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MADRAS GOVERNMENT MUSEUM.

Bulletin No. 1.

PEARL AND CHANK FISHERIES

OF THE

GULF OF MANAAR.

BY

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Government of Madras.

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PREFACE.

IN 1890, my 'Notes on the Pearl and Chank Fisheries and Marine Fauna of the Gulf of Manaar' were published in a single volume; and a friendly critic pointed out that the effect thereof was somewhat marred by their publication together, and by the arrangement adopted.

The edition being exhausted, and fresh material awaiting incorporation, I have taken advantage of the opportunity to commence a series of bulletins, dealing with the results of my wanderings on behalf of the Madras Museum; and send forth the first issue in the form of a revised edition of the 'Note on Pearl and Chank Fisheries,' leaving the 'Marine Fauna of the Gulf of Manaar' to be dealt with hereafter.

EDGAR THURSTON.

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DESCRIPTION OF PLATES.

PLATE I.

Pearl oyster (natural size) with one valve of the shell removed:—

- a. byssus filaments with fragments of coral, from which they have been torn by the diver, attached;
- b. adductor muscle;
- c. 'ovarium,' wherein the pearls are situated;
- d. mantle.

PLATE II.

Fig. I. Section of pearl oyster, magnified:—

- a. alimentary canal;
- b. liver;
- c, c. generative tubes;
- d. organ of Bojanus.
- e, e. sections of parasites encysted between the alimentary canal and generative tubes.

Fig. II. Section of pearl oyster, magnified, showing portion of the byssus gland with the filaments arranged in laminae, and invested by muscular and connective tissue.

PLATE III.

Fig. I. Section of pearl oyster, less highly magnified than the preceding, showing the byssus gland with its laminae, invested by muscular and connective tissue, and surrounded by generative tubes.

Fig. II. Section of pearl oyster, magnified, showing ovum imbedded among generative tubes.

PLATE III-A.

Specimen of *Rhinodon typicus* preserved in the Madras Museum (length 2 feet).

PLATE IV.

Chank shell (*Turbinella rapa*), natural size.

" Know you, perchance, how that poor formless wretch—
The Oyster—gems his shallow moonlit chalice?
Where the shell irks him, or the sea-sand frets,
This lovely lustre on his grief."

Edwin Arnold.

I.—TUTICORIN PEARL FISHERY.

TUTICORIN, the "scattered town," situated in the Tinnevely district on the south-west coast of the Gulf of Manaar, from which the Madras Government pearl fisheries are conducted, is, according to Sir Edwin Arnold,¹ a sandy maritime little place, which fishes a few pearls, produces and sells the great pink conch shells, exports rice and baskets, and is surrounded on the land side by a wilderness of cocoa and palmyra palms. Summed up in these few words, it does not appear the important place which, in spite of its lowly aspect when viewed from the sea and the seeming torpor which reveals itself to the casual visitor, it is in reality. For not only is it a medium of communication between Tinnevely and Ceylon, to and from which hosts of coolies are transported in the course of every year, but it is also an important mercantile centre for the shipment of Tinnevely cotton (the most valuable of the cottons grown in the Madras Presidency), jaggery,² (molasses), onions, chillies, etc.

With respect to the shipment of jaggery, I was told, during a visit to Tuticorin, that, during the seasons at which jelly-fish abound in the muddy surface water of the Tuticorin harbour, so great is the dread of their sting, that coolies, engaged in carrying loads of jaggery on their heads through the shallow water to the cargo boats, have been known to refuse to enter the water until a track, free from jelly-fish, was cleared for them by two canoes dragging a net between them.

¹ *India Re-visited*, 1887.

² "The fresh juice of the palmyra palm, if boiled down, yields molasses or jaggery, from which sugar may be refined. The juice collected for this purpose has a small piece of lime placed in it to prevent fermentation while suspended from the tree."—(*Dict. Econom. Prod.*),

Tuticorin is, indeed, as Sir Edwin Arnold records, "an abominable place to land at." Nature has unfortunately ordained that large vessels are unable to approach nearer to the shore than a distance of six miles or thereabouts. A due regard for their safety compels them to lie at anchor outside Hare Island, one of a number of coral-girt islands in the neighbourhood, where hares and partridges may be shot, and sluggish holothurians (*béches de mer*) captured in abundance at low tide as they lie impassive on the sandy shore, which is strewn with broken coral fragments, detached by wave-action from the neighbouring reef, and riddled with the burrows of nimble oecypods (*O. macrocera* and *O. ceratophthalma*.)

Not far from the north end of the town of Tuticorin, on the sandy shore, are the kilns, in which corals, coarse mollusc shells (*Ostræa*, *Venus*, *Cardium*, &c.) and melobesian nodules (calcareous algæ) are burned and converted into *chunâm*,³ i.e., prepared lime used for building purposes, and by natives for chewing with their beloved betel (the leaves of *Piper Betle*). A Native friend informs me that in Northern India pearls are bought by wealthy natives to be used instead of *chunâm* with the betel. In India relations and friends put rice into the mouth of the dead before cremation, while in China seed pearls are used for the same purpose.

During my visit to Tuticorin in 1887, I used to watch, almost daily, grand, massive blocks of *Porites*, *Astræa*, and various species of other reef-building coral genera, being brought in canoes from the reefs, and thrown into the ground to form the foundation of the new cotton mills, which, in consequence, bear the name of the Coral Mills.

Lecturing at the Royal Institution⁴ on the "Structure, Origin, and Distribution of Coral Reefs and Islands," Mr. John Murray stated that "if we except Bermuda and one or two other outlying reefs where the temperature may occasionally fall to 66° Fahr. or 64° Fahr., it may be said that reefs are never found where the surface temperature of the water, at any time of the year, sinks below 70° Fahr., and where the annual range is greater than 12° Fahr. In typical coral reef regions, however, the temperature is

³ The familiar house frog (*Rhacophorus maculatus*) of Madras is popularly known as the *chunâm* frog from its habit of sticking by means of the discs on its toes on to the *chunâm* walls of dwelling houses.

⁴ March 16, 1888.

higher and the range much less." No regular series of records of the temperature of the water in the coral-bearing Gulf of Manaar has as yet been made. The surface temperature, which I recorded from time to time during my visit to Rânésvaram island in the latter half of July, 1888, varied from 79° Fahr. to 91° Fahr. between the hours of 7 A.M. and 6 P.M.

The following table shows the temperature range of Tuticorin during the year 1887, the readings being taken in the shade at 10 A.M. and 4 P.M. :—

			Range.	Min.	Max.
January	..	..	9°	75°	84°
February	..	..	6°	78°	84°
March	..	..	9°	80°	89°
April	..	..	12°	79°	91°
May	..	..	13°	83°	96°
June	..	..	9°	86°	95°
July	..	..	10°	86°	96°
August	..	..	11°	84°	95°
September	..	..	9°	85°	94°
October	..	..	6°	80°	86°
November	..	..	7°	79°	86°
December	..	..	11°	75°	86°

Tuticorin has been celebrated for its pearl fishery from a remote date, and, as regards comparatively modern times, Friar Jordanus, a missionary bishop, who visited India about the year 1330, tells us that as many as 8,000 boats were then engaged in the pearl fisheries of Tinnevely and Ceylon.

In more recent times the fishery has been conducted, successively, by the Portuguese, the Dutch, and the English. The following excellent description by Martin of the pearl fishery in the year 1700, during the Dutch occupation of Tuticorin, shows that the method of fishing adopted at that time agrees, in its essential characteristics, with that which is in vogue at the present day :—

"In the early part of the year the Dutch sent out ten or twelve vessels in different directions to test the localities in which it appeared desirable that the fishery of the year should be carried on; and from each vessel a few divers were let down who brought up each a few thousand oysters, which were heaped upon the shore in separate heaps of a thousand each, opened and examined. If the pearls found in each heap were found by the appraisers to be worth an *écu* or more, the beds from which the oysters were taken were held to be capable of yielding a rich harvest; if they were worth no more than thirty sous, the

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As to the cause of the failure of the pearl oysters to reach maturity on the banks in large numbers, in recent times, except after long intervals, I for my part confess my ignorance. Whether the baneful influence of the mollusca known locally as *súran* (*Modiola*, sp.) and killikay (*Avicula*, sp.), the ravages of rays (*Trygon*, &c.) and file-fishes (*Balistes*), poaching, the deepening of the Pámban channel, or currents are responsible for the non-production of an abundant crop of adult pearl-producing oysters during more than a quarter of a century (1862-89) it would be impossible to decide, until our knowledge of the conditions under which the pearl oysters live is much more precise than it is at present.

The argument that the failure of the pearl fishery is due to poaching is from time to time, brought forward; but, as Mr. H. S. Thomas wisely and characteristically remarks: ⁵ "The whole system of the fishery has been carefully arranged, so that every one in any way connected with it has a personal stake in preventing poaching, and oyster poaching is not a thing that can be done in the night; it must be carried out in broad daylight; and, to be worth doing at all, it must be done on a large scale. Ten thousand oysters cannot be put in one's pocket like a rabbit, nor are there express trains and game-shops to take them. Every single oyster has to be manipulated, and it is only the few best that can be felt at once with the finger, and the usual way is to allow the oyster to rot and wash away from the pearl. Oysters could not be consigned fresh in boxes or hampers by rail to distant confederates; they could not even be landed without its becoming known; and, if known, every one is interested in informing the Government officer and stopping poaching." I cannot, however, refrain from quoting the following touching description of an ideal poach in a recent pamphlet: "Mutukuruppan and Kallymuttu are two fishermen brothers: they start out after their cold rice, ostensibly to get their lines ready in their canoe, and paddle away to their fishing ground; there they drop their stone anchor: presently one observes that it is warm and he would like a bathe; over the side he goes down by his mooring rope to see what the bottom is like. He brings up a handful of oysters and gives them to Thamby; then Thamby thinks

⁵ Vide Report on Pearl Fisheries and Shank Fisheries, 1884, by the Hon. Mr. H. S. Thomas.

he would like a bathe, and he goes down also, and brings up a fist full. When they are tired, they get back into the canoe and open their spoils, taking out what pearls they can find, and pitching the shells back into the sea. This sort of thing goes on day after day and year after year up and down the coast, and this will partially account for the dead shells so often found on the banks. Is it to be wondered at that oysters take alarm at this constant invasion of their domain and naturally seek some other place of rest?"

Far more prejudicial to the welfare of the oysters than an occasional raid upon them by a stray Mutukurupam or Kallymuttu is, in all probability, the little mollusc, *súran*, which clusters in dense masses over large areas of the sea bottom, spreading over the surface of coral blocks, smothering and crowding out the recently deposited and delicate young of the oyster. Time after time there is, in the carefully kept records of the superintendent of the pearl banks, in one year a note of the presence of young oysters, either pure or mixed with *súran* and mud or weed, while, at the next time of examination, generally in the following year, it is noted that the oysters have disappeared, and the *súran* remained. A few examples will suffice to make this point clear:—

Deví Par ⁶— to $6\frac{1}{2}$ to $7\frac{1}{4}$ fathoms.

May, 1881. Young oysters mixed with sooram ⁷ and mud.
 „ 1882. Sooram.

Permandu Par—6 to $6\frac{1}{4}$ fathoms.

May, 1880. A few oysters of one year age.
 „ 1881. Young oysters mixed with sooram and mud.
 „ 1882. Sooram.

Athombadu Par— $7\frac{1}{4}$ to 9 fathoms.

May, 1880. Covered with sooram.
 „ 1881. Large number of oysters of one year age, with sooram in some places and covered with weeds.
 „ 1882. No oysters; sooram in some places.

The bank, which was fished during the fishery of 1889, is situated about 10 miles east of Tuticorin, and known as the

⁶ *Par* or *paar* = bank.

⁷ *Sooram* = *súran*.

beds were considered unlikely to yield a profit over and above the expense of working them. As soon as the testing was completed, it was publicly announced either that there would, or that there would not be a fishery that year. In the former case enormous crowds of people assembled on the coast on the day appointed for the commencement of the fishery; traders came there with wares of all kinds; the roadstead was crowded with shipping; drums were beaten, and muskets fired; and everywhere the greatest excitement prevailed, until the Dutch Commissioners arrived from Colombo with great pomp, and ordered the proceedings to be opened with a salute of cannon. Immediately afterwards the fishing vessels all weighed anchor and stood out to sea, preceded by two large Dutch sloops, which in due time drew off to the right and left and marked the limits of the fishery, and when each vessel reached its place, half of its complement of divers plunged into the sea, each with a heavy stone tied to his feet to make him sink rapidly, and furnished with a sack into which to put his oysters, and having a rope tied round his body, the end of which was passed round a pulley and held by some of the boatmen. Thus equipped, the diver plunged in, and on reaching the bottom, filled his sack with oysters until his breath failed, when he pulled a string with which he was provided, and, the signal being perceived by the boatmen above, he was forthwith hauled up by the rope, together with his sack of oysters. No artificial appliances of any kind were used to enable the men to stay under water for long periods; they were accustomed to the work almost from infancy, and consequently did it easily and well. Some were more skillful and lasting than others, and it was usual to pay them in proportion to their powers, a practice which led to much emulation and occasionally to fatal results. Anxious to outdo all his fellows, a diver would sometimes persist in collecting until he was too weak to pull the string, and would be drawn up at last half or quite drowned, and very often a greedy man would attack and rob a successful neighbour under water; and instances were known in which divers who had been thus treated took down knives, and murdered their plunderers at the bottom of the sea. As soon as all the first set of divers had come up, and their takings had been examined and thrown into the hold, the second set went down. After an interval, the first set dived again, and after them the second; and so on turn by turn. The work was very exhausting, and the strongest man could not dive oftener than seven or eight times in a day, so that the days' diving was finished always before noon.

