that there is a *Hæmogregarina zamenis* named by Laveran, and I have not yet had the opportunity of seeing his description. There is a young endocorpuscular phase without a capsule, and a free motile form also without a capsule.

The cobra also showed a hæmogregarine; possibly it will prove to correspond with some of the already named species found in this snake.

A large python harboured a hæmogregarine, which was most interesting on account of its extraordinary activity. The free form moved with a rapid swimming motion, and was repeatedly seen to enter a blood corpuscle by simply piercing it, to swim round between the nucleus and the corpuscle wall, and burst the corpuscle by

curling itself up and suddenly straightening itself. The process takes only a very few seconds ; it also can be seen to injure corpuscles which it touches in passing, the corpuscle losing all its hæmoglobin immediately.

The rapidity and the business-like precision of the animal's movements were positively amazing. I was able to make out that the animal swims by means of rapid shallow waves of contraction passing backwards down its body, a slightly spiral twisting of the whole creature often taking place at the same time. This hæmogregarine shows an endocorpuscular stage very closely resembling the free form.

I do not wish it to be inferred that I have in any way made an exhaustive search through the Ceylon reptiles. I examined the animals I met, but it was more to my purpose to try and follow up the positive cases than to spend the time reviewing the reptilian fauna. In a later publication I hope to deal with these forms in much greater detail.

I subjoin the diagnoses of the new species mentioned in this paper.

Trypanosoma vittatæ, mihi. Fig. 1.

Massive trypanosome, body about 50–56 μ in length, and about 6 μ well developed membrane. Free flagellum 22–30 μ in length. Rod-shaped kinetonucleus body behind kinetonucleus very variable in length. Trophonucleus generally about 6–8 μ in front of kinetonucleus, but sometimes much further forward. Characteristic spiral movement, very small forms present in the blood of vertebrate host. Divides in transmitting host into four (also on sealed slide) ; small flagellated individuals with kinetonucleus anterior to the trophonucleus. These develop later in slender trypanosomes. Transmitting host, a small water leech, Glossiphonia (sp. ?) ; vertebrate host, *Emyda vittata*. Infection found all over Ceylon.

Hæmogregarina vittatæ, mihi. Figs. 2 and 3.

Hæmogregarine infection associated almost invariably with *T. vittatæ*. Two forms present : (1) broad massive form ; (2) recurved form with pale protoplasm ; the two limbs are equally long, dense nucleus, length when uncurled 22–26 μ. Broad form shows reticulate dense protoplasm, rather delicate loose nucleus ; the larger forms have two red staining plastid (?) like bodies at one end. Schizogony occurs in the spleen and liver ; 8 reproductive bodies are formed ; these are enclosed in pairs in a delicate boat-shaped capsule. Transmitting host probably Glossiphonia, as above; vertebrate host, *Emyda vittata*. Infection found all over Ceylon.

Hæmogregarina leschenaultii, mihi. Figs. 4, 5, 6, 7.

Hæmogregarine with two free motile forms always present in the blood. (1) Slender free form with dense nucleus rather actively motile; no granules in the protoplasm; length 26–28 μ. (2) Broad massive granular form; less active periods of movement succeeded by periods of rest; length about 26--28 μ. Two endocorpuscular forms also present: (1) long recurved form corresponding exactly with the slender free form, causes hypertrophy of blood corpuscle; this is always the prevailing type in any infection; (2) broad form with reticulate nucleus, grows to a large size, as much as 30 μ (specimen in the figure is not full grown); never very numerous even in good infection. Schizogony occurs in the blood. Transmitting host not known. Parasitic in the blood of *Hemidactylus leschenaultii*. Found at Trincomalee, Ceylon, October, 1907.

Trypanosoma leschenaultii, mihi. Figs. 8 and 9.

