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## Introduction: Narrative and Route of the Expedition

John Stanley Gardiner

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The Fauna and Geography  
of the  
Maldivé and Laccadive Archipelagoes

Being the Account of the Work carried on and  
of the Collections made by an Expedition  
during the years 1899 and 1900

Edited by

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of the University of Cambridge.

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## INTRODUCTION.

### NARRATIVE AND ROUTE OF THE EXPEDITION.

(With 2 Maps.)

AT the end of March, 1899, I left England for Ceylon in the company of Mr L. A. Borradaile. On arrival at Colombo we found that the Board of Trade s.s. *Ceylon* had just left for Minikoi owing to a wreck on that atoll. This necessitated a delay of seven weeks, before we could hope to sail thither, a detention further increased to eight weeks owing to stress of weather. Mr Borradaile accordingly proceeded to the Jaffna Peninsula, where he spent a month in familiarising himself with the life and conditions on coral reefs. I meantime prepared our stores, and made arrangements for the Maldive cruise, subsequently visiting the raised limestone hills and area of the north of Ceylon<sup>1</sup>. After returning to Colombo I traversed the entire coast between Negombo and Dondra Head, a distance of about 120 miles. Mr Borradaile joined me, and we then settled down for a fortnight at Weligama—the Beligam of Prof. Haeckel—where there is a deep bay with reefs of small size across its entrance. The rich variety of animal life on the reefs both here and off the Jaffna coast as compared to the reefs of the Maldives and Minikoi is a most noticeable feature.

After a tedious week's detention in Colombo, we finally left Ceylon for Minikoi on June 17th, experiencing a very heavy north-west gale the whole way; in spite of this the sea one night was white with phosphorescence, a very unusual phenomenon in these waters. We located ourselves, and built a bungalow at a distance of about one-third of a mile from the south-west end of Minikoi island, under the shadow of the lighthouse, the boat belonging to which was through the kindness of Capt. Channer, R.N., freely placed at our disposal. The island here is about 470 yards across between tide-marks, and a broad ride has been cut, giving the only open space of any size in the island. The vegetation is extremely dense, and forms a low jungle of *Pandanus*, *Hibiscus*, *Hernandea*, *Ricinus*, coconut and other trees, with *Pemphis acidula*, *Scaevola koenigii* and *Tournefortea argentea* on the shores. At the south-west end of the island is a shrine, the grave of a holy, Moslem sheikh, connected by a good, shaded path with the village in the centre of

<sup>1</sup> Vide *Report Brit. Ass.*, pp. 400—2, 1900.

the island. A small settlement formerly existed round the shrine, but it has long been abandoned, and the jungle near it is now far thicker and less trodden than elsewhere. The land has the same character up to the village, but further north it is much more open, and can indeed be traversed almost anywhere<sup>1</sup>. Our situation then was not unnaturally the best possible for the land fauna, on which the lighthouse lamp too had doubtless no inconsiderable influence. The open ride formed both by night and day our best collecting ground, sugaring never meeting with any measure of success elsewhere.

For marine observations and collecting, we had within a stone's throw of the house on the seaward face of the island a broad reef-flat, on which the sea continually breaks. Towards the north this gradually narrows, but westwards broadens, and continues round the atoll. A broad boulder zone, which can be waded conveniently up to half-tide, extends the main (Minikoi) island inside the reef-flat to Wiringili and thence to Ragandi and round the atoll. These islets are mere rocky patches, the former with a few coconut trees, under the shade of which strangers are buried. Towards the lagoon there is a great sand-flat, exposed at spring tides from 100 to 200 yards from the beach. The situation was also chosen, as during the summer months the south-west monsoon blows, the effect of which I wished particularly to study. Unfortunately the monsoon of 1899 was very abnormal, the prevailing winds coming from west to west-north-west until the second week in August, when the proper monsoon commenced, bringing heavy rain in its train. The latter made work extremely difficult and unpleasant; the bottom could nowhere be seen on account of the surface disturbance; bottom living animals contracted, or retired into the sand or other shelters; the surface fauna sank to considerable depths.

The disadvantages of the position lay in the considerable distance of the house from the village and from the north passage into the lagoon, through which alone access to the open sea could be obtained in this monsoon. Natives had to be hired from the village for each several job, and it was too far for the children or fishermen to bring any strange animals they might find. The wind being dead in our teeth, and the numerous shoals making short tacks necessary, it was difficult to visit the northerly reefs of the atoll, and on no occasion was I enabled to approach them from seaward within about 200 yards.