"The diving over, the vessels returned to the coast and discharged their cargoes; and the oysters were all thrown into a kind of park, and left for two or three days, at the end of which they opened and disclosed their treasures. The pearls, having been extracted from the shells, and carefully washed,

were placed in a metal receptacle containing some five or six colanders of graduated sizes, which were fitted one into another so as to leave a space between the bottoms of every two, and were pierced with holes of varying sizes, that which had the largest holes being the topmost colander, and that which had the smallest being the undermost. When dropped into colander No. 1, all but the very finest pearls fell through into No. 2, and most of them passed into Nos. 3, 4, and 5; whilst the smallest of all, the seeds, were strained off into the receptacle at the bottom. When all had staid in their proper colanders, they were classified and valued accordingly. The largest, or those of the first class, were the most valuable, and it is expressly stated in the letter from which this information is extracted that the value of any given pearl was appraised almost exclusively with reference to its size, and was held to be affected but little by its shape and lustre. The valuation over, the Dutch generally bought the finest pearls. They considered that they had a right of pre-emption. At the same time they did not compel individuals to sell, if unwilling. All the pearls taken on the first day belonged by express reservation to the King or to the Sétupati according as the place of their taking lay off the coasts of the one or the other. The Dutch did not, as was often asserted, claim the pearls taken on the second day. They had other and more certain modes of making profit, of which the very best was to bring plenty of cash into a market where cash was not very plentiful, and so enable themselves to purchase at very easy prices. The amount of oysters found in different years varied infinitely. Some years the divers had only to pick up as fast as they were able, and as long as they could keep under water; in others they could only find a few here and there. In 1700 the testing was most encouraging, and an unusually large number of boat-owners took out licenses to fish; but the season proved most disastrous. Only a few thousands were taken on the first day by all the divers together, and a day or two afterwards not a single oyster could be found. It was supposed by many that strong under-currents had suddenly set in owing to some unknown cause. Whatever the cause, the results of the failure were most ruinous. Several merchants had advanced large sums of money to the boat-owners on speculation, which were, of course, lost. The boat-owners had in like manner advanced money to the divers and others, and they also lost their money."

In the present century the following fisheries have taken place:—

1822	..	..	..	profit	£13,000.
1830	..	..	..	do.	£10,000
1860-62	..	..	..	do.	Rs. 3,79,297
1889	..	..	..	do.	„ 1,58,488
1890	..	..	..	do.	„ 7,803

Tholayiram Par, the condition of which, as regards oyster supply, since the year 1860, is shown by the following extract from the records of the superintendent of pearl banks :—

April, 1860. Plenty of oysters 3½ years old.
 Nov., 1861. Oysters scarce; nearly all gone.
 April, 1863. Sooram and killikay with some young oysters.
 Nov., 1865. }
 April, 1866. } Blank.
 " 1867. }
 Nov., " }
 April, 1869. }
 Mar., 1871. Five oysters with a quantity of sooram.
 Feb., 1872. Five oysters of 3 years age found.
 May, 1873. Three oysters found.
 Jan., 1875. Three oysters of 2 years age found.
 Mar., 1876. North part blank.
 April, 1877. South part blank.
 " 1878. Thickly stocked with oysters of 1 year age.
 May, 1879. } Blank.
 " 1880. }
 " 1881. Some oysters of 1 year mixed with killikay.
 " 1882. No living oysters; dead shells and sooram.
 April, 1883. Three oysters found.
 Mar., 1884. Plenty of oysters of one year age; clean and healthy.

From 1884 the Tholayiram Par was carefully watched, and the growth of the oysters continued steadily, unchecked by adverse conditions, as the following figures show :—

10 shells lifted. {
 March, 1884 weighed 1 oz.
 October, " " 3½ "
 March, 1885 " " 6½ "
 October, " " 7 "
 April, 1886 " " 7½ "
 November, " " 8½ "
 March, 1887 " " 10½ "
 October, " " 13 "
 November, 1888 " " 15½ "

In November, 1888, 15,000 oysters were lifted, and their product valued by expert pearl merchants at Rs. 206-13-9, i.e., Rs. 13-12-8 per thousand,* as shown by the following copy of the statement of valuation :—

* The product of 12,000 oysters lifted from the Ceylon pearl bank, the fishing of which took place synchronously with that of the Tuticorin bank, in November, 1888, was valued at Rs. 122. A further sample of 12,650 oysters, lifted in February, 1889, was valued at Rs. 142.

Description.	Size in basket.	Number.	Quantity in chevu.	Weight.		Value.	Total value.	Per chevu.	Per kalungy.
				Kalungy.	Manjady.				
Ani	20	1	158/320	1½	1½	RS. A. P. 43 3 0	43 3 0	25 star pagodas.	22 star pagodas.
Kurunel	30	1	25/320	1½	1½	4 6 0	4 6 0	do.	10 do.
Kalippu	50	6	45/320	1½	1½	7 14 0	7 14 0	do.	5 do.
Pisal	50	3	...	1½	1½	0 10 0	0 10 0	do.	1 do.
Kodai	20	4	...	1½	1½	0 10 3	0 10 3	do.	7 do.
Vadivu	100	...	176/320	1½	1½	77 0 0	77 0 0	...	3½ do.
Do.	200	...	112/320	1½	1½	5 7 6	5 7 6	...	...
Pisal	400	...	64/320	1½	1½	7 0 0	7 0 0	...	...
Kodai	...	...	...	1½	1½	0 5 6	0 5 6	...	...
Tul	600	...	...	1½	1½	42 14 0	42 14 0	...	...
Mosie	800	...	...	1½	1½	16 6 6	16 6 6	...	...
Shell pearl	1,000	...	...	1½	1½	1 1 0	1 1 0	...	...
Total ...							206 13 9	Average per 1,000 oysters ...	
							13 12 8		

sieur Humbert, a Swiss zoologist, has, by his own observations at the last pearl fishery, corroborated all I have stated about the ovaria or genital glands and their contents, and he has discovered, in addition to the filaria and cercaria, three other parasitical worms infesting the viscera and other parts of the pearl oyster. We both agree that these worms play an important part in the formation of pearls, and it may yet be found possible to infect pearls in other beds with these worms, and thus increase the quantity of these gems. The nucleus of an American pearl drawn by Möbius is nearly of the same form as the cercaria found in the pearl oysters of Ceylon."

The Gulf of Manaar pearl oyster (*Avicula fucata*, Gould) is represented in plate I, as it appears after removal of one valve of the shell, the "ovarium," mantle, gills, adductor muscle and byssus being exposed.

Plates II and III, reproduced from drawings made from micro-photographs of sections of a pearl oyster from the Tuticorin banks, illustrate some of the points in the structure of the animal.

In plate II-2 and plate III-1, the byssus gland is shown with the parallel rows of laminae, to which are attached the numerous fine, green, silky filaments, of which the byssus is made up. This byssus is capable of being protruded beyond or retracted within the shell, and by means of it the animal is able to anchor itself on the sea-bottom, to a neighbouring oyster or other molluscan shell, coral-rock, melobesian nodule, or other convenient object, and it is said that the animal can, even in the adult stage, voluntarily shift its quarters and migrate to a considerable distance. That the young oyster can, during its phase of existence as a minute, free-swimming organism, wander about and eventually settle down on some congenial spot no one will dispute; but the evidence that the adult can, under natural conditions, migrate to any considerable distance is wholly insufficient, even though it has been demonstrated by experiments that a young pearl-oyster, under unnatural conditions in a soda-water tumbler full of sea-water can, though weighted with two other oysters of nearly its own size, climb up a smooth vertical surface at the rate of an inch in two minutes. The disappearance of about 150,000,000 oysters ripe for fishing from one of the Ceylon banks in 1888 must, I think, be attributed either to the action of a strong under-current which tore out the byssus from its gland, setting free the oysters from their moorings, or to one of those unknown

It may not be out of place to elucidate the meaning of some of the terms used in the above statement, and I cannot do better than quote from the excellent article on the Pearl Fisheries of Ceylon by Mr. G. Vane, C.M.G., who writes as follows⁹ :—

“Sorting and sizing the pearls into ten different sizes, from the largest to the smallest, is done by passing them through ten brass sieves of 20, 30, 50, 80, 100, 200, 400, 600, 800, and 1,000 holes each of the ten sizes may include some of every class of pearls; the 20 to 80 and 100 may each have the *āṇi*, *anātari*, and *kallipú* kinds, and this necessitates the operation of classing, which requires great judgment on the part of the valuers.

“Perfection in pearls consists in shape and lustre, viz., sphericity and a silvery brightness, free from any discolouration; and, according as the pearls possess these essentials, the valuers assign their appropriate class, namely,—

- | | |
|------------------------|---|
| “ <i>Āṇi</i> | Perfect in sphericity and lustre. |
| “ <i>Anātari</i> | Followers or companions, but failing somewhat in point of sphericity or lustre. |
| “ <i>Masaṅkú</i> | Imperfect, failing in both points, especially in brilliancy of colour. |
| “ <i>Kallipú</i> | Failing still more in both points. |
| “ <i>Kural</i> | A double pearl, sometimes <i>āṇi</i> . |
| “ <i>Pisal</i> | Misshapen, clustered, more than two to each other. |
| “ <i>Maḍaṅku</i> | Folded or bent pearls. |
| “ <i>Vaḍivu</i> | Beauty of several sizes and classes. |
| “ <i>Tál</i> | Small pearls of 800 to 1,000 size. |

“The pearls having been thus sized and classed, each class is weighed and recorded in *kaḷañchu* (kalungy) and *mañchāḍi* (manjadaḍy).

“The *kaḷañchu* is a brass weight equal, it is said, to 67 grains Troy. The *mañchāḍi* is a small red berry¹⁰; each berry, when full sized, is of nearly, or exactly the same weight; they are reckoned at twenty to the *kaḷañchu*.

“The weights being ascertained, the valuation is then fixed to each pearl class or set of pearls according to the respective sizes and classes: the inferior qualities solely according to weight in *kaḷañchu* and *mañchāḍi*; the superior *āṇi*, *anātari*, and, *vaḍivu* are not valued only by weight, but at so much *per chevu* of their weight, this *chevu* being the native or pearl valuer’s

⁹ *Journal, Ceylon Branch, Royal Asiatic Society*, 1887, vol. X, No. 34. Paper read at the Conference Meeting of the Colonial and Indian Exhibition, October 6, 1886.

¹⁰ The seeds of *Abrus precatorius*, which are used in India for poisoning cattle.

mode of assigning the proper value by weight to a valuable article of small weight, form and colour also considered.”

The pearls of commerce are, of course, for the most part those which are formed within the soft tissues of the animal, and not the irregular pearly excrescences (*oddumutta*) which are found as outgrowths of the nacreous layer of the shell, frequently at the point of insertion of the adductor muscle. The nacreous layer of the Gulf of Manaar pearl-oyster shell is very thin, and of small commercial value as compared with that of the pearl-oyster of Queensland and the Mergui Archipelago (*Avicula margaritifera*); and the shells, after the extraction of the pearls by the process of decomposition, are used mainly in the manufacture of chunám. The shells are, I believe, also exported to England from Ceylon for manufacture into buttons.

As regards the cause of the formation of pearls, concerning which many theories have been hazarded, the most prevalent idea being that they are a morbid secretion produced as the result of disease, I may quote from the excellent ‘Guide to the Shell and Starfish Galleries in the British Museum (Natural History),’ 1888, which tells us that “some small foreign body, which has accidentally penetrated under the mantle and irritates the animal, is covered with successive concentric layers of nacre, thus attaining sometimes, but rarely, the size of a small filbert. The nacre is generally of the well-known pearly-white colour, very rarely dark, and occasionally almost black.¹¹ The effort of the animal to get rid of the irritation caused by a foreign substance between its valves, by covering it over with nacre, and thus converting it into a pearl, is strikingly illustrated by two specimens in which, in the one case, an entire fish, and, in the other, a small crab has been so enclosed.” According to Streeter¹² the nucleus of the pearl may be either a grain of sand, the frustule of a diatom, a minute parasite, or one of the ova of the oysters, thin layers of carbonate of lime being deposited around the object concentrically, like the successive skins of an onion, until it is encysted.

Writing in 1859¹³ as to what may be termed the worm theory of pearl formation, Dr. Kelaart stated that “Mon-

¹¹ Among the pearls from the samples lifted at Tuticorin in November 1888, there is one dumb-bell shaped specimen, of which one-half is white, the other dark brown.

¹² *Pearls and Pearling Life*, 1886.

¹³ *Report on the Natural History of the Pearl Oyster of Ceylon*, 1858-59.

agencies by which gregarious animals, fishes, bivalve molluscs, &c., are occasionally known to be killed off wholesale and transported to a considerable distance. That the disappearance of the oysters was due to their voluntarily migrating, like snipe, seems improbable.

In plate II-1 the tissues which intervene between the alimentary canal and generative organs are seen to contain two parasites, which careful microscopical examination has shown to be undoubtedly larvæ of some platyhelminthian (flat-worm), the life history of which is unknown, and would require long and patient inquiry to ascertain. Similar parasites were found, on microscopical examination, to be very abundant in the alimentary canal, from which some of them must have bored their way, as ciliated larvæ, into the surrounding tissues, while others remained to develop within the alimentary canal. It is not improbable that these minute parasites may form in the tissues foci favourable to the laying down of layer after layer of nacreous deposit.

In plate III-2 an ovum is represented among the generative glands. This ovum was the only one found during the examination of a number of sections; and it has been suggested to me that it may be the ovum of the parasite referred to.

In September, 1890, I paid a hurried visit to Tuticorin in order to examine some living oysters, and the divers went out to the banks, and brought in a sample of about seventy oysters. The living animals I cut open by a vertical longitudinal section, and found, in a large majority of them, the genital duct occupied by a long, transparent, cylindrical, gelatinous body, which could be easily removed entire from the duct. Unfortunately I had no microscope with me, but a number of the tubes were placed in alcohol and submitted to microscopical examination on my return to Madras, small portions of the tubes being teased out on a slide and treated with various reagents. They were found to contain diatoms, and vast numbers of delicate sinuous bodies. In order to see if these bodies were possessed of motion, an attempt was made about a fortnight later to get some oysters alive in a tank of sea-water by train from Tuticorin to Madras. The hot railway journey, however, of nearly thirty hours proved fatal to them, though they were, on their arrival, sufficiently fresh for purposes of examination. The gelatinous bodies were now no longer present, and scrapings from the internal surface of the duct, only revealed under the microscope,

divers could together send up 12,000 shells an hour in shallow water, or, allowing for delay in hauling up in 12 fathoms of water, say, 9,000 shells an hour; and as, allowing for shifts, each diver should work four hours a day, the quantity sent up by a pair of divers in a day would be respectively $4 \times 12,000 = 48,000$, or $4 \times 9,000 = 36,000$ shells a day, which is equivalent to the work of 24 or 18 naked native divers sending up 2,000 shells a day.