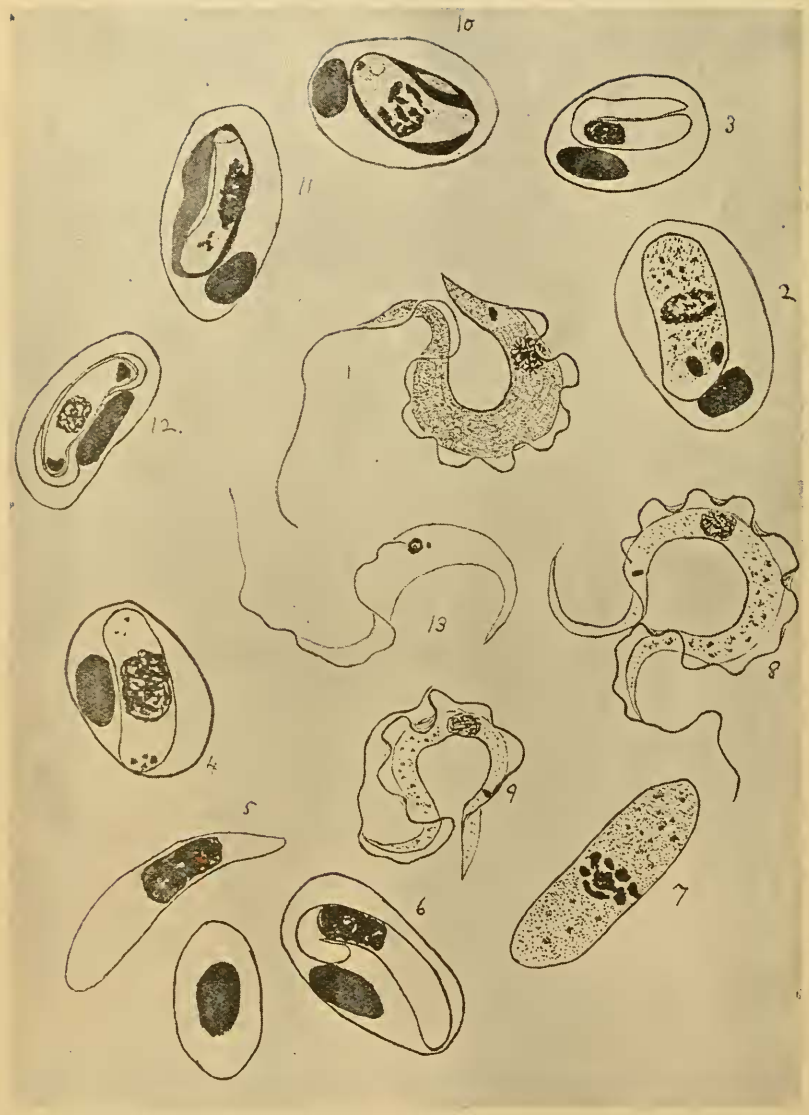
Length of body of larger specimens 56–60 μ, length of free flagellum, 17–22 μ. Many specimens much smaller; rod-shaped kinetonucleus, well-developed membrane. Body extends a long way behind the kinetonucleus; actively motile, often revolving in the figure of a wheel; body very flexible. Parasitic in *H. leschenaultii*. Transmitting host not known. Found at Trincomalee Ceylon, October, 1907.

Trypanosoma pertenue, mihi. Fig. 13.

Very delicate trypanosome; length of body 30–35 μ, length of free flagellum 15–20 μ. Body very thin with very little protoplasm; no granules; small compact circular nucleus lying about half way from the non-flagellate tip. Kinetonucleus very minute, situated immediately behind the trophonucleus membrane, not sharply marked off from body. Parasitic in both *Hemidactylus triedri* and *Hemidactylus leschenaultii*. Got at Trincomalee, in Ceylon, October, 1907. Transmitting host not known.

Hæmogregarina triedri, mihi. Figs. 10 and 11.

Hæmogregarine with double capsule, delicate inner capsule, and loose outer capsule, with tendency to stain very deeply with Giemsa's stain. The inner capsule has an opercular lid at one end. Long slightly recurved specimens with elongated nuclei present, so also broader rather bean-shaped forms. Both forms frequently show an irregularly shaped body at one end, which stains a bright red with Giemsa's stain. The young forms have no capsule. Parasitic in *Hemidactylus triedri*. Got at Trincomalee in Ceylon, October, 1907. Transmitting host not known. The length of this form is from 13-15 μ.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Description of Figures.

1. *Trypanosoma vittatæ*, M. R.

2. Broad form of *Hæmogregarina vittatæ*, M. R. Note the two "red bodies" at the one end.

3. Slender recurved form of *H. vittatæ.*

4. *H. leschenaultii*, M. R., broad endocorpuscular form; this specimen is not full grown.