During the months of July and August a heavy easterly swell came up with large rollers, three times dying down and again regaining force. This swell was very abnormal at the time of year, and apparently was due to some cause completely outside the ordinary winds and currents. On enquiry I ascertained that it was also observed on the east coasts of Ceylon and India and on the large Ocean Liners proceeding from Ceylon to Albany. Subsequently I found that it had been felt throughout the whole of the Maldives; in Suvadiva and Addu it did considerable damage, sweeping over islets and land, which had never been

<sup>1</sup> Owing to an old arrangement the produce of half the island is deemed to belong to the Bebe of Cannanore. An arbitrary line of division exists near the village with gates and guards, who rigorously exact three-fifths of the coconuts gathered south of the fence. In this portion no timber of large size or old growth exists, the whole surface at one time having been cleared and planted. Subsequently on the hold of the Bebe becoming weakened or relaxed, vegetation was allowed again to assume its sway, resulting in the present dense, jungly growth. On the management of the Bebe's dominions being undertaken by the British Government, the

old line of division as found was retained permanently with much injustice to the inhabitants, as it had been formerly periodically open to revision. Since that time the north half of the island has been very rapidly washing away, while the south half has, if anything, been increasing somewhat in breadth. The north half cannot now annually support one-third of the present population, while the south has become a dense jungle, rapidly going to waste. It produces annually under the present system only a few hundred rupees' worth of coconuts, which the government might well commute for a fixed annual charge.

affected before. The origin of the swell can only, I consider, have been due to submarine volcanic disturbances probably towards the East-Indian region.

During the first five weeks of our stay at Minikoi, while I was engaged in a survey of the land and shores, Mr Borradaile occupied himself mainly with a thorough study of the land Crustacea<sup>1</sup>. An incautious exposure on the reef, while collecting, then laid him up with sunstroke, so that I had no option but to send him to Ceylon, whence he was ordered to return as soon as possible to England. For the remaining eight weeks I was absolutely alone, being deprived by illness even of my Singhalese servants.

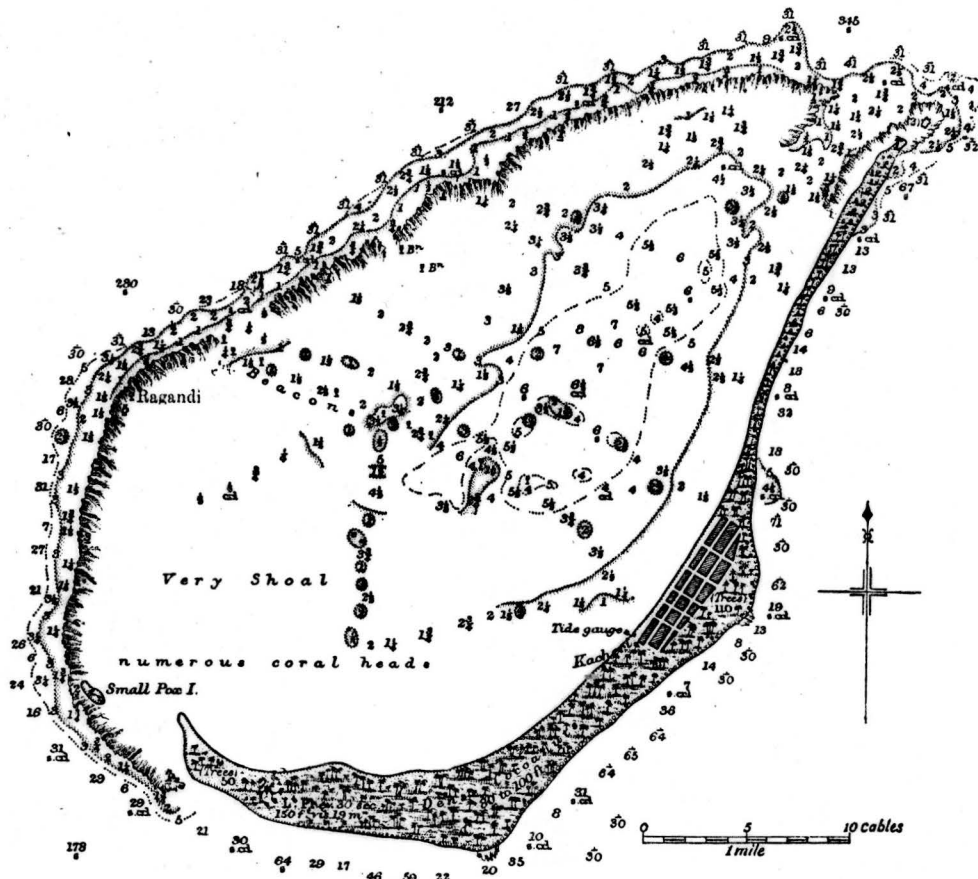


FIG. 1. Minikoi Atoll, from the Admiralty Chart. (*Wiringili*, native name for *Small Pox I.*).