The results of the work done by the two helmeted divers who were employed as an experiment at the Tuticorin fishery for some inexplicable reason fell far short of this estimate, and compared very unfavourably with the work done by the skilled native divers without helmets.

The diving operations cease for the day some time after noon, and the boats, if aided by a favourable sea breeze, reach the shore by 4 p.m., their arrival being awaited by large crowds of natives, some of whom come from curiosity, others to speculate on a small scale. On reaching the shore the boats are quickly made fast in the sand, and the oysters carried on the heads of the divers into the kottu, where they are divided into separate heaps, each set of divers dividing their day's haul into three equal portions. One of these, selected by the Superintendent of the fishery or some other official, becomes the property of the divers, who quickly remove their share from the kottu, and, squatting on the sand, put their oysters up for sale at prices varying from about fifteen to forty for a rupee. On the first day of the fishery the oysters, for a short and, to the divers, lucrative time, were sold for four annas a piece. The two heaps which are left by the divers in the kottu, become the property of Government, and are counted by coolies engaged for the purpose. Usually about 6 p.m. the Government oysters are sold by public auction, duly announced by tom-tom, and put up in lots of one thousand. The purchaser can, subject to the consent of the auctioneer, take a certain number of thousands at the same rate as his winning bid. Occasionally a combination is organised among the merchants who are buying on a large scale, and come to the auction determined not to bid more than a very small fixed sum per thousand. A struggle then takes place between the auctioneer and merchants, the former refusing to sell, the latter refusing to raise their price; and the struggle invariably ends in the collapse of the merchants, when they find that their supply of oysters is cut off. No credit is allowed, and the buyers, as soon as they have paid their

money into the treasury, remove their oysters to the washing kottus, or send them away up-country by railway.

Buyers of oysters on a very small scale open them at once with a knife, and extract the pearls by searching about in the flesh of the animal; but, by this method, a number of the very small pearls are missed, and it would be impossible to carry it out when dealing with oysters in large numbers. Boiling the oysters in water and subsequent extraction of the pearls from the dried residue might be, with advantage, resorted to as a more wholesome and less unsavoury process than the one which is resorted to of leaving the oysters to putrify in the sun, and subsequently extracting the pearls from the residue after it has been submitted to repeated washings to free it from the prevailing maggots, pulpy animal matter, sand, &c. The process of putrefaction is greatly aided by flies—big red-eyed blue-bottles. At the Ceylon pearl fishery, which I was sent to inspect on the termination of my work at Tuticorin, the merchants complained at first of the scarcity of flies; but, later on, there was no cause for complaint, as they were present not only in the kottus, but in other parts of the camp, in such enormous numbers as to form a veritable plague, covering our clothes with a thick black mass, and rendering the taking of food and drink a difficult and unpleasant process until the evening, when they went to rest after twelve hours of unceasing activity.

To those who are in authority, a pearl fishery is a time of constant anxiety. The probabilities are delightful, but the possibilities are frightful. When all goes well a fishery is a time of money-making to all concerned, to the Government, the merchants, the divers and boatmen. But there is to those who are responsible the constant dread of epidemic disease—notably cholera—which may appear at any moment and ruin the expectation of a prosperous fishery. Such an invasion of cholera, bringing with it death and panic, I witnessed in 1889 at the Ceylon fishery, which collapsed entirely in consequence thereof, the camp being burned down and the fleet of nearly two hundred boats, with their panic-stricken crews, disappearing within the space of only a few hours.

The prospects of a pearl fishery may, when success seems certain, be abruptly ruined by accidents from sharks, of which the divers have a superstitious but not altogether unreasonable dread. Before the fishery of 1889, I read in the *Times of Ceylon*, that there were 150 boats, with their full

ciliated epithelium, leptothrix, &c. The conclusion which must, I think, be arrived at is that the sinuous bodies are the spermatozoa compacted by a gelatinous secretion into spermatophores, and are probably subsequently discharged from the genital duct for the direct or indirect fertilisation of another oyster.

The Tuticorin pearl fishery of 1889 was carried on from a temporary improvised village, erected on the barren sandy shore at Salá patturai, two miles north of the town, and built out of palmyra and bamboo, the inflammability of which was demonstrated on more than one occasion when the camp was, for a short time, in danger of being burnt to the ground. The village consisted of the divers' and merchants' quarters and bazárs, where, as the fishing progressed, the product of the oysters was exposed for sale; bungalows for the officials connected with the fishery; a tent used by myself as a marine zoological laboratory; dispensary; kottus or koddus (*i.e.*, enclosed spaces in which the counting, decomposition, and washing of the oysters are carried on); a Roman Catholic chapel; and the inevitable and highly necessary isolated cholera quarters.

The fishery commenced on the 25th of February under a combination of adverse conditions which seriously affected the revenue, viz., the fact that the pearl bank was at a distance of ten miles from the shore and in 10 fathoms of water, and the co-existence of a fishery on the Ceylon coast, where the oysters were to be obtained at a distance of about five miles from the shore and at a depth of five to seven fathoms. The natural result was that the natives, more keen as to their own interests than those of the Government, went off with their boats from the Madras seaport towns of Pámban and Kílakarai to the Ceylon fishery, where they could earn their money more easily and with less discomfort than at Tuticorin, leaving the Tuticorin bank to be fished by a meagre fleet of about forty boats.

An excellent account of the method of conducting the pearl fishery at Tuticorin has been published in the 'Hand-Book of Directions to the Ports in the Presidency of Madras and Ceylon,' 1878, from which the following varies only in points of detail.

The landwind, under favourable conditions, commences to blow soon after midnight, and a signal gun is fired by the beach master as a warning that the fleet of native boats, each with its complement of native divers, can start out to

sea. Their departure is accompanied by a good deal of noise and excitement. The bank should be reached by daylight, and the day's work commences on a signal being given from a schooner, which is moored on the bank throughout the fishery. An attempt is made to keep the boats together within an area marked out by buoys, so as to prevent the bank from being fished over in an irregular manner; and the temper of the European officer in charge of the schooner is sorely tried by the refusal of the boatmen to comply with the conditions. All being ready on board, a diving stone, weighing about thirty lbs., to which a rope is attached, and a basket or net fastened in a similar manner, are placed over the boat's side. The ropes are grasped by the diver (who wears no diving dress) in his left hand, and, placing a foot on the stone, he draws a deep breath, and closes his nostrils with his right hand, or with a metal nose clip which he wears suspended round his neck by a string. At a given signal the ropes are let go, and the diver soon reaches the bottom, his arrival there being indicated by the slackening of the rope. He then gets off the diving stone, which is drawn up to the surface, and, after filling the basket or net with oysters, if he is on a fertile spot, gives the rope a jerk, and comes up to the surface to regain his breath.

The contents of the basket or net are emptied into the boat, and the live oysters separated from the dead shells, débris, &c. The divers work in pairs, two to each stone, and the oysters which they bring up are kept separate from those of the other divers. A good diver will remain below the surface about fifty seconds, and, in exceptional cases, sixty, seventy, or even ninety seconds.

The largest number of oysters collected as the result of a single day's fishing by forty-one boats during my visit to the fishery was 241,000, giving an average of 5,878 oysters per boat; a very small quantity when compared with the results of the Ceylon fishery in 1857, when the daily yield varied from one to one and-a-half million oysters, some boats bringing loads of thirty to forty thousand.

From experiments made with divers equipped with diving helmets, gathering stones instead of oysters, by Mr. Thorowgood when Superintendent of the Madras Harbour Works, it was calculated¹⁴ that a pair of helmeted

¹⁴ Vide Madras Board of Revenue Resolution, No. 677, 3rd August, 1888.

complement of men, all waiting at Kilakarai on the Madras coast in readiness to proceed to the scene of the fishery, after some festivities, which were to take place on a stated day, and at which prayers were to be offered for protection against the attacks of sharks. "The only precaution," Tennent writes,¹⁵ "to which the Ceylon diver devotedly resorts is the mystic ceremony of the shark-charmer, whose power is believed to be hereditary, nor is it supposed that the value of his incantations is at all dependent upon the religious faith professed by the operator, for the present head of the family happens to be a Roman Catholic. At the time of our visit this mysterious functionary was ill and unable to attend; but he sent an accredited substitute, who assured me that, although he was himself ignorant of the grand and mystic secret, the fact of his presence, as a representative of the higher authority, would be recognised and respected by the sharks." At the Tuticórin fishery in 1890 a scare was produced by a diver being bitten by a shark, but the scare subsided as soon as a "wise woman" was employed by the divers. Her powers do not, however, seem to have been great, for more cases of shark bite occurred, and the fishery had to be stopped in consequence at a time when favourable breezes, clear water, plenty of boats, and oysters selling at from Rs. 22 to Rs. 31 per thousand indicated a successful financial result.

As a means of keeping sharks off Captain Donnan, the superintendent of Ceylon pearl fisheries, took with him to the pearl banks in 1891 a number of specially-prepared cartridges, which he meant to try the effect of exploding daily under water in the event of sharks putting in an appearance. Before the commencement of the fishery, he exploded a cartridge suspended midway between the surface and the bottom to try the effect produced at a distance. The Government divers were down at the bottom at the time of the explosion at a distance of half to three quarters of a mile, and they said that the sound of the explosion was very distinct, and that they were satisfied that it would have frightened the sharks away.

Where, as in a pearl-fishing camp, a mass of uneducated men of strong passions and good physique, belonging to different countries and of different religious persuasions, is gathered together, it is not unnatural that serious conflicts should at times arise, which require the presence of a com-

petent police force, and prompt and judicious magisterial action. At the Ceylon fishery of 1890 the Government agent had to deal promptly with a disturbance in which the Arab divers were the aggressors. "Yesterday" writes the *Ceylon Observer*, "there was a wild scene. The 'Perseverance' started somewhat late for the banks. On her way out she picked up and took in tow several boats that were unable to get out. One of these contained Arab divers, and another which was being towed alongside contained Tamils. The Arabs wanted the Tamils to drop their boat astern to prevent the wash of the sea getting into their boat, but the Tamils very naturally refused. This was quite enough for the Arabs: ever ready for a row. They jumped into the Tamil boat and commenced to slack the rope. This was resented by the Tamils, and the result was a pitched battle, very warm while it lasted. The 'Perseverance' put back, picking up on her way some twelve or fourteen divers who had fallen or else been knocked into the water in the course of the fight. The Arabs were the smaller body in point of numbers, and got a thorough thrashing. One man had several of his front teeth knocked down his throat, while another had an eye knocked out, and probably, if the fight had occurred further out at sea, some of the men would have lost their lives."

For months after the conclusion of a pearl fishery poor natives may be seen hunting in the sand on the site of the pearl camp for pearls; and it is reported that in 1797 a common fellow, of the lowest class, thus got by accident the most valuable pearl seen that season, and sold it for a large sum.

The experiments of Sarasin and Fol showed that an electric light was distinctly seen at a depth of 33 metres, at 67 metres the clear image being replaced by a diffuse light faintly perceptible. Towards the latter end of 1888 it was suggested that an electric light apparatus should be acquired in connection with the pearl fishery, by means of which one would be able to examine the condition of the bank from the deck of a ship, and which, it was thought, would help to solve the enigmas that still hang about the migrations of the pearl-oyster. The notice of Government was drawn to the fact that a boat had been fitted up with a brush-dynamo and electric globe for the pearl fishery in South Australia by a Glasgow firm. During a short visit to Europe in 1888, I made a series of inquiries as to the possibility of obtaining a light, such as was required; but,

¹⁵ *Ceylon*, 1860, vol. II, pp. 564-65.

though there was abundant evidence as to the usefulness of the electric light for surface work, salvage operations, and scientific dredging,¹⁶ the general opinion of those best qualified to judge was that it would, for the proposed purpose, be a failure. It has been suggested by Mr. Phipps, who was for many years superintendent of the Tuticorin pearl banks, that, if a sheet of thick glass could be let into the lower plates of a vessel and there protected both outside and inside in some way from accident, a study of the sea-bottom in clear water, either by day with the sun's rays or by night by the use of a powerful electric light, might be made. In a letter to Government Mr. Fryer, Inspector of Fisheries, makes the sound suggestion "that the observations which the Government of Madras desire to make upon the habits of the pearl-oysters would be greatly facilitated by the employment of a diver equipped with an ordinary diving dress. By this means a prolonged stay could be made by an observer on the sea-bottom, who could not only make an accurate survey of the bed, but could periodically examine the same ground, select specimens, and make minute observations, which would be impossible to a native diver, whose stay at the bottom is limited to a minute or so." To these remarks I may add my own experience at the Tuticorin fishery, where, by examination of the shells of the oysters brought up by the divers, by expending small sums of money which tempted the native divers to bring me such marine animals as they met with at the sea-bottom; by conversation with the European diver, who was, further, able to bring up large coral blocks (*Porites*, *Madrepora*, *Hydnophora*, *Pocillopora*, *Turbinaria*, &c.) for examination, and by dredging, I was able to form some idea as to the conditions under which the pearl-oysters were living. On clear days it was possible to distinguish the sandy from the rocky patches by the effect of light and shade, and from hauls of the dredge over the former not only many mollusca, &c., but also specimens of *Branchiostoma*, sp.¹⁷ (Lancelet) were obtained, of which the largest measured two inches in length. Mollusca were also obtained in

¹⁶ Vide Herdman's *Second Annual Report on the Puffin Island Biological Station*.