5. Free slender form of *H. leschenaultii.*

6. Slender recurved endocorpuscular form of *H. leschenaultii.*

7. Broad free form of *H. leschenaultii.* Note granular protoplasm.

8. *Trypanosoma leschenaultii*, M. R., large form.

9. *T. leschenaultii*, smaller specimen.

10. Broad endocorpuscular form of *Hæmogregarina triedri*, M. R. Note the deeply staining outer capsule.

11. Slender endocorpuscular form of *H. triedri.* Note the dark outer capsule and the delicate inner capsule with the operculum.

12. Hæmogregarine from *Zamenis mucosus* and *Chrysopelea ornata.* Note the highly refringent capsule thickened at either end. Note also the deep staining area at either end of the hæmogregarine.

13. *Trypanosoma pertenue*, M.R. Note characteristic appearance of the trophonucleus and the kinetonucleus, and absence of granules of any kind.

NOTES.

1. *Miscellaneous Records. Callophis trimaculatus.*—This small snake is so rarely met with in Ceylon that the capture of a specimen is something of an event to a naturalist. Whilst riding along the road from Niroddumunai to Trincomalee, shortly after sunrise on October 4 last, I came upon a very slender snake lying across the track, and rode over it without injuring it, so slim is its body. Upon picking it up I recognized it at once by its black head relieved by two pale round occipital spots behind the parietal shields. Besides the black upper surface of head and nape, there is a more or less interrupted band of black behind the vent and another similar fenestrated band before the tip of the tail. The specific name doubtless refers to these three patches of black, which are conspicuous upon an otherwise uniform pale grayish brown ground colour. The nearly white occipital spots are sharply defined, about half a millimètre in diameter, and evidently an important element in the scheme of coloration. They may possibly belong to the category of the so-called "false eyes,"* which may produce a terrifying effect on certain enemies, and thus act as warning signals. They can only be faintly discerned in specimens preserved in alcohol.

Another feature which disappears in alcohol is the orange colour of the ventral surface. Beginning in the anterior region as a pale yellowish median tract, it gradually widens and becomes denser, until it occupies the whole extent of the ventral shields as a bright orange yellow band until it reaches the end of the abdomen, where the anal and preanal shields are dark orange red, almost scarlet. This brilliantly coloured preanal tract is immediately followed by the post-anal black belt. The subcaudals are pale bluish, with a few irregularly distributed orange red spots.

It is a venomous snake allied to the cobra and bungarum, but is too small to be dangerous, and can be handled with impunity, making no attempt to bite. In captivity it seeks to hide its head under whatever cover may be afforded.

The length of the specimen under description is 12 inches, the diameter 4 mm. The previous records of the occurrence of this species in Ceylon are summarized in this Journal, Vol. I., p. 85. From these it appears that the snake is a characteristic member of the eastern fauna of the Island.

Flight of Butterflies at Trincomalee.—Between 11 A.M. and 1 P.M. on last October 4, I witnessed an extraordinary flight of brown and speckled butterflies at Trincomalee, comparable in

* See this Volume, p. 92.

intensity to the November flight of the yellow *Catopsilia* which occurs annually northwards over Colombo. The great majority consisted of the brown *Euplœa asela*, but perhaps two or three per cent. (this small percentage representing a goodly number, so vast was the total swarm) were the speckled *Danais septentrionis*, the male of which has a peculiar pouch on the hind wing. They were passing in a southerly direction over Trincomalee.

The brown *Euplœa* is a very common species occurring diffusely throughout the country, often met with in considerable companies settling upon damp places by the roadside. This time, however, there was no such casual meeting of individuals alternately flitting low and resting, but a high concerted and sustained movement over the trees and houses and along the seashore in incredible numbers.

It is a seasonal flight, and is recognized as such by the inhabitants of the district, who aver that the butterflies are going to Kataragam, a famous Hindú sanctuary in the south of the Island, a few miles from Tissamaharama.

Small samples of each kind were taken for examination. Of 16 examples of *Euplœa asela*, 12 were males, 4 females; of 14 *Danais septentrionis*, 10 were males, 4 females.