I returned to Ceylon in the middle of September, Mr Forster Cooper shortly afterwards joining me from England. After some unavoidable delay we left Colombo on Oct. 18th for Male, the capital of the Maldives and residence of the Sultan. Owing to a succession of accidents we did not arrive until Oct. 23rd, when we at once landed our stores, transferring sufficient for a three months' cruise to our schooner. The latter was lent to us by His Highness the Sultan; she was a vessel of about 16 tons, built in the islands, of coconut

<sup>1</sup> *Vide* Mr Borradaile's account in the same part of this publication.

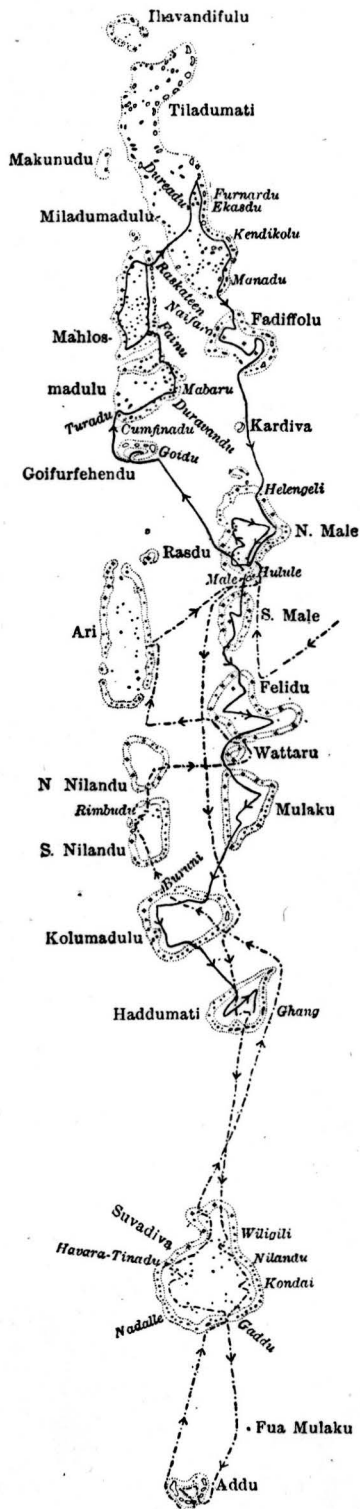


FIG. 2. Maldive Group, showing the route of the expedition. Scale 60 miles to 1 inch.

wood, moderately seaworthy, but not laying within six points of the wind. The Sultan also appointed Hassan Didi Velamanikofanu, his third vizier, to accompany us, and gave orders that every facility should be granted to us. After presenting our offerings to the Sultan and his viziers, we sailed from Male for Goifurfehendu (Horsburgh) atoll.

We at once had a house built on Goidu island, from which as centre we visited all the other land of the atoll and the greater part of the reef. A stay of altogether eleven days was made, and everything was unpacked and properly stowed on the schooner; the dredges and instruments were overhauled, and indeed all preparations were completed for the work in Mahlos and other atolls. The reef-animals were collected and preserved, being sent by native boat to Male to await our arrival. On leaving Minikoi I brought with me two boys, whom I had taught to collect in that atoll; these I largely employed in Goidu and subsequently in other islands in collecting the land fauna and flora.

The remainder of October, 1899, was spent in S. Mahlosmadulu. This group of reefs really consists of three atolls, a small central one separated from larger on each side by narrow channels of over 100 fathoms in depth. The three lie on a shallow bank, which tapers to the north but has a broad base to the south-east. The plateau is studded all over with reefs, the outside ones forming a chain round the perimeters of the three parts. The reefs along the west side of the bank are for the most part ring-shaped, small atolls (atollons or *faro*) with deeper water (the lagoon or *velu*) in the centre. On the east and south sides, however, isolated islands with fringing reefs mostly form the boundaries. The general depth of the atolls is about 27 fathoms, most of the channels between the numerous encircling reefs having over 20 fathoms.