¹⁷ Specimens of *Amphioxus belcheri*, Gray, were obtained by Mr. Giles when dredging from the Marine Survey SS. 'Investigator' off Seven Pagodas (Mahabalipuram) 30 miles south of Madras during the season 1887-88.

great variety by passing the debris, which was swept from the floor of the kottu every day after the oysters have been cleared away, through sieves. The big *Murex anguliferus* (elephant chank) was brought in from the banks by the divers nearly every day, and the animal served up for their hard-earned evening meal. The oysters shells were largely encrusted with bright-coloured sponges, of which the most conspicuous was *Clathria indica*, an erect-growing bright red species, recorded as a new species by Mr. Dendy in his report on my second collection of sponges from the Gulf of Manaar.¹⁸ Very abundant, too, was the large cup-shaped *Petrosia testudinaria*, of which a specimen in the Madras Museum measures 1.5 feet in height. Enveloping the oyster shells were tangled masses of marine algæ,¹⁹ and floating in dense masses on the surface was the Sargasso weed, *Sargassum vulgare*. The various minute living organisms entangled in the meshes of the algæ must serve as an efficient food-supply for the oysters. The outer surface of the living oyster shells was frequently covered with delicate bryozoa, which also flourished on the internal surface of the dead shells in the form of flat or arborescent colonies. In no single instance did I see an oyster shell from the Tuticorin bank encrusted with coral; whereas at the Ceylon fishery, and on the occasion of my subsequent inspection of the Ceylon pearl banks, I found the surface of a large number of the shells, both dead and living, covered, and frequently entirely hidden from view by delicate branching *Madrepora* or *Pocillopora*, or the more massive *Astræa*, *Cœloria*, *Hydnophora*, *Galaxea*, &c. A specimen of *Galaxea* encrusting a single valve of an oyster shell, which I picked up on the shore and is now in the Madras Museum, weighed as much as 5 oz. 15 dwts.

Several species of echinoderm, which had not previously been recorded from the coast of the Madras Presidency,²⁰ were brought up by the divers, and were identified by my friend Professor Jeffrey Bell. Of recorded species those which were brought on shore most frequently were the crimson-lake coloured *Oreaster lincki*, and the long-armed, usually salmon-coloured *Linckia levisgata*, and, not

¹⁸ *Ann. Mag., Nat. Hist.*, Feb. 1889.

¹⁹ The collection of algæ made at Tuticorin has been sent to Mr. G. Murray, of the British Museum (Nat. History) for identification.

²⁰ Vide *Proc., Zool. Soc., Lond.*, June 19, 1888.

unfrequently, dense clusters of *Antedon palmata* were found in crevices hollowed out in coral blocks, from which also, when broken open, specimens of ophiuroids (commonly met with their arms turned round the branches of a *Gorgonia*, or in the canal system of sponges), chaetopods, crustaceans, and stone-boring mollusca (*Lithodomus*, *Parapholas*, *Venerupis*, &c.) were obtained.

II.—CEYLON PEARL FISHERY, 1889. .

On the completion of my investigations at the Tuticorin pearl fishery in 1889, I proceeded, in compliance with instructions received from the Madras Government to Ceylon, to report on the pearl fishery which was being carried out on the Muttuwartu par (or bank) off Dutch Bay.

It was originally intended that I should travel up the coast by S.S. 'Active'; but, as she was laden with stores for the pearl camp, there was no available space, and I had, unfortunately, to wait for a passage on the small coasting steamer 'Prince Alfred', which left Colombo two days later. As we neared Dutch Bay, on the shore of which the pearl camp was located, in the early morning, the familiar odour of decomposing oysters was perceptible some distance out at sea, and we watched a few boats at work on the pearl bank. Arrived at the camp, I found Mr. Twynham, the Government Agent, Captain Donnan (whose name is connected with a Gulf of Manaar sponge, *Axinella donnani*), and other administrative officers living on board the schooner 'Serendib' moored close to the shore, communication with which was maintained by means of a gangway. Several deaths from cholera occurred on board during the return journey of the 'Serendib' to Colombo, and, among others Captain Robson, who had acted as kottu superintendent throughout the fishery, fell a victim to the dread disease.

The few boats, which had been at work on the bank, were towed into the bay by the 'Active', reaching the shore opposite the kottus before 4 p.m. I gathered that the steamer had been of very great service during the fishery; for, with her assistance, not only were the boats enabled to get to and from the bank in spite of contrary winds, but the work of the divers, which is very severe, was considerably lightened by the simple fact that the steamer could bring them back at an early hour on days when, without her assistance, they would have been out at sea until late in the evening, and not inclined to start off for the bank on the following morning.

Fortunately I examined the oysters which were brought in by the boats; for, as events turned out, it was my solitary

opportunity of making an examination thereof. I was at once struck with the fact that the shells of the oysters presented an entirely different appearance to those of the Tholayiram par (Tuticorin); for, whereas the latter were enveloped in dense masses of algæ (sea weeds) and the surface of the shells was covered by variously colored branching and sessile encrusting sponges, the surface of the shells of the former which was uppermost during life was, in very many cases, covered over by young stony corals, which, according to the species, formed either encrusting masses or branching tufts. A series of specimens of the shells, with the attached corals, many of which were to be seen lying strewn along the sandy shores of the bay, discarded by natives after extraction of their contents, has been deposited in the Madras Museum, where they form a very attractive exhibit. Further examination of these coral-bearing shells at various ages would be of interest; for, as the age of the oysters can be approximately fixed, a very good idea could be obtained, by weighing and by observation of the size of the corals on oysters of different ages, as to the rate at which the corals grow.¹ Chemical analyses of the sea water over the Ceylon and Tuticorin pearl banks, especially with reference to the percentage of lime salts, should also be carried out. In connection with my observation that the Tuticorin shells were covered with algæ while the Ceylon shells were encrusted by corals, a Ceylon correspondent wrote as follows:—"From the fishery of 1887 we took away specimens, very beautiful to look at, but several of which showed that the unfortunate animals inhabiting the shells had their residences converted into their tombs by the fatal industry of the coral animals. But our specimens were not obtained from the Modaragam par, which was that we saw fished, and the shells taken from which are always covered with red-colored algæ, and never with corals. We gathered our coral-covered specimens from the mounds of dried shells on the sea-shore, and learned that they had been taken in a previous fishery from another bank."

The mid-day heat at Dutch Bay was very intense; the sand became so hot that even horny-soled coolies could not walk on it; and the blue-bottle flies were an intolerable pest from early morn till sun down. The plague of flies at the Ceylon fisheries has occurred on former occasions, and

Mr. G. Vane, who conducted the fisheries from 1855-60, rites as follows:—

"Then come flies, innumerable, of the largest kind; indeed flies are constant plagues, but are worse with a southerly wind, everything being covered with a black mass; a glass of wine or water must be drunk as poured out, or it is filled with flies, but southerly winds do not last long, and it seems as though providentially arranged that the prevailing winds should aid the purposes and needs of a pearl fishery."

Early in the morning of the day following my arrival at Dutch Bay my suspicion over-night that all was not well was confirmed by the receipt of information that deaths from cholera had occurred in camp, and that there was a panic among the divers, who had struck work. It was promptly decided to abandon the fishery, and permission was given for the boats to leave. The divers' quarters and sale kottus (the fences of which had begun to throw out leaves) were, as a matter of precaution, burned down, and by 4 P.M. most of the boats were out at sea, many making for the Madras coast and carrying thither the epidemic disease.

The general arrangement of the Dutch Bay camp corresponded, in all essential particulars, with the arrangement of the Tuticorin camp. The latter is, in fact, based on what I may term the Ceylon type.

The camp is described by a newspaper correspondent in the following words²:—"What was only the other day a sandy desert is now a populous and thriving town, with rows of buildings and well-planned streets. The two principal streets run parallel to each other. Each is about a mile long and 120 feet wide. These are again intersected by cross roads at intervals of 200 feet, an arrangement which permits of free ventilation, &c. Along the centre of each principal street there is a row of wells and lamps . . . That portion of the town described above is situated at the south end of Dutch Bay, and is occupied by merchants, boutique-keepers, divers, *et hoc genus omne*. To the west of this, where the buildings are of a superior order and more apart from each other, we have the custom-house, court-house, police station with the Union Jack flying gaily in front of it, the Government Auditor's quarters, the doctor's buildings, the general hospital, out-door dispensary,

¹ The rate of growth of corals is fully discussed in Darwin's *Structure and Distribution of Coral Reefs*, 3rd ed., 1889.

² *Ceylon Observer*, 2nd March, 1889.

rest-houses, &c. On the spit of sand (a sand bank) are built the Government and private kottus and the sale bungalow. Here, too, are the head-quarters of the police . . . By the side of this spit of land, and closely moored to it, are the Dib, the Antelope, and the Sultan Iskander which serve as quarters of the Government Auditor, Captain Donnan, and their subordinate officers. Far away from this site and at the very end of the spit can be described some of a dozen yellow flags, which are said to indicate the situation of the quarantine station and the hospitals for cholera and small-pox patients. . . . Somewhere about the commencement of the spit stands a dilapidated Roman Catholic church, sea-eaten and falling into ruins. Father Dineaux, who is temporarily in charge, tells me that his church is in imminent danger of total disappearance owing to encroachments from the sea like the proverbial building that was built on the sands. The cemetery which belonged to this church and formed part of its grounds has long since been claimed by the sea, and those who were once buried in terra firma now sleep beneath the wave."

A small guard steamer was employed in cruising about the bay during the fishery, so as to prevent the divers, on their return from the bank, from dropping bags of oysters in the shallow water, which could afterwards be picked up. This form of fraud—and the frauds perpetrated by pearl divers are many—was scarcely possible at Tuticorin, where the boats arrived on shore opposite the kottu straight from the open sea.

Good fresh water was obtained from shallow wells dug in the sandy shore, and there was an abundance of water, condensed by the 'Serendib,' in a large tank; but the condensed water did not seem to be appreciated by the natives.

I had, unfortunately, no opportunity of watching the process of counting the oysters in the kottu, or the management of an auction on a large scale; but, so far as I could gather from the counting and sale of the oysters brought in by the few boats already referred to, the system was the same as that adopted at Tuticorin.

Turning now to a comparison of the Tuticorin and Dutch Bay fisheries in 1889, the latter had the advantages of—

- i. a large fleet (193) of boats, and a correspondingly large staff of divers;

- ii. the presence of an efficient steam-tug throughout the fishery, by means of which both time and labour were saved;
- iii. the existence of the oysters in comparatively shallow water and near to land.

The Tuticorin fishery laboured, on the other hand, under the disadvantages of—

- i. a very small fleet (44) of boats, and small staff of divers;
- ii. the absence of a tug for a long time after the commencement of the fishery;
- iii. the existence of the oysters in deeper water, and at a great distance from the shore than at Dutch Bay.

And there was, if the health of the camp is left out of the question, no compensatory advantage at Tuticorin.

The following table shows the results of the Ceylon fishery from the date of its commencement up to March the 27th:—

Date.	Number of boats.	Total number of oysters fished.	Sold for Government.	Average rate per 1,000.	Revenue.
2nd March	89	542,527	361,685	RS. 28	10,133.87
4th "	170	1,030,342	686,895	22	14,340.80
5th "	...	1,183,455	788,970	28.79	22,718.10
6th "	191	1,343,415	895,610	26.19	23,461.47
7th "	188	1,611,616	1,074,410	20.00	21,488.20
8th "	...	1,357,365	904,910	20.05	18,143.11
9th "	190	1,432,717	955,145	21.96	20,983.19
11th "	193	1,623,750	1,082,500	20.17	21,834.00
12th "	191	1,683,430	1,125,620	15.01	16,909.30
13th "	190	1,599,045	1,066,030	15.00	15,990.45
14th "	190	1,803,240	1,202,160	16.44	19,769.56
15th "	187	1,926,000	1,284,000	19.04	24,453.00
16th "	190	2,209,688	1,473,125	21.63	31,868.75
18th "	191	1,992,847	1,328,565	19.31	25,656.30
19th "	189	2,439,802	1,626,535	15.95	25,956.03
20th "	188	1,946,250	1,297,500	15.00	19,462.50
21st "	190	2,238,998	1,492,665	19.95	29,781.63
22nd "	189	2,215,725	1,477,150	22.55	33,320.15
23rd "	187	2,372,003	1,581,335	18.36	29,035.70
25th "	187	...	1,325,875	15	19,888.13
26th "	...	...	1,099,070	17	17,780.12
27th "	...	...	1,052,045	17	18,918.86

The total quantity of the Government share of oysters, was, therefore, 25,184,015, and the total sum realised as the result of 22 days' fishing Rs. 4,81,887-52.

Comparing these results with those of the Tuticorin fishery, the following table shows the results obtained at the latter during the time of the Dutch Bay fishery, viz., from 2nd March to 27th March :—

Date.	Number of boats.	Total number of oysters.	European diver.	Bombay diver.	Sold for Government.	Rate per 1,000.	Revenue.
2nd March ...	3	6,000	...	...	4,000	Rs. A. P. 43 0 0	Rs. A. P. 172 0 0
4th " ...	...	...	...	...	...	...	...
5th " ...	38	151,500	...	...	101,000	25 6 4	2,565 0 0
6th " ...	38	180,000	...	...	120,000	25 13 2	3,099 0 0
7th " ...	40	180,000	...	...	120,000	24 14 3	2,987 0 0
8th " ...	41	187,333	254	80	125,000	26 1 5	3,261 0 0
9th " ...	42	224,654	130	562	150,000	25 6 8	3,813 0 0
11th " ...	44	204,907	592	594	137,000	22 10 3	3,102 0 0
12th " ...	42	235,121	643	115	157,000	21 0 4	3,301 0 0
13th " ...	44	235,917	1,405	760	158,000	21 3 2	3,350 0 0
14th " ...	37	148,280	439	...	99,000	21 8 5	2,131 0 0
15th " ...	35	158,905	190	...	106,000	20 10 8	2,191 0 0
16th " ...	44	213,809	2,000	2,381	144,000	21 2 6	3,067 0 0
18th " ...	...	...	...	...	...	...	...
19th " ...	24	97,450	99	...	65,000	26 10 1	1,731 0 0
20th " ...	12	82,500	...	...	55,000	26 13 4	1,476 0 0
21st " ...	43	360,572	966	890	241,000	22 2 7	5,341 0 0
22nd " ...	44	292,473	1,452	1,602	186,000	21 12 9	4,274 0 0
23rd " ...	35	244,500	...	...	163,000	22 5 7	3,643 0 0
25th " ...	...	...	...	...	...	...	...
26th " ...	2	4,565	3,070	1,000	4,400	30 5 0	133 6 5
27th " ...	44	379,025	950	...	253,000	24 10 2	6,234 0 0

The total quantity of the Government share of oysters, was, therefore, 2,398,400, and the total sum realized during the time under notice Rs. 55,871-6-5.