The suddenness with which the apparition vanished was remarkable. Looking out over the maidan in front of the resthouse at 1.25 P.M. not a butterfly was to be seen. It was essentially a mid-day fight. During the afternoon a few isolated stragglers were noticed, but the main advance ended sharply as described. It is not difficult to assign a climatic reason for this flight. The date at which it occurred was during the lull which succeeded a strong access of the south-west wind, preceding the onset of the north-east rains, the clouds for which were already banking up to burst in a blind squall the next evening. In this part of the Island the south-west and north-east monsoons coincide accurately with the dry and rainy seasons respectively. This is not the case in the Western Province. The south-west blow which freshened during the last ten days of September was accompanied on the west coast by heavy rain, but not in the neighbourhood of Trincomalee.

Probably the swarm had been travelling in a column for miles along the seaboard. No enemy was following them. I do not know whether a corresponding flight had taken place at noon on the day previous, but I do know that on the day following, which happened to be the occasion of the annual Kumbom or Flower Festival, there was no repetition of it.

The fact of the simultaneous emergence of the butterflies in myriads in powerful flight in a fixed direction gives to it an appearance of objectivity which it may not possess in reality. It may be nothing more than a static seasonal brood, not an actual migration from one place to another. One is reminded of the story of the Catopsilias heading towards Adam's Peak to dash themselves to

death against the Samanalakanda or Butterfly Rock. I have seen them, however, in the month of December (1907) flying across the Labugama Reservoir away from the direction of Adam's Peak, being pursued by numerous Philippine Bee-eaters at noontime. Owing to their rapid zigzag flight the birds found considerable difficulty in catching them on the wing, often missing. When one had been caught, the bird would fly away with it to a tree, not bolting it outright. Amongst the bee-eaters was to be seen an occasional Ashy Wood Swallow, also hawking over the reservoir.

A. WILLEY.

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2. *Review: Fisheries of New South Wales.*—In view of the interest which is being displayed in the local fisheries, it may be useful to append some extracts from the report of the Board of Fisheries of New South Wales for the year 1907, which has been received at the Museum by the courtesy of the authorities.

The subject matter may be divided into three main sections: statistical, restrictive, and constructive. As in all cases where the State takes cognizance of the fisheries, the utility of recording returns of the catches is recognized. A return compiled from "Weekly Statements furnished by Fish Agents in the Metropolitan Markets" shows the quantity of fish received by them for sale. The form of return includes the following headings:—Name of Water, Name of Market, Description of Fish (classified as fish; "crayfish," by which is meant the spiny lobster or *Langouste*, *Palinurus hugelii*; lastly, prawns). The total quantities for 1906 and 1907 are—

	Baskets of Fish.	Dozens of Crayfish.	Baskets of Prawns.
1906 ..	128,854 ..	4,916 ..	2,984
1907 ..	124,078 ..	7,075 ..	4,678

Clarence river is the leading water, with an output of 23,737 baskets of fish; Port Jackson and Parramatta river yielded only 3,559 baskets of fish, 61 dozens of crayfish, and 228 baskets of prawns in 1907. Lake Illawarra contributed 5,294 baskets of fish, 3 dozens of crayfish, and 2,916 baskets of prawns. Hastings river furnished 3,037 baskets of fish, 2,833 dozens of crayfish, and 20 baskets of prawns. The average price of crayfish in the market is estimated at 8 shillings per dozen.

The numbers quoted above are from the Sydney market returns, and do not include quantities consumed elsewhere. Thus, the report of the Inspector of Fisheries for the Northern District shows that the total catch from the Hastings river waters was 5,451 baskets

of fish in 1907, as against 2,167 in 1906. A table on page 48 shows the quantities of different kinds of fish taken in each month of the year, the most productive months being March and September–November, November leading. The sub-totals for the year are the following :—

Hastings River Returns, 1907.

	Baskets.
Mullet	2,319
Whiting	897
Bream	838
Blackfish	684
Schnapper	253
Garfish	219
Jewfish	113
Miscellaneous	164
Total ..	5,451

Besides this grand total, the Hastings river yielded 4,085 dozens of crayfish (of which 2,833 dozens were put upon the Sydney markets). "This industry has at length been systematically established at Port Macquarie, and has been carried on during the year by two steam smacks from 15 to 20 tons, each working from 35 to 40 pots." The smacks at the same time were employed in line-fishing for schnapper or red fish, which were very plentiful, but when sent to market they failed to bring satisfactory prices, "and consequently, when the crayfish season ended, they gave up the line-fishing and returned to Newcastle." As numbers of crayfish died in transit in the hot weather, the divisional inspector recommended that they should be carried in ships' tanks, "preferably of wood, fed with a constant supply of salt water, and subdivided fore and aft and athwart them with perforated parting boards to prevent damage to the fish by the wash in heavy weather."