The weather during our stay in S. Mahlos was extremely calm, our vessel indeed being towed by boats from island to island. This was singularly unfortunate, as usually strong winds may be depended upon in November. We had hoped to systematically dredge a large number of the deep channels between the reefs, that edge the atoll. As their general depth is about 25 fathoms, this was found to be impracticable, rowing boats not having sufficient weight to carry even the smallest dredges along a rough bottom at this depth. Accordingly we confined ourselves to a traverse of the whole south of the atoll. Our first anchorage was off Turadu, an island situated on the rim of a somewhat ill-defined *faro* at the south-west corner of the bank. We visited every part of its reef and collected a few animals. The lagoon (*velu*) of the *faro* was dredged, yielding

*Asymmetron* and *Ptychodera* from 20 fathoms. The island itself proved most interesting. Its rocky barrier of beach-sandstone had in 1896 been overlapped by the waves of a cyclone. These attacked the sand behind, eating deeply into the island, with the result that the beach-rock has been left in lines many yards from the shore. The natives have now erected breakwaters round a great part of the island—and also a new mosque—but in spite of these no trace of it is likely to be left in 20 or 30 years' time, unless some considerable change in the currents or reefs alters its conditions.

From Turadu we visited all the reefs to Mabarū, the most easterly point of the whole group, anchoring at Hitadu, Heddufuri, Mahrus and Duravandu. At Cumfinadu we found some large rocks, standing up in the lagoon well inside the boulder zone; *Bonellia* was living on the reef-flat, and *Ptychodera* was the most abundant form of life on the shores of the island.

We finally left for N. Mahlos on Nov. 29th, but, meeting with strong currents to the west-south-west, we only fetched Kuderah-Heelu in the central atoll that evening. However we reached Fainu in N. Mahlos on the following day, and remained there at anchor for three days, which were devoted to dredging and an examination of the islands of Fainu, Kenurus and Ingurahdu, and Berriam-furi faro. We then separated, Mr Forster Cooper dredging with the schooner along the east side, and examining its islands and reefs. I meantime embarked in a small open boat for the western side, where the lagoon of the atoll is filled up with a perfect maze of small reefs and shoals. I first visited five of the lagoon islands, and then, a strong north-east breeze setting in, worked up along the edge of the atoll, sailing from dawn to dusk, and anchoring at night to leeward of the nearest reef. I examined all the reefs and islands, and sounded the velu (lagoons) of all the faro (atollons) along the western rim, rejoining the schooner on Dec. 11 at the north of the atoll. Unhappily a series of collections, made by myself and my boys, to illustrate the populating of sand-banks by both animals and plants, was ruined by my capsizing our fishing boat near Cunderudu.

On Dec. 12th, after taking in wood and water, we sailed for Miladumadulu, a similar bank to Mahlosmadulu but with relatively far fewer reefs and a less determinate rim. We anchored the same night at Guthardu, and at daybreak made sail towards the east side of the atoll. Owing to a strong south-westerly set of the current we took two days in reaching Dureadu in the middle of the bank, a distance of seven miles. This is the island of a round faro, one mile in diameter; its lagoon has 19 fathoms of water, a depth which makes the faro peculiar among all its fellows in the Maldives. We landed the same night for firewood and water, but, none of the latter being obtainable, were compelled to sail at dawn. A strong north-east gale coming out, we stood up the atoll and watered at Rymaggu, anchoring that night at Furnardu, a large island on the east edge of the atoll. The islands of this rim of Miladumadulu tend to be closely fringed by the reef on all sides, and to have a *kuli* (shallow lake, French *barachois*) in the centre, surrounded by mangroves, through which the sea has in some found access. While Mr Forster Cooper dredged with the schooner down to Kendikolu, I visited ten of these islands in a fishing boat; two were very small, three had definite *kuli* or else mangrove swamps (Ekasdu, a large lake swarming with a species of *Leander*), and four were crescentic in shape, their *kuli* now open to the sea. Kendikolu is one of the largest islands in the Maldives, being two-and-a-half miles long by two-thirds of a mile in breadth. There are four *kuli* down the centre surrounded by mangroves, which abound in rails; on their surfaces we saw



a few duck, while their waters, which are quite fresh, four to five feet deep, teem with small fish. However, as Ramazan, the Mahommedan fast month, was approaching, we had to hurry on, and only stayed two nights. We accordingly, on Dec. 19th, dredged down to Landu, obtaining a large variety of sponges and Polyzoa with a quantity of red *Polytrema* and some nullipores, in addition to corals, of which the black *Dendrophyllia ramea* was very abundant in 12 to 20 fathoms off the reefs. We visited and dredged Ma and Eddu faro with three to four fathoms of water in their velu, obtaining a few Cephalochorda, and examined some of the central islands of the atoll. At Manadu we caught a single specimen of *Typhlops*, which is evidently very rare in the archipelago, since it has no native name.