A comparison of these two tables is very instructive, and brings out very clearly the fact that, whereas in Ceylon the fishery was carried on without interruption (no fishery took place either in Ceylon or at Tuticorin on Sunday the 3rd, 10th, 17th and 24th), and, after the first few days, during which time all the boats had not arrived, or were not ready for work, a large and uniform number of boats were at work daily and regularly bringing in good loads of oysters; at Tuticorin, on the other hand, not only was there no fishery at all on three days (exclusive of Sundays), but on different occasions, out of the entire fleet of 44 boats, as few as 2, 3, and 12 boats were at work, with the result that, during 6 out of the 22 working days under review, only 63,400 oysters, yielding Rs. 1,781-6-5, fell to the Government share, i.e., the total yield of six days was less than that

which was, with one exception, the 19th, obtained as the result of a single day's work.

In view to the possibility of clashing of the fisheries in future years, a mutual agreement, relating to the division of the pearl fishery season between the Ceylon and Tuticorin pearl banks, has been come to between the Madras and Ceylon Governments; and the proposal of the Madras Government that the Ceylon fisheries should begin in February and close at the end of March, leaving April and May for the Tuticorin fisheries, met the wishes of the Government of Ceylon.

A steamer has recently (1893) been acquired by the Madras Government, which will be of infinite service on the occasion of future pearl fisheries, and for carrying out systematic annual and periodical inspections of the pearl banks.

III.—INSPECTION OF CEYLON PEARL BANKS.

HAVING received permission from Sir Arthur Gordon, K.C.M.G., Governor of Ceylon, to accompany Captain Donnan, Inspector of the Ceylon pearl banks, on his annual inspection cruise, I left Madras for Colombo by S.S. 'Bewa' on the 3rd October, 1889, taking with me some young plants of *Victoria regia*, reared in the nursery of the Madras Agricultural Society, for planting in the tank of the new Fort Gardens at Colombo, where they subsequently flowered.

While in Colombo I took the opportunity of examining the excellently preserved specimen of *Rhinodon typicus* in the Ceylon Government Museum for the sake of comparison with the specimen (plate III-A), 22 feet in length from the end of the snout to the extremity of the tail, which was cast on shore at Madras in February, 1889, when I was unfortunately far away from head-quarters, so that the chance was missed of examining its stomach contents and internal anatomy. The telegram which reached me announcing the arrival of the monster ran as follows:—"Whale on shore. Stupendous spectacle." But, on the following day, I learnt, from the evidence of an expert, that the whale was a shark. As the following extract shows, but few specimens of this gigantic elasmobranch have been recorded:¹—

"For many years the sole evidence of its existence rested upon a stray specimen, 15 feet in length, which was brought ashore in Table Bay during the month of April 1828, and fortunately fell into the hands of the late Sir Andrew Smith, then resident in Capetown, who named, described, and figured it. The specimen itself was preserved by a French taxidermist, who sold it to the Paris Museum, where it still remains in a much deteriorated condition. Forty years later—in 1868—Dr. Percival Wright, whilst staying at Mahé with Mr. Swinburne Ward, then Civil Commissioner of the Seychelles, met with this shark,

¹ In his *Account of the Pearl Fisheries, of Ceylon*, Captain Steuart records having seen on one occasion "a spotted shark of almost fearful size; it was accompanied by several common sized sharks, and they appeared like pilot fish by its side."



RHINODON TYPICUS.

CALCUTTA PHOTODUPE CO.

and obtained the first authentic information about it. It does not seem to be rare in this Archipelago, but is very seldom obtained on account of its large size and the difficulties attending its capture. Dr. Wright saw specimens which exceeded 50 feet in length, and one that was actually measured by Mr. Ward proved to be more than 45 feet long. Nothing more was heard of the creature until January, 1878, in which year the capture of another specimen was reported from the Peruvian coast near Callao. Finally, in the present century, Mr. Haly, the accomplished Director of the Colombo Museum, discovered it on the west coast of Ceylon, and succeeded in obtaining two or three specimens.² One of these was presented by that institution to the Trustees of the British Museum, and, having been mounted by Mr. Gerrard, it is now exhibited in the fish gallery, where it forms one of the most striking objects, although it must be considered a young example, measuring only 17 feet from the end of the snout to the extremity of the tail.

"A true shark in every respect, *Rhinodon* is distinguished from the other members of the tribe by the peculiar shape of the head, which is of large size and great breadth, the mouth being quite in front of the snout, and not at the lower side, as in other sharks. Each jaw is armed with a band of teeth arranged in regular transverse rows, and so minute that, in the present specimen (Ceylon), their number has been calculated to be about 6,000. The gill openings are very wide; and three raised folds of the skin run along each side of the body. Also in its variegated coloration this fish differs from the majority of sharks, being prettily ornamented all over with spots and stripes of a buff tint."

The following measurements of the Madras specimen were made by my friend Dr. A. G. Bourne when the fish was lying on the beach:—

	INCHES.
Total length 22 feet	or 264
Root of 1st dorsal (fin) to upper jaw ...	118
Anterior edge of 1st dorsal	22
Base of 1st dorsal	24
Distance between 1st and 2nd dorsal ...	27
Anterior edge of 2nd dorsal	11½

² In April, 1890, a further specimen of *Rhinodon*, 14 feet 6 inches in length was caught off Bambalapitiya (Ceylon).

	INCHES.
Base of 2nd dorsal	10½
Length of upper caudal lobe	60
„ of lower do.	30
Anterior edge of pectoral fin	38
First branchia to anterior edge of pectoral fin	15
Breadth of pectoral fin at base	20
Length of 1st gill opening	23
„ of 2nd do.	23½
„ of 3rd do.	21
„ of 4th do.	20
„ of 5th do.	17
Eye diameter	1½
Spiracle	¾ inch by 1
Mouth	30
Teeth, lower jaw	(14 rows)
Top of snout to 1st branchia	40
Tip of snout to eye	10
Eye to spiracle	4

After waiting for several days on the chance of a moderation of the prevailing south-west wind, I left Colombo with Captain Donnan on the barque 'Sultan Iskander,' which towed after her the diving boats, each with its crew composed of coxswain, rowers, divers, and munducks (who attend to the divers, letting them down by ropes, pulling them up, &c.). The crew made the schooner almost unbearable by cooking for their evening meal putrid fish, which in smell rivalled the well-known *gnapè* of Burma. As an inspection of a reported pearl bank off Negombo was out of the question owing to the heavy swell, we sailed straight on to Dutch Bay, where we anchored, after a somewhat boisterous passage, on the following morning, inside the long and rapidly extending spit of sand, which forms the western boundary of the bay, on which the sale bungalow, kottus, &c., were standing during my last visit in March at the time of the collapse of the pearl fishery from cholera. The Bay now presented a very deserted appearance. The sandy shore was crowded with hosts of wading birds, and the sole human occupants were a few fishermen and a number of natives, from near and distant parts of the island, engaged in searching for stray pearls in the sand formerly occupied by the washing kottus, the site of which was indicated by the remains of the fences and heaped up

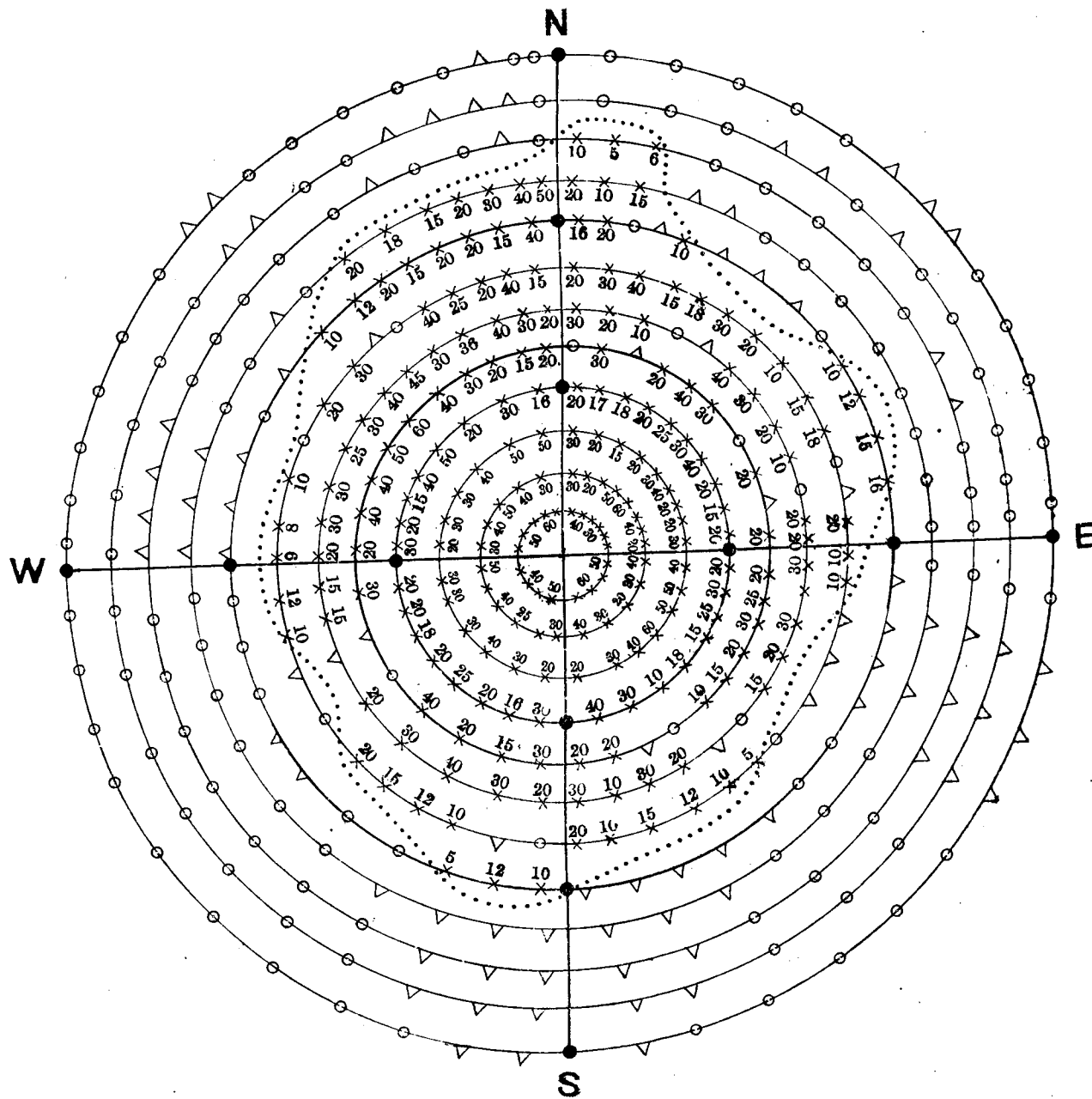
piles of oyster shells, and gaining as the reward of their labour from one to two rupees a day. It was reported that one woman had found five pearls, each of the size of an ordinary pepper pod, for which she had been offered and refused 150 rupees. The seaward face of the sand-spit was strewn with coral fragments rolled in by the waves from the reef, which intervenes between the shore and the pearl bank, and is partially laid bare at low tide; and the sand was riddled with the burrows of a very large ocy pod (*O. platytarsis*), the carapace of a male of which species captured by me after an exciting chase measured 56 mm. in length and 66 mm. in breadth. If one of these crabs is killed and left on the shore, its cannibal fellow creatures carry it away into a burrow, and, doubtless, devour it.

On the day after our arrival at Dutch Bay we sailed in one of the diving boats to Karaitivu and Ipantivu islands and the mainland in search of a possible spot adapted for the requirements of a pearl camp at the next fishery. In the shallow water near the shore of Karaitivu island fishes—*Mugil* and *Hemiramphus*—some of which leaped into the boat and were eventually cooked, fell easy victims to fishing eagles and gulls. Two hauls of the dredge in the sand and mud brought up *Amphioxus*, *Lituarina phalloides*, the Trepang *Holothuria marmorata*, *Astropecten hemprichii*, *Philyra scabriuscula*, *Chloeia flava*, and many molluscs; a large number of the species of mollusc, both here and in Dutch Bay, being common to the Indian and Ceylon Coasts of the Gulf of Manaar. On the mainland forming the eastern boundary of Dutch Bay, into which the river Kala Oya discharges its water by several mouths, dense jungle and swampy ground teeming with the mollusc *Pyrazus palustris* reach right down to the water's edge; and, as we walked along the shore, we came across solid evidence of the recent presence of elephants. We were told by a native that bears and wild pigs are so thick in the jungle that one trips over them as one walks along!

In 1868 large numbers of young pearl-oysters are reported to have been spread over a considerable extent of the muddy bottom of Dutch Bay in from one to two fathoms of water, but the situation was, evidently, not favourable for their healthy growth.