Restrictive measures depend partly upon the conflict between line-fishing and net-fishing. Certain waters are closed to net-fishing for a specified term, ranging from eighteen months to three years.

Mr. H. C. Dannevig, Superintendent of Fisheries Investigations and Fish Hatcheries, proceeded to Hobart on July 21 to obtain a stock of Tasmanian flounder, during the spawning season, for transfer to Gunnamatta Hatchery. About 1,500 fishes of various sizes were placed in fish-tanks on board a steamer which conveyed them to the hatchery. When placed in the pond at the hatchery, they commenced to spawn almost immediately. About fifteen million fry were hatched out and liberated in suitable localities at Port Hacking, Botany Bay, Middle Harbour, Lane Cove, and Brisbane Water.

In the month of July Mr. H. Dawson, Representative of Inland

Fisheries, visited Melbourne to arrange for the introduction of live roach in New South Wales. It was intended to strip the fish, and after fertilization to convey the eggs in suitable vessels from Melbourne to Sydney. Unfortunately they were not able to secure any fish for stripping, "as the roach shoal passed from the lower to the upper waters of the Yarra river without being observed by the scouts who were on the look out for them, and they were therefore compelled to collect eggs which were deposited in weeds in the river." About 30,000 eggs were collected in this manner, and were hurriedly despatched in wooden buckets to Sydney; but on arrival at Prospect Hatchery on the following day, all but about 100 were dead, and the survivors were so low in condition as to give no hope of fry being obtained for any practical purpose. "The eggs were evidently in too advanced a stage of development when obtained from the river to ensure success, and this was evidenced by the bulk of them hatching out on the journey, and the fry dying at once on account of the unsuitable conditions."

Other work in connection with inland fisheries chiefly concerned river pollution and trout acclimatization.

A conference of fisheries experts, convened by the Federal Government in connection with the Australian fisheries, was held at Melbourne in August, 1907. It was agreed that the first duty was to ascertain the nature and extent of the native fish. For this purpose it was decided to equip a vessel, and to appoint a person of practical acquaintance with fish and fisheries to be Commissioner of Fisheries, whose duty would be to engage upon a systematic investigation of waters off the coasts of Australia and Tasmania and of the biological and physical problems which they present, "with the object of determining the character, abundance, distribution, and economic value of the inhabitants of the waters, as also their migrations and the causes influencing or regulating the same, the object being to arrive at the life-history of all species having economic value, as well as those species to which they are intimately and essentially related."

The report from which the preceding selections have been made is a lengthy one of 71 pages. It will be seen that the Australian Commonwealth have quite recently inaugurated a system of fishery investigation in no niggardly spirit.

ED.

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3. *Spider Mimicry.*—Last year Mr. E. E. Green described a remarkable case of mimicry on the part of an Attid spider which resembled a Mutillid wasp (see *Spolia Zeylanica*, vol. IV., p. 181;

and V., p. 91). The spider has recently been identified by Mr. R. I. Pocock as belonging to the species *Cœnoptychus pulchellus*, Simon, 1885. Some years later it was described and figured by another arachnologist, Dr. F. Karsch, who gave it the synonym *Onychocryptus mutillarius*, not knowing that it had been already recorded under another name (*cf.* E. Simon, Hist. nat. des Araignées, 2nd edit., vol. 2, p. 174, 1897; and F. Karsch, Arachniden von Ceylon und Minikoy gesammelt von Drs. P. und F. Sarasin, Berliner Entom. Zeit. XXXVI., 1891, pl. XI., fig. 17).

From the specific name given by Karsch it is clear, as Mr. Pocock points out in a letter, that he too had noticed its similarity to a Mutillid wasp. Mr. Green's confirmation of this case of mimicry is therefore very interesting.

Ed.

Erratum.

On page 110 of this volume, instead of *Tinnunculus alaudariu* read *Tinnunculus alaudarius.*

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ERRATUM TO VOLUME IV.

Page 173, for "*Lygosoma punctatolineatum*" read "*Lygosoma punctatolineolatum.*"

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