Fadiffolu atoll was reached on Dec. 23rd; it differs from the preceding in being a true atoll, having a well-defined, encircling reef, especially to the east, and an open lagoon with but few shoals. We first moved down the east side, examining the reefs, but then dredged across to Innawari. The natives, although not actively hostile, were very unfriendly, so that on Christmas morning we sailed down to Naifaro. The winter rains now commenced, and continued intermittently with heavy squalls from the north-east for a month, making navigation among reefs difficult. The schooner too was decidedly unpleasant, as the whole of our cabin accommodation had to be utilised for storing our books, instruments and various collections. We remained at Naifaro four days, restowing and repairing our vessel, as she had been somewhat strained in the recent heavy weather. The time was occupied in a survey of the neighbouring islands and reefs, and in thoroughly dredging some of the passages into the atoll.

The shores of all the islands at the north end of Fadiffolu I found abundantly strewn with the shells of *Spirula*. Enquiring of the natives as to its "fish," I was surprised to receive an accurate description of it. It appeared that the animals were extremely abundant in January of 1897 in the channel towards Miladumadulu. "They float on the surface, and may be picked up with the boat-bailer. They are never seen inside the atoll, but periodically occur in the north-east monsoon in the open sea. None were seen in 1898." I offered a reward of 50 rupees for the first specimen, but, although eight or nine boats went out daily during my stay, I did not secure one. That the people of Naifaro and Innawari really know the animal is undoubted. Yet this is peculiar, as I did not find on close enquiry that it was known to the natives of any other part of the whole archipelago, though its shell occurs sparingly everywhere. The native name for the shell is *markana taludandi*, the heron's key.

Leaving Naifaro we again dredged across the atoll on a more southerly course, subsequently cruising along the eastern side, dredging and examining the islands and reefs. On Jan. 2nd, 1900, we set sail for Male atoll, anchoring off Helengeli the same afternoon. This atoll is intermediate in its characters between Mahlos and Fadiffolu; except at the south end it has practically no islands in the lagoon. There are evidently great changes in its topography since the original survey, two islands of the eastern edge at least, resting on their own reefs, having disappeared. There seemed to be still greater alterations in respect to the shoals in the lagoon, but in our somewhat dependent position any real survey was impossible owing to constant interference from Male. We, however, saw some of the western reefs on our way to Goifurfehendu, and on our return journey to Male, which we reached on Jan. 5th, 1900, we dredged down as close as possible to the eastern reefs. Further Mr Forster Cooper in the middle of February made a most successful

dredging cruise of eight days in the atoll, taking 34 hauls, to ascertain the character of the bottom in every position, and I at the same time visited most of the islands and reefs within five miles of Male.

Ramazan had now commenced, and, dependent as we were entirely on Mahomedan boys, it would have been useless to continue our cruise. Our vessel too was in want of a thorough overhaul, the rigging being very bad. After a couple of days in Male, we had a house erected on Hulule, the island of a neighbouring faro, and at once transferred to it sufficient stores for a stay of four or five weeks' duration.

Hulule island is about  $1\frac{1}{4}$  miles long by 800 yards broad; it is about two miles distant from Male. The greater part of its surface is covered with coconut trees, but a large patch along the western side has been allowed to revert to jungle. The principal trees are the banyan, candle-nut and *Calophyllum*, the branches of which abound in frugivorous bats. On account of the island's proximity to Male, where all foreign vessels for the group have to enter, many plants have been introduced. Few of the fruits thrive, but half-a-dozen brilliant flowers relieve the everlasting green. Sweet-smelling plants, jessamine, frangipanni, roses and various herbs, make the proximity of the mosque and village pleasantly fragrant. The western shores are fringed with *Pemphis acidula*, the white, perfumed flowers of which prove a great attraction to insects. As some of our boys delighted in this work, the land fauna and flora was exhaustively collected. As compared with Minikoi, we found the insect and spider faunas to be decidedly poor except in butterflies, although it may be deemed to be thoroughly representative of any rich island in the centre of the Maldives. A certain number of insects must have been introduced with the plants, but the successful acclimatisation of any considerable number of the latter only dates back to the eruption of Krakatoa in 1883. Before this time pumice (*feng-bo-ga*, the water-swimming stone) was not known in the group. Its fertilising properties have now been discovered, and in many islands baskets of it are collected and strewn over the garden land. The capture of two specimens of snakes on pandanus trees at Hulule was of interest.