The weather being unfavourable for the work of inspecting, we had to remain unwilling prisoners in Dutch Bay, the days being spent in cruising about, and dredging in the shallow water. But on the 29th, as the wind had changed

DIAGRAM. B



and the sea abated, we made a start for the neighbouring pearl bank—Muttuwartu par—to which we were towed by the 'Active.' As soon as we had anchored on the south end of the bank, a diver was sent down from the ship's side in $6\frac{1}{2}$ fathoms, and brought up his rope basket containing plenty of healthy, living oysters, which, he reported, came away easily from the rock to which they were attached by their byssi.³ At the fishery in March the divers complained of the difficulty in detaching the oysters; and the degree of ease with which they can be gathered is considered a sign of their ripeness for fishing, the byssus being said to begin after the fifth year to break away from the substance to which it adheres tightly during the early life of the oysters.

The excellent plan which is employed in the inspection of the Ceylon banks, and by which a thorough knowledge of the condition of the banks as regards the oyster supply is obtained, is the same in principle as that adopted by searchers for lapwing's eggs in England. The inspection barque is anchored in a position fixed on the chart by bearings from the shore. The steam tug, towing a boat with buoys bearing flags on board, first lays out buoys in the north, south, east, and west at distances of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ of a mile from the barque. Buoys are then laid out at a distance of $\frac{3}{4}$ of a mile from the barque in the north-east, north-west, south-east, and south-west. Four diving boats, each with a coxswain in charge, five rowers, three divers, and two munducks, are arranged in line between the north $\frac{1}{4}$ mile buoy and the barque, the distance being equally divided between the boats. The rowers work round in a circle, and the divers make frequent dives in search of oysters until the starting point is reached. The boats are then again arranged in position, and the circle between the $\frac{1}{4}$ and $\frac{1}{2}$ mile buoys is explored. Lastly, the third circle, between the $\frac{1}{2}$ and $\frac{3}{4}$ mile buoys, is, in like manner, explored; so that, when this circle is completed, each boat has described three circles with the inspection barque as a centre. And, in this way, twelve circles in all are described by the four boats. The oysters are then brought to the ship, counted, and put in sacks daily, until a sufficient number (15,000) to form a sample for washing and valuation by experts has been col-

³ "The term rock is applied to pieces of coral, living or dead, averaging about a foot in diameter, which are scattered more or less thickly over certain parts of the banks.

lected.⁴ The coxswain of each boat records on a diagram, provided by the Inspector, the approximate position of each dive which is made, the nature of the bottom (a triangle = rock, a circle = sand, and a cross = oysters), and the number of oysters lifted. Diagram A represents the day's work done by a single boat over ground which, with the exception of a sandy patch between the north and east $\frac{1}{2}$ mile buoys, was rocky, and on which oysters were plentiful except over a portion of the outer circle. Diagram B, made up from the four coxswains' reports, represents a single day's work done by all the boats, and shows the distribution of the oysters over the area inspected, and the limits of the bank. As soon as the buoys have been taken up by the tug, the inspection barque is moved to a new position $1\frac{1}{2}$ mile distant from its former one, and the buoys are again laid out in circles, to act as guides to the boats in the next day's work. Without the assistance of the buoys the boats would not be able to describe separate circles, but would work in an irregular manner, and two or more boats would, very probably, go over the same ground. But, with the assistance of the buoys, the whole bank can be systematically surveyed.

The Muttuwartu par, which was fished in the spring of 1889, is situated about five miles from the seaward shore of Dutch Bay, and covers an approximate area of $3 \times 1\frac{1}{2}$ miles, the depth of water over the bank ranging from 5 to 10 fathoms with an average of about 7 fathoms. The temperature of the water at the bottom, registered with a Negretti and Zambra's deep-sea thermometer, varied from 80° to 82° between 8 A.M. and 5 P.M. Between the bank and the shore is a coral reef, the presence of which was indicated by the waves breaking over its outer face amid a prevailing calm, and by gulls resting on the coral blocks. The most conspicuous madreporaria on this reef, which is surrounded by $4\frac{1}{2}$ to 5 fathoms of water, belong to the genera *Madrepora* and *Pocillopora*, while *Galaxea* and *Leptoria* are present in less abundance. The bright white patches of sand, which cover large spaces between the coral growths, teem with protozoa and a calcareous alga, and are more rich in delicate molluscs than any other deposit which I have examined in the Gulf of Manaar. Sheltered among the coral tufts were sluggish holothurians and hosts of small crustaceans; and, clinging to the branches of a madrepora,

⁴ If a young bank is being inspected, samples are brought up by the divers, but they are not washed for valuation.

I found a single specimen of the quaint crustacean, *Thenus orientalis*.

Outside the seaward face of the pearl banks on the Indian coast of the Gulf of Manaar the depth of the sea increases very gradually, so that, for example, outside the Tholayiram par, a depth of only 15 to 20 fathoms is reached at a distance of 3 miles. Outside the Muttuwartu par, however, the area of shallow water ceases very abruptly, and the depth increases rapidly to 150 fathoms at a distance of three-quarters of a mile from the seaward face of the bank, where the following temperatures were recorded (in the month of November):—

Surface	.. 83°	60 fathoms	.. 68°
10 fathoms	.. 81°	100 "	.. 61°
20 "	.. 80°	150 "	.. 55°
30 "	.. 72°		

On the 19th March, 1890, the temperatures recorded by Captain Donnan 4 miles west of the Muttuwartu par were:—

Surface	.. 85°	100 fathoms	.. 59°
30 fathoms	.. 81°	150 "	.. 54°
60 "	.. 68°	200 "	.. 52°

Several hauls of the dredge brought up *Polytrema cylindricum*, *Gorygonia*, *Heteropsammia cochlea*, *Cirripathes spiralis*, *Spongodes* sp., *Fibularia ovulum*, &c., but no pearl oysters.

The divers received instructions to keep apart for me everything, other than oysters, which they came across during their day's work, under the general heading of corals, shells, *poochees*, and weeds; and, by examination of the specimens which they reserved and going rapidly over the oysters, I was enabled not only to make a rich collection, but also to ascertain roughly in what respects the fauna of this portion of the west coast of Ceylon differs from that of the Indian coast of the Gulf of Manaar. The first day's inspection of the Muttuwartu par showed not only that the oysters were very abundant, in spite of the disturbance to which they were subjected during the fishery in the spring, 4,580 living specimens being brought up in 291 dives; but, further, that the coral-incrusted shells, to which I have already referred (p. 30), as being a distinguishing characteristic of this bank as compared with the Tholayiram par, are very abundant, the living corals growing on the shells of living oysters, which, did they migrate, would have, sometimes, to carry about with them a weight of nearly

eight ounces. The coral-incrusted shells had, prior to the fishery of the Muttuwartu par this year, only been seen by Captain Donnan on the north-west Chéval par; and, when the oysters disappeared from the latter in 1888, the drift-oysters, which were eventually found, were recognised by the coral-growths upon them. Arborescent sea-weeds, forming tangled masses, such as abound on the Tholayiram par, were conspicuously absent; but the oyster shells were largely encrusted with sponges, and the orange-coloured sponge, *Axinella donnani*, which receives its specific name after the present Inspector of Pearl Banks, was very common. In addition to the shell-incrusting corals, massive corals, mainly belonging to the genus *Madrepora*, flourish on the bank, forming a convenient habitat and hiding place for chaetopods, crustaceans, molluscs, &c., which can live there safe from the attacks of predaceous enemies. As far as I could gather from repeated examination, on different parts of the bank, of the residue left after shaking up the oysters in a bucket of water, and of the contents of the digestive tract of a holothurian (*H. atra*) which abounds on the bank, the sea-bottom is mainly composed of a white deposit, such as I have only seen on the Indian coast of the Gulf of Manaar, which consists of a calcareous alga and of foraminifera, among which *Rotalia calcar*, *Heterostegina depressa*, and *Amphistegina lessonii* are the most conspicuous. It was long ago pointed out by Captain Steuart that the places, on which pearl fisheries have been successfully held in Ceylon, appear to be beds of madrepora of irregular heights, having the spaces between the ridges nearly filled up with sand. The transparent clearness of the water over the banks and the clean state of the sea bottom, which is free from sediment carried down by currents, must, I think, be regarded as important conditions favouring the healthy growth of the oysters thereon.

Swimming about on the surface of the water over the bank were many black and yellow striped sea-snakes, which are believed by the divers to feed on the oysters. Indeed, in 1862, the European diver reported that he had seen the snakes eating the oysters, darting into the shells when opened. But this report must be viewed with grave suspicion. Apart from snakes, the reputed enemies of the pearl oyster on the Ceylon banks are molluscs, fishes, and currents. Among molluscs are mentioned the chank (*Turbinella rapa*) and a big *Murex* (*M. anguliferus*), known as the elephant chank. But, as Mr. Holdsworth observes, "they may be looked on

as part of the vermin of the banks, but I have no reason to think they cause more destruction on the oyster beds than the hawk and the polecat do among the game of an ordinary preserve." It is noticeable that the little *Modiola* known as *suran*, which assumes such a prominent position in the reports of the Inspector of Pearl Banks at Tuticorin, does not, though present, occur, so far as I am aware, in any great quantities on the Ceylon banks. Among fishes the trigger fishes (*Balistes*), commonly known as "old wives," are abundant on rocky parts of the banks, and I saw many specimens caught by the boatmen fishing from the side of the ship as we lay at anchor. Concerning these fishes Captain Steuart reports that "the sea over the pearl banks is well stocked with various fishes, some of which feed on the oysters, and, when caught by the seamen on board the guard vessel, pearls and crushed shells are often found in their stomachs, particularly in the fish called by the Malabars, the clartée; by the Singhalese, the pottooberre; and by seamen, the old women. This fish is of an oval-shape, about 12 inches in length and 6 inches in depth from the top of the back to the under part of the belly, and is covered with a thick skin. We saw ten pearls taken from the stomach of one of these fish on board the *Wellington*." The contents of the stomach and intestines of *Balistes*, which I examined while we were inspecting the Chéval par, consisted entirely of young oysters crushed by their sharp cutting teeth. In addition to the trigger fishes, rays are said to be always more or less numerous on the banks, and Mr. Holdsworth states that "when the fishery of 1863 commenced on the south-east part of the Chéval par, the divers reported the ground so covered with skate as to interfere with their picking up the oysters. After a day or two the continual disturbance by the divers had the effect of driving the skates away from that part of the bank, and these fish, many of them of very large size, were seen going in the direction of the Modrigam, which was then covered with oysters, whose age was estimated by the Superintendent at $2\frac{1}{2}$ —3 years, by the Inspector at $3\frac{1}{2}$ —4, and by the native headman at 4 years. The skates were in shoals, and their total number was estimated at from 10 to 15 thousand. Further, in his report on the inspection of banks in March 1885, Captain Donnan notes the fact that "on the way from the north Mótaram, and just about the south side of the bed of oysters, we passed through a large patch of thick discoloured water, caused by a shoal of rays

plundering about on the bottom, and stirring up the sand. Some of them could, at times, be seen near the surface, and I have no doubt they were feeding on the oysters." Some years ago the Sea Customs Officer at Dutch Bay counted as many as 300 rays in a single haul of a fishing net. The native belief is that the rays break up the oyster shell with their teeth, and suck out the soft animal matter. The stomach contents of a big ray (*Etobatis narinari*), 5 feet in breadth and with a tail $8\frac{1}{2}$ feet in length, which was caught by fishermen from a canoe off Silávaturai when we were at anchor there, consisted of sea-weed. The same fishermen caught for me off the Silávaturai reef a male Dugong, 9 feet in length, whose stomach contents consisted of sea-weed and large numbers of a nematode worm (*Ascaris halicore*, Owen).

It was roughly estimated as the result of the inspection of the Muttuwartu par, which lasted over three days, an average of 16 oysters to a dive being allowed, that it contained 30 million oysters spread over an area of $9\frac{1}{2}$ million square yards, which should produce a revenue of 5 lakhs of rupees.

On November, 2nd we left the Muttuwartu par, and anchored in 8 fathoms, about 2 miles further north, so as to hunt for a possible bed of oysters. The divers, making the usual preliminary dives, brought up blocks of dead coral-rock with living *Turbinariae* and *Porites* growing on them, and containing, imbedded in the crevices, a large number of foraminifera. The sample of 15,000 oysters from the Muttuwartu par, which were beginning to be unpleasant fellow-passengers, was sent up to Silávaturai to be washed. It is stated by Captain Steuart that the offensive effluvium of decomposing oysters "is not considered to have an unhealthy tendency on the persons engaged in the kottus, and it is astonishing how soon the most sensitive nose becomes accustomed to the smell. Indeed some Europeans have fancied their appetites sharpened by visiting the kottus, and being surrounded by immense heaps consisting of millions of oysters in all stages of decomposition."

The surface of the water, always rich in organisms, was exceptionally so on the following morning, the tow-net, dropped from the stern of the barque and kept distended by the gentle current which was running, becoming speedily filled with a gelatinous mass composed mainly of *Sagittæ* mingled with a host of ctenophora, glassy pteropods, and hungry fishes preying on crustacean and other

them to the greatest perfection. We know there is something in the nature of the bottom of certain parts of the sea, which is favourable to the subsistence and growth of particular fishes, and which improves the flavour for the food of mankind: for instance, the sole and the plaice caught in Hythe bay on the Kentish coast are esteemed better than those caught off Rye on the western side of Dungeness; and we also know that cod, turbot, oysters, and, indeed, most edible fishes are prized in proportion to the estimation in which the banks are held, from whence they have been taken." The productiveness of the banks off Aripu (Chéval and Mótaramam) was attributed by Mr. Vane, who was formerly Superintendent of the pearl fisheries, to their position affording a degree of protection from the influences of the weather and currents—conditions which would be favourable for permitting the young oysters to settle on the sea-bottom instead of being carried away.