The whole faro is  $4\frac{1}{2}$  miles long by  $1\frac{1}{2}$  broad; its lagoonlet, or velu, in the centre has a depth of 6 to 7 fathoms. The reef everywhere is awash at low tide, and, though differing greatly in its characters, quite well defined on the side towards the lagoon of the large atoll. Besides numerous rocks there are two islands respectively at the north and south ends, Farukolufuri and Hulule. During our stay every part of the faro was surveyed, and the fauna carefully collected for comparison with that of Minikoi atoll. *Asymmetron* was very abundant in certain places in and around the velu, and at least three species of Enteropneusts of two or three genera were found, each in its own characteristic environment. Two specimens of a remarkable *Thalassema*, 2 feet long when alive, were secured from the boulder zone, besides a number of specimens of smaller species. The sand was remarkably rich in Actinians of many species, all of which withdrew into the shelter of the sand at every rain-squall. Mollusca were not numerous, but *Cryptoplax*, *Chiton*, and each of the three families of the Zygobranchiata were represented; autotomy of the foot seems to be a widespread phenomenon, as several forms with the foot thus cut off were obtained.

We returned to Male in the middle of February. Mr Forster Cooper at once sailed for his dredging cruise in the atoll, while I remained to carry on a series of observations

on the currents in the channels on each side of the island. During my whole stay I dispensed medical aid freely to the people. At this time there was in one district of Male an epidemic of malaria, with which I was naturally much brought into contact. Mr Forster Cooper returned to find that I had caught the infection. I saw, however, our collections to date properly packed for England, and the schooner victualled and equipped. As complications set in and I was getting worse instead of better, Mr Forster Cooper on Feb. 28th took advantage of the chance visit of a British India Steamship Co.'s steamer to place me in charge of Capt. Pigott, R.N.R.<sup>1</sup>, for Colombo. He himself determined to carry out his part of the projected work, and sailed from Male on March 3rd for the southern atolls.

I cannot speak too highly of the pluck, determination and resource, shown by Mr Forster Cooper, who had had no previous experience of the tropics. He worked his native crew in a manner, which I have never seen excelled even in the Pacific, and took no less than 88 dredgings in five different atolls. However, I append Mr Forster Cooper's report, which may be allowed to speak for itself:

"On March 3rd, accompanied by Mahommed Didi as interpreter and representative of the Sultan, I crossed over to S. Male, in which three days were spent. Gurahdu island and reef were visited, but neither land nor reef in the atoll appeared to exhibit any novel features. The group consisting of a series of almost isolated reefs, I dredged principally in the outer passages and in the centre to ascertain the differences in the bottom-fauna. The hauls in the centre were very unproductive, but in the channels a large quantity of the same sessile forms, as in the northern atolls, was brought up. Just inside the northern passage a coral, *Goniopora stokesi*, was obtained; it forms round heads on thick stalks, covered by an epitheca, which is completely buried in the sand, or mud.

"On March 6th we sailed on to Felidu atoll, where we visited Alimata and Tinadu islands alone, at night anchoring generally to the nearest reef. We remained eight days, but only took 18 hauls of the dredges owing to head winds, strong currents across the atoll and dead calms. Indeed throughout the whole cruise the unfavourable winds and the poor sailing qualities of the schooner prevented us from surveying as much of the atolls and from taking as many dredgings, as I would have liked. We attempted for three successive days to get up the almost completely enclosed eastern horn of the atoll, but were unable to tack up more than half-way. The lagoon in it is open with few reefs or shoals, and has a general depth of 40 fathoms; its bottom is hard, covered with sand, and absolutely unproductive to the dredge. In the rest of the atoll weed and broken shells were found towards the centre of the lagoon and rubble in the channels. *Diaseris* is very common almost everywhere and its skeleton forms one of the chief constituents of the rubble.