In 1885 Captain Donnan attempted to cultivate the pearl-oyster on a coral reef, three miles from the shore, which was considered to be sufficiently far removed from the baneful influence of the Aripu river during the freshes. A tank for the reception of the oysters was dug in the centre of the reef, and surrounded by blocks of coral to form a barrier round its edge, heaped up high enough to be just awash at the highest tide. But the experiment failed, as, out of 12,000 oysters which were placed in the tank, only 27 remained alive at the end of seven months. "Some of the oysters," Captain Donnan writes, "may have been washed out of the tank by the south-west monsoon sea, as it was not completely sheltered from the wash of the waves, but the bulk of them have, I believe, died off and been destroyed by some fish preying upon them. About 100 dead shells were found in the bottom of the tank, many of which bore evidence of having been bored and nibbled away. It is just possible that some fish may have got into the tank, and preyed upon the oysters, either by getting over the coral barrier around it, which would be slightly under water at high-water, or through the interstices of the coral underneath. The experiment so far has been a failure, and may be attributable to four causes:—

- "(1) overcrowding the oysters in the tank;
- "(2) deficiency of nourishment in water so near the surface;
- "(3) destruction by fish, which had got into the tank and preyed upon them;

"(4) by excessive agitation of the water in the tank during the south-west monsoon sea; or, probably, to all these causes combined."

In March, 1886, another experimental tank was made on a more sheltered part of the reef, and 5,000 oysters were placed in it. But, in the following year, all the oysters were found to be dead. The artificial cultivation of the pearl-oyster was attempted some years ago in a nursery made in the shallow muddy water of the Tuticorin harbour without success; and, in his final report to the Ceylon Government, Mr. Holdsworth expresses his opinion, with which I thoroughly concur, that there is no ground for thinking that artificial cultivation of the pearl-oyster can be profitably carried out on the Ceylon coast, as the conditions necessary for the healthy growth of the oysters are not to be found in the very few places, where they could be at all protected or watched.

On the way to Captain Donnan's tank, which we visited, we rowed over extensive banks of alcyonians, of the luxuriant growth and size of which only a very feeble idea is obtained from dried or spirit specimens as seen in museums. On the sandy bottom a large number of echinoderms, solitary or clustered together, were clearly visible; and, with the assistance of the divers and the dredge, the following species were procured:—*Temnopleurus toreumatiscus*, a violet-spined *Temnopleurid*, *Pentaceros thurstoni*, *Salmacis bicolor*, *Laganum depressum*, *Fibularia volva*, *Echinolampas oviformis*, *Holothuria atra*, and *Colochirus quadrangularis*. These species, as also *Oreaster lincki* and *Linckia laevigata*, which abound on the Muttuwartu par, are all found on the opposite coast of the Gulf of Manaar. A single young specimen of *Hippocampus* was also brought up in the dredge. The tank, washed by the gentle swell, showed no signs of pearl-oysters, which had, doubtless been smothered and disappeared below the surface of the bottom. But, growing from the inner side of the barrier of dead coral which formed the wall of the tank was a fringe of living corals—*Montipora*, *Pocillopora*, *Madrepora*, &c. As these corals had grown in their present position since the construction of the tank, which was built up entirely of dead blocks of solid coral brought from the shore, the living corals on the reef being found to be too brittle to form a suitable wall, it was obvious that, as the tank was built in March 1886, the age of the corals did not exceed three years and nine months. Accordingly I

larvæ. Only a few young oysters being found, we again proceeded northward, and anchored in $8\frac{1}{2}$ fathoms, the preliminary dives bringing up madrepores with *Antedons* entwined round their branches, and large melobesian nodules. Again only a few scattered oysters were obtained as the result of a day's work, but the divers brought me many specimens of alcyonians, and the bright-red sponge *Ari-nella tubulata*, living attached by a broad base to dead coral-rock, and associated with its commensal worm.⁵ The following temperature observations were made half a mile west of the ship, where no bottom was reached with the sounding line at 140 fathoms:—

Surface	.. 81.5°	50 fathoms	.. 75°
20 fathoms	.. 76.5°	100 "	.. 62.5°
30 "	.. 76°	140 "	.. 55°

On the afternoon of the 4th, we moved on, still northward, to the Karaitivu par,⁶ which was estimated, at the inspection in November, 1887, to contain 1,605,465 oysters. The divers, going down from the ship, alighted on a bank of *Fungia*, and brought up some living 5-year old oysters and melobesian nodules. Attached to one of the nodules was an extensive creeping colony of the delicate crimson-coloured organism named *Tubipora reptans* from the single small specimen which has hitherto been recorded by Mr. H. J. Carter.⁷ The present specimens were in a more advanced stage of growth than the one described by Mr. Carter, which I examined in the Liverpool Museum, and the calyces were proportionately higher. By about four hours' work next morning a sample of 8,000 oysters was collected for valuation, and the abundance of oysters may be judged from the fact that, on more than one occasion, as many as 100 oysters were brought up at a single dive. My own share of the morning's work consisted of a *Fungia* (*F. repanda*) and three living specimens of the mother-of-pearl oyster, *Avicula* (*Meleagrina*) *margaritifera*, attached by its byssus to coral-rock. Captain Donnan informed me that he had only seen about a dozen specimens of this mollusc during his 28 years' experience as Inspector of the banks,

⁵ Vide *Ann. Mag. Nat. Hist.*, Feb. 1889, p. 89.

⁶ The Karaitivu par was fished in December 1889; but the fishery came to an abrupt termination owing to a diver being killed by a shark. Apparently three men went down into the water, and two came up almost directly, saying that the third had been carried off by a shark. The rest of the divers could not be prevailed on to resume work, and left the bank.

⁷ *Ann. Mag. Nat. Hist.*, June 1880, p. 442.

so that it cannot be present in any abundance. Shell-incrusting corals, though present on the bank, were far less common than on the Muttuwartu par.

On the afternoon of the 5th we sailed about 20 miles north, and anchored in 2 fathoms, 3 miles south of the village off Aripu, off Silávaturai, which is made the headquarters at times when the Chéval and Mótaram (Mud-rigam) banks are fished. Rising from the sandy shore between Aripu and Silávaturai is a miniature sand-cliff, reaching a maximum height of about 12 feet, and extending over a distance of about half a mile, which contains a thick bed composed almost entirely of pearl-oyster shells—evidence of the enormous number of oysters which have been taken from the neighbouring banks at fisheries in the past. Similar beds of oyster shells were exposed in sections nearly a mile inland. The Chéval and Mótaram banks are situated from 9 to 12 miles out at sea in water varying in depth from 6 to 10 fathoms. Between the shore and the banks the water gradually reaches a depth of 6 fathoms; but, as in the case of the Muttuwartu and Karaitivu pars, the depth increases rapidly to 150 fathoms outside the banks. The sea bottom between the shore and the banks is made up mainly of sand with many worn shells, a luxuriant growth of sea-weeds, and scattered coral patches. Among mollusca *Modiola tulipa*, and the chank (*Turbinella rapa*) were very abundant. No fishing for chanks is permitted south of the Island of Manaar, lest, at the same time, raids should be made on the pearl banks.⁸ The fishery is, however, actively carried on north of the island on a different system to that which is in force at Tuticorin (p. 56), the boat-owners paying a small sum of money annually to Government, and making what profit they can from the sale of the shells.

Writing of the banks off Aripu, which have been, for many years, the sheet-anchor of the Ceylon fishery, Captain Steuart observes that "the number of successful fisheries obtained on the banks lying off the Aripu coast, more than on any other banks in the Gulf of Manaar, and the high estimation in which the pearls from these fisheries are deservedly held, would seem to indicate some peculiar quality in the bottom of the sea in these parts, which is favourable to the existence of pearl-oysters, and for bringing

⁸ See *Ordinance relating to Chanks*, pp. 58 to 62.

had the largest specimen of *Montipora* carefully detached from the dead coral-rock on which it was growing, and found that it measured 40 inches in length, 9 inches in height, and 16 inches in breadth, and weighed 17 pounds.

After remaining at anchor for some days off Silávaturai, we started on the morning of the 10th for the western side of the great Chéval par, which is known by the divers as *kodai* (umbrella) par from the prevalence on it of a shallow cup-shaped sponge, *Spongionella holdsworthi*, which is supposed, by their imaginative brains, to resemble an umbrella. In a letter to Mr. Bowerbank, by whom this sponge was described,⁹ Mr. Holdsworth stated that "is only found on the 9-fathom line of the large pearl bank. It is attached to pieces of dead coral or stones. When alive it is of a dark brown; and when taken out of water it looks exactly like dirty wet leather. . . . This sponge is so strictly confined to the locality above mentioned that its discovery by the divers is considered the strongest evidence that the outer part of the bank has been reached." Another conspicuous sponge on this bank was the large, pale pink-coloured *Petrosia testudinaria*, which also lives on the Tholayiram par off Tuticorin.

It was from the Chéval par that, in 1888, about 150 millions of oysters, ripe for fishing, disappeared in the space of two months, between November and February. This disappearance *en masse* was attributed by the natives to a vast shoal of rays, called *sankoody tyrica* or *koopu tyrica*, which are said to eat up oyster shells. But the more practical mind of the Inspector of the pearl banks attributed the disaster—for such it was from a financial point of view—to the influence of a strong southerly current, which was running for some days in December; a current so strong that the Engineer of the 'Active' had to let go a second anchor to prevent the ship from dragging.

The divers, going down from the ship as soon as we were at anchor over the bank in 6½ fathoms, reported abundance of young oysters, whose average breadth at the hinge was .75 inch, said by some to be three months, by others six months' old. The samples which they brought up from the bottom, which was rocky and interspersed with patches of fine sand, were attached to dead coral, melobesiae, sponges, and any other rough surface suitable for the attachment of the byssus. That the pearl-oyster prefers a rough to a

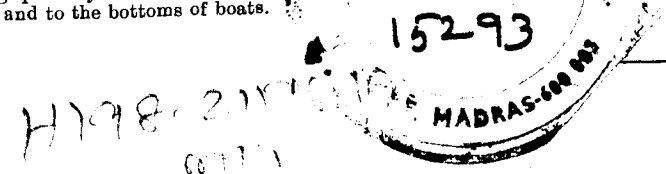
⁹ *Proc. Zool. Soc.*, 1873, p. 25, pl. v.

smooth surface as an anchorage is shown not only by its usual habitat, but also by the observation that young oysters have been found clinging to the coir rope moorings of a bamboo, but not to the bamboo itself or the chain moorings. The number of young oysters on a small nodule brought up by the divers was counted, and found to be 180, scattered among which were 20 specimens of the little *suran*.

The prevailing stony corals on the west Chéval par, brought up by the divers with dense clusters of young oysters adhering to them, belonged to the genera *Porites*, *Astræa*, and *Cyphastrea*, growing from a base of conglomerated sand-rock, which is known by the divers as 'flat rock.' These corals, when broken up, proved a rich hunting ground for small crustaceans, tubicolous worms, and lithodamous mollusca. Very abundant on the bank were the bright-red *Juncella juncea* and the cork-like *Suberogorgia suberosa*, on the axes and branches of which clusters of young oysters were collected.

At the time of his annual inspection of the west Chéval par in 1888, Captain Donnan found a large portion of it stocked with oysters one year old, which had, in the interval between the inspections, died from natural causes, or been killed off, and replaced by another brood. The life of the pearl-oyster must be a struggle, not only during the time at which it leads a wandering existence on the surface,¹⁰ and is at the mercy of pelagic organisms, but even after it has settled down on the bottom, where it is liable to be eaten up by fishes, holothurians, molluscs, &c., or washed away from its moorings by currents; and comparatively few out of a large fall of "spat" on a bank can reach maturity even under the most favourable conditions. "Much," Captain Steuart writes, "appears to depend on the depth of water over the ground, and the nature and quality of the soil upon which brood oysters settle, whether any portion of them eventually reaches the age of maturity. If the deposit be of small extent, or be thinly scattered, the young oysters are often devoured by fishes, before the shells are hard enough to protect them. But when the deposits settle in dense heaps upon places favourable for their nourishment and growth, many of them survive to become the source of considerable revenue." How great is the struggle of the pearl-oyster for

¹⁰ Young pearl-oysters have been found attached to floating timber and buoys, and to the bottoms of boats.



existence is very clearly shown by the records of the Tuticorin inspections, in which, time after time, a bank is noted in one year as being thickly covered with young oysters, and in the next year as being blank. Not, in fact, till a bank is thickly covered with oysters two years old can any hope be held out that it will eventually yield a fishery.

Outside the west Chéval par-a sand flat extends for some distance north and south, from which the dredge brought up masses of coarse, broken shells, and, among other specimens, large numbers of *Amphioxus* and *Clypeaster humilis*, and single specimens of *Ophiothrix aspidota* and *Astropecten hemprichii*; the digestive cavity of the latter being distended by a large *Meretrix* (*M. castanea*) and seven other smaller molluscs, which it had swallowed. From the stretch of sand between the east and west Chéval pars the echinoids *Echinodiscus auritus* and *Metalia sternalis* were obtained.

During our stay on the west Cheval par, large numbers of the butterfly *Papilio* (*Menclaudes*) *hector* were seen daily fluttering around the ship 10 miles out at sea. The 'Active' steaming at the rate of 4 knots an hour, and the diving boats under sail caught many seir fish (*Cybbium guttatum*) with a long line towing astern and made fast to the yard arm of the lug sail, and baited with a piece of white rag. For catching seir the hooks are sometimes baited with a small fish or the white of a cocoanut cut into the shape of a fish. From the barque at anchor many *Balistes* and the crimson-coloured *Lutjanus erythropterus* were caught by the crew with lines baited with fish. The stomachs of the former always contained crushed pearl-oysters, and those of the latter small fishes.

On the 14th we inspected the small Periya par, situated 3 miles westward of the west Chéval par, which we found irregularly stocked with young oysters. Sounding seaward from the bank, we found 9 fathoms at a distance of 1 mile, 14 fathoms at a distance of 2 miles, and did not strike bottom at 150 fathoms at a distance of 4 miles. The sea bottom shelves here less abruptly than outside the Muttu-wartu par, where a depth of 150 fathoms was obtained at a distance of $\frac{3}{4}$ of a mile from the seaward face of the bank. The thermometer registered 54° at 150 fathoms, and 59° at 100 fathoms, the surface temperature being 83°. On this and the two preceding days a bright blue-eyed *Palæmonid* larva was very abundant on the surface.