"We fetched Mulaku atoll on March 14th, and remained six days, taking 17 dredgings. The atoll is remarkable for the broad, almost continuous reef along its eastern side. There are a number of very narrow, shallow passages to the north, but from Maduvéri to Curaille a distance of 30 miles, the reef is continuous save for a single passage opposite Mulaku island. All the islands lie on the seaward side of this reef; extending down its centre is a series of long, linear velu (small lagoons), which off Raimandu is double, two series lying parallel to one another and the edges of the reef. In dredging I ran two lines across the lagoon, and then moved down along the eastern side. Among other forms we collected a

<sup>1</sup> I cannot sufficiently express my indebtedness to this gentleman for all his kindness to me.

large number of soft-bodied echinoids, a few black crinoids and some holothurians, with which were associated a number of Polychaeta, crabs, caribs and molluscs. All were of the same ground shades as their various Echinodermata, whose colour was, as it were, photographed upon them.

"Kolumadulu atoll was entered on March 21st, but no work could be done from the schooner owing to the calm weather until the 26th inst. I meantime took the small boat out, and made various scattered dredgings in the north-east corner of the atoll with but indifferent success, while I sent the collecting boys to Kolufuri to obtain the land fauna and flora. I did not personally visit any of the islands in this atoll nor Haddumati, which we next dredged, as they all appeared to me to present the same features as in the northern groups. I was also anxious, as these two atolls are almost completely encircled by reefs, to ascertain precisely the characters of the bottom in every part. I sailed finally right across the centre of Kolumadulu lagoon, taking 16 dredgings down to 45 fathoms and incidentally running the vessel ashore on a small reef, off which we warped her without any great difficulty. The centre was found to be covered with fine mud, on which a few Crustacea, molluscs and flat-fish of small size alone appeared to exist. We obtained also a larval form of *Fierasfer* out of a holothurian from 25 fathoms.

"In Haddumati atoll I took 16 dredgings in the centre and eastern part of the lagoon, where the bottom was mostly covered with fine mud. They were very unproductive owing doubtless to the all but continuous reef of the eastern side. Relatively little work could be accomplished, as the schooner was in a horribly dirty state with bilge, etc.; she also had been somewhat strained on the reef, and her bottom was thickly covered with barnacles and weed.

"To summarise, the cruise yielded between March 3rd and April 8th 88 dredgings in every part of the lagoons of five different atolls. The hauls must have averaged at least one mile each, and hence 88 miles of the bottom was covered. The latter was found to be of an almost uniform dead-level between the reefs and shoals, which, arising precipitously, uniformly reach to within a few feet of the surface. It was to me most remarkable that we did not meet with a single knoll of any sort jutting up to indeterminate depths<sup>1</sup>."

After paying a second visit to the Jaffna district, I returned to the Maldives, having secured Sheikh Jeevunjee Noorbhai's steamer *Ileafae*, Capt. Molony, for a short cruise. I took on board at Male Mohammed Didi, Chief Vizier and uncle to the Sultan, Mafekiligefanu, the religious head of the community, and Hassan Didi, third vizier, with their suites as well as a Said, descendant of the Prophet, who had a family in Addu. After discharging some of our Male cargo we steamed south down the deep central basin of the group, coasting S. Male and Kolumadulu atolls. We steamed into Haddumati atoll on April 8th, and relieved Mr Forster Cooper, who joined us. After transferring the collections, instruments and nets, we sent the schooner back under the native mate to Male, and at once sailed on to Suvadiva atoll, which we entered by the north-east passage on the morning of the 9th. This atoll lies between the equator and lat. 1° N.; it is separated from the central group by the "One and a half Degree Channel," 55 miles in breadth.

<sup>1</sup> It is scarcely necessary to point to the great importance of this fact, as bearing on the question of the formation of the atolls and reefs of the Maldives.

It has a well-defined rim with passages at intervals, and is about 34 miles long by a little less in breadth; its lagoon has a maximum depth of 50 fathoms. As Addu atoll was to be our turning point, we now spent only two days in Suvadiva, dredging and sounding along the east side of the lagoon. We anchored with banked fires for two nights at Nilandu and Gaddu, and I further, leaving the dredging to my companion, visited Wiligili and Kondai.

Addu is a small atoll, 10 miles long by 6 broad, lying about lat.  $0^{\circ}40'S$ . Its reef is perfect except for two small passages to the north and two larger ones to the south. The lagoon has a maximum depth of 36 fathoms; it is fairly open in the centre, but against the encircling reefs has a perfect maze of coral heads, arising from 7 to 10 fathoms. It is noticeable that the greater part of the circumference of the atoll is surrounded by land. The "Equatorial Channel," 48 miles across, separates Addu and Suvadiva. In its centre is the island of Fua Mulaku, said to have a deep kuli (lake) in its midst; it is two miles long by one broad, and has a fringing reef only. On our passage to Addu, and subsequently on our return journey, we tried to visit it, but the heavy sea made both anchoring and landing quite impossible. We remained at Addu until April 15, examining the reefs and islands, in both of which there have been great changes since Moresby's survey. We also checked the soundings on the chart, and took 14 hauls of the dredge in the lagoon and on the outer slopes. In one of the latter from 40 fathoms we obtained a large quantity of *Heliopora coerulea* with almost colourless corallum. The vegetation of the islands was far more luxuriant than any we saw in other parts of the Maldives, but the land fauna was very scanty as compared with Hulule. The animal life of the encircling reefs seemed to be both poorer and less varied than to the north; the growth of fixed forms of life in the lagoon was, however, decidedly lavish.

Revisiting Suvadiva on our return journey, we dredged and sounded within the lagoon along the south and west sides, anchoring for three nights at Gaddu, Nadalle and Havara-Tinadu, beyond which I did not land anywhere. On April 19th we entered Kolumadulu, having in the morning coasted along the east side of Haddumati. We dredged the passage, as we entered, and dropped anchor at Buruni, at once going on shore.

On April 20 we ran a line of soundings across to S. Nilandu, an atoll somewhat similar to Male. We twice traversed the lagoon, anchoring that night at Rimbudu. Six dredgings were taken in 19 to 35 fathoms; they proved to be in their result the richest series that were obtained in the whole archipelago, although I do not think we found any forms of which we had not previously preserved specimens.

On April 21 we sounded the channel across to N. Nilandu atoll, which we crossed. We then ran a line of soundings to Wattaru atoll across the central basin, which has very generally been supposed to owe its origin to the lagoon of a much larger atoll, now completely lost. We further sounded the channel between Mulaku and Wattaru atolls, anchoring for the night off Rakidu in Felidu atoll. On April 22nd we sounded the channel between Felidu and Wattaru atolls, and then ran a second line across to the western chain, about 15 miles north of the first. We sounded the channel between N. Nilandu and Ari atolls, continuing northwards sounding at intervals to Mahiaddu in the latter atoll, where we dropped anchor. On April 23rd we made a straight course for Male, putting down our third line of soundings across the central basin. We ran our line out

along the channel between N. and S. Male atolls, obtaining finally a depth of 1005 fathoms, two miles S.W.  $\frac{1}{4}$  W. of the S. point of the reef of Hulule faro. That night we anchored off Male and, after taking our collections on board, bade good-bye to the Maldives on April 25, 1900.

The collections may be allowed to speak for themselves in the subsequent parts of this publication. A word is necessary as to the dredgings, of which 273 were recorded in the Maldives. They were intended to ascertain the character of the bottom within the atolls as well as its fauna in every position, in which the physical conditions might vary. Naturally a considerable number were under these circumstances absolutely barren, but all served their purpose. Seven dredges were used, both rectangular and triangular, of Naples or Plymouth models, as well as an otter and three beam trawls of 3,  $4\frac{1}{2}$  and 6 feet. The latter were made to my own design, an adaptation of Prof. Agassiz' model; they were for trawling from the steamer weighted with fire-bars; their nets were of coconut fibre (sinnet or coir), and were made by my boys. Swabs of hempen rope, three feet long, were found best adapted to our work; they were always thrown overboard, when we were at anchor, about one fathom of rope being allowed beyond the depth, if the bottom was fairly level. For sounding from the schooner and small boats, besides regular lead lines, we used loosely spun cod-fishing line, as recommended by Mr J. Y. Buchanan. On the steamer we had an old Lucas deep-sea machine, which was lent us by the Admiralty, Mr Lucas kindly providing about 3000 fathoms of wire. Of leads we employed the Telegraphic Construction and Maintenance Company's snapper, and valved leads of the Admiralty pattern. Other apparatus and instruments will be referred to where necessary in the account of the work of the expedition.

J. STANLEY GARDINER<sup>1</sup>.

[Note. The collections of plants have been presented to the Royal Botanical Gardens, Peredeniya, Ceylon. A full report on them will be shortly published in the "Journal of the Gardens" by Mr J. C. Willis, the Director. J. S. G.]

<sup>1</sup> This account has been checked by Mr L. A. Borradaile and Mr Forster Cooper.