The next four days, during which the weather was very unpleasant and suggestive of a cyclonic storm in the Bay of Bengal, were spent in inspecting the east Chéval par. The divers, going down as soon as we had anchored at the north end of the bank, brought up blocks of incrustated sand-rock, and specimens of the black-colored sponge *Spongionella nigra*, but no oysters, which were, in fact, absent over the entire bank. This bank is mainly characterised by the abundant growth on it of *Suberogorgia suberosa*, on the branches of one of which an *Astrophyton* (*A. clavatum*?) was entwined, and heather-like *Hydroids* (*Campunularia juncea*, Allman), the tangled branches of which were studded with the striped *Avicula zebra*, and which should afford good anchorage for young oysters. Conspicuous among other specimens which were obtained, were the sponge *Hircinia clathrata* affording a home to *Balanus* (*Acasta*) *spongites*, the corals *Turbinaria crater* and *Turbinaria patula*, and the echinoderms *Antedon palmata*, *Salmacis bicolor*, *Clypeaster humilis*, and *Echinaster purpureus*. A single specimen of *Ophiothrix aspidota* was found coiled up in a cavity in a block of *Porites*. As on the other banks which we inspected, sea-weeds were not present in any quantity. The quantity of weed on the banks is said, however, to vary much from year to year.

The inspection of the east Chéval par completed, we went a short distance south, and spent a couple of days on the Môtaragam pars, which were also blank so far as oysters were concerned. The pearls from these pars are highly valued by the pearl-merchants, and, at the fishery of 1888, the oysters fetched from 100 to 109 rupees per thousand at auction, a single day's fishing realizing over 60,000 rupees. The weather had cleared up by this time, and the divers were again able to work in comfort for a short time. Rain interferes very much with an inspection, as the divers complain that it makes them cold and shivery when they come out of the water. Here, as on the east Chéval par, the animal collected in greatest abundance was *Clypeaster humilis*; but the divers also brought up many specimens of the chank, the unpleasant looking animal of which is eaten by the natives; *Pinna bicolor*, which is said to occur on the sandy parts of the banks in beds of some extent; and the hammer-headed oyster. The hydroid, which was so conspicuous a feature of the east Chéval, was absent from the Môtaragam par.

IV.—TUTICORIN CHANK FISHERY.

THE sacred chank, conch, or sankhu, is the shell of the gastropod mollusc *Turbinella rapa*, of which a full-grown specimen is represented on plate IV, and is, like the pearl oyster and the edible trepang (*Holothuria marmorata*), one of the commercial products of the Gulf of Manaar.

The chank shell, which one sees suspended on the forehead and round the necks of bullocks in Madras, is not only used by Hindus for offering libations and as a musical instrument in temples, but is also cut into armlets, bracelets, and other ornaments. Writing in the sixteenth century, Garcia says:—"And this *chanco* is a ware for the Bengal trade, and formerly produced more profit than now and there was formerly a custom in Bengal that no virgin in honour and esteem could be corrupted unless it were by placing bracelets of *chanco* on her arms; but, since the Patáns came in, this usage has more or less ceased, and so the *chanco* is rated lower now."

"The conch shell," Captain C. Day writes in "his Music and Musical Instruments of Southern India," is not in secular use as a musical instrument, but is found in every temple, and is sounded during religious ceremonies, in processions, and before the shrines of Hindu deities. In Southern India the sankhu is employed in the ministration of a class of temple servers called Dássari. No tune, so to speak, can of course be played upon it, but still the tone is capable of much modulation by the lips, and its clear mellow notes are not without a certain charm. A rather striking effect is produced when it is used in the temple ritual as a sort of rhythmical accompaniment, when it plays the part of *kan-nagólu* or *tálavinyasa*.

The use of the chank as ornament is well shown by a series of specimens in the ethnology court of the Indian Museum, Calcutta, which comprises necklaces worn by Naga women, armlets worn by Kuki women, bracelets worn by Mikir and Butia women, and bracelets (some of gauntlet pattern) made at Dacca.

The chank appears as a symbol on some of the coins of the Chalukyan and Pándyan kingdoms of Southern India, and on the modern coins of the Máharájas of Travancore.

At this stage a strong south-west wind came on, accompanied by an unpleasant swell, and drove us into Silávaturai; but, luckily, all the important work of the inspection tour was finished, two small banks alone remaining to be examined. A rolling journey on the tug 'Active' brought me back to Colombo, and my second visit to Ceylon, more auspicious than the first, was over.

During the last quarter of a century, the Ceylon Government has derived a handsome profit from its pearl banks, which have been lucratively fished on ten occasions; while, during the same period, the banks belonging to the Madras Government have yielded only two small fisheries, not because the oysters have ceased to settle, when young, on the banks, but because they have failed, owing to a combination of physical and other unfavourable conditions, to reach maturity there. Writing, in 1697, for the instruction of the political council of Jaffnapatnam, the then commandant of that town justly remarked that the pearl fishery is an extraordinary source of revenue, on which no reliance can be placed, as it depends on various contingencies, which may ruin the banks, or spoil the oysters. And this remark holds good after the lapse of two centuries. In 1740 the Baron von Imhoff, on his departure from the Government of Ceylon, in a memoir left for the instruction of his successor, stated that "it is now several years since the pearl banks have fallen into a very bad state both at Manaar and Tuticorin; this is mere chance, and experience has shown that, on former occasions, the banks have been unproductive even for a longer period than has yet occurred at present." And a century later, in 1843, Captain Steuart, at the commencement of his admirable "Account of the Pearl Fisheries of Ceylon," refers to the failure at that time of the now lucrative Ceylon fishery. Is it then rash, looking back to the fluctuating experience of the past, to express a belief that, in the not far distant future, the reputation of the Tuticorin banks will rival that of the at present well-favoured banks of Ceylon?

The name of Captain Donnan has repeatedly appeared in this chapter, and I should be, indeed, ungrateful were I to fail to acknowledge not only the great assistance which I received from him in carrying out my zoological work, but also the vast store of information on matters connected with the Ceylon pearl-fisheries which I gathered from him during our month of pleasant banishment from the outside world.



Lith. Govt. School of art. Calcutta.

have been thus described by my predecessor, Dr. G. Bidie, who says of them³: "The spawn of the *Turbinella* consists of a series of sacs or oviferous receptacles, the transverse markings in the figure indicating the dimensions of each capsule. In the fresh state the membranous walls of the sacs are pliable, although tough and horny; and it will be observed that, during the drying process, the spawn has, from the irregular shrinking of the two sides, become curved and twisted so as to have somewhat the appearance of a horn. The larger oviferous sacs of the *Turbinella* spawn contain from 8 to 10 young shells each, but the smaller ones, towards the end of the specimen, are barren."

The largest number of young shells which I found in a single egg-case was 235, of which the average diameter was .62 inch.

The chank fisheries of the Ceylon coast of the Gulf of Manaar are protected and regulated by an ordinance, which I give in detail.

ORDINANCE RELATING TO CHANKS.

No. 18.—1890.

WHEREAS it is expedient to amend the Laws relating to chanks and to prohibit the diving for, and collecting of, chanks, bêche-de-mer, coral, or shells in the seas between Mannár and Chilaw: Be it therefore enacted by the Governor of Ceylon, by and with the advice and consent of the Legislative Council thereof, as follows:—

1. This Ordinance may be cited for all purposes as "The Chanks Ordinance, 1890," and it shall come into operation at such time as the Governor in Executive Council shall, by proclamation in the *Government Gazette*, appoint.

2. The Ordinance No. 4 of 1842, intituled "An Ordinance for the protection of Her Majesty's rights in the digging for

and Chanks," and the Ordinance No. 5 of 1842, intituled "An Ordinance for the protection of Her Majesty's Chank fishery," are hereby repealed, but such repeal shall not affect the past operation of either of the said enactments, anything duly done or suffered, or any obligation, or liability, or penalty accrued or incurred under them or under either of them.

Where any unrepealed Ordinance incorporates or refers to any provision of any Ordinance hereby repealed, such unrepealed Ordinance shall be deemed to incorporate or refer to the corresponding provision of this Ordinance.

Definitions. 3. In this Ordinance, unless the context otherwise requires—

"Chanks" includes both live and dead chanks.

"Person" includes any company or association or body of persons whether incorporated or not.

4. (1) There shall be levied and paid on all chanks entered for exportation a royalty at such rates not exceeding one cent on each chank, as the Governor, with the advice of the Executive Council, shall, from time to time by notification in the *Government Gazette*, appoint.

(2) No chanks shall be exported save and except from any port mentioned in the schedule A hereto, or from any other port which the Governor in Executive Council may appoint by notification in the *Government Gazette*.

5. (1) The person entering outwards any chanks to be exported from any port shall deliver to the collector a bill of the entry thereon, expressing the name of the ship and of the master, and the place to which the chanks are to be exported, and of the person in whose name the chanks are to be entered, together with the number and value thereof, anything in the Ordinance No. 17 of 1869 to the contrary notwithstanding, and shall at the same time pay to the collector any sum which may be due as royalty upon the exportation of such chanks.

(2) Such person shall also deliver at the same time one or more copies of such entry, and the particulars to be contained in such entry shall be written and arranged in such form and manner, and the number of such copies shall be such as the collector shall require, and such entry being duly signed

³ *Madras Journal of Literature and Science*, vol. XXIV, 1879, pp. 232-234.

The chank fishery is conducted from Tuticorin, and the shells are found in the vicinity of the pearl banks, in about seven to ten fathoms,¹ either buried in the sand, lying on the sea bottom, or in sandy crevices between blocks of coral rock. The fishery goes on during the north-east monsoon, from October to May, and is worked by native divers, who, putting their foot on a stone to which a long rope is attached, are let down to the bottom, carrying a net round the waist, in which they place the chanks as they collect them. The shells of the chank are scattered about, and not aggregated together in clusters like those of the pearl oyster, so that the divers have to move about on the bottom from place to place in search of them. The divers usually stay beneath the surface about fifty seconds. The longest dive which I have myself witnessed was fifty-four seconds, and on that occasion the diver, on his return to the surface, innocently inquired how many minutes he had been under water. A single case is on record of a native diver being drowned from greed in overloading his net so that he was unable to rise to the surface.

The number of chanks collected in a day varies very much according to the number of divers employed and other conditions; and the records show that as many as six thousand or as few as four hundred have been collected. The divers, who are furnished with canoes, ropes and other apparatus, are paid at the rate of Rs. 20 per thousand shells. At the close of the day's fishery the chanks are brought on shore, and examined. Those which are defective, either from cracks or irregularities of the surface from their having been gnawed by fishes or bored by marine worms, are rejected. The remainder are tested with a wooden gauge having a hole $2\frac{3}{4}$ inches in diameter. Those shells which pass through this hole are discarded as being too small, and returned to the sea on the chance that the animal may revive and continue to grow; those which are too large to pass through the hole are stored in a godown (store-house), where the animal substance is got rid of by the process of putrefaction, which is assisted by flies and other insects. In the month of July the shells are sold by auction in one lot to the highest bidder. In 1886 the highest offer was Rs. 96 per thousand by a native of Kilakarai, which was accepted.

¹ For a discussion of the chank as an enemy of the pearl oyster, vide Mr. H. S. Thomas' Report on Pearl Fisheries and Chank Fisheries, Madras, 1884.

The following statement shows the number of chank shells fished, and the net amount realised from 1881 to 1893 :—

1893:—

Years.	Chanks fished.	Net amount realised.	Remarks.
		RS.	
1881-82	303,590	28,450	The good results in 1880-81 were due partly to the beds having been very little fished for three years; but mainly to the employment of coral divers, whom the Ceylon Government refused to receive for their pearl fishery.
1882-83	247,696	22,038	
1883-84	210,005	11,347	
1884-85	No fishery.		
1885-86	332,757	23,970	
1886-87	183,398	10,703	
1887-88	50,558	4,137	
1888-89	26,537	901	
1889-90	55,639	3,091	
1890-91	343,726	19,413	
1891-92	316,354	8,038	
1892-93			
Total	...	1,32,088	

It would seem from Simmond's 'Commercial products of the Sea' that the chank fishery was, in days gone by, more lucrative than it is at present; for it is there stated that "frequently 4,000,000 or 5,000,000 of these shells are shipped in a year from the Gulf of Manaar. In some years the value of the rough shells, as imported into Madras and Calcutta, reaches a value of £10,000 or £15,000. The chank fishery at Ceylon at one time employed 600 divers, and yielded a revenue to the Island Government of £4,000 per annum for licenses."

A right-handed chank (*i.e.*, one which has its spiral opening to the right), which was found off the coast of Ceylon at Jaffna in 1887, was sold for Rs. 700. Such a chank is said to have been sometimes priced at a lakh of rupees (Rs. 1,00,000); and, writing in 1813, Milburn says² that a chank opening to the right hand is highly valued, and always sells for its weight in gold. Further, Baldæus, writing towards the end of the seventeenth century, narrates the legend that Garroude flew in all haste to Brahma and brought to Kistna the *chianko* or kinkhorn twisted to the right.

The curious egg capsules of the chank, of which many specimens were brought up for me by the Tuticorin divers,

² *Oriental Commerce*, vol. I, p. 357.

in the Criminal Procedure Code to the contrary notwithstanding.

(2) All forfeitures may be sold or otherwise disposed of in such manner as the police court may direct.

12. It shall be lawful for the court imposing a fine under this Ordinance to award to the informer any share not exceeding a moiety of so much of the fine as is actually recovered and realised.

SCHEDULE A.

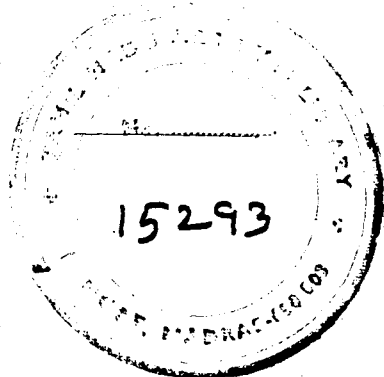
Kankésanturai.
Kayts.

Jaffna.
Pésálai.

SCHEDULE B.

Eastward of a straight line drawn from a point six miles westward of Talaimannar to a point six miles westward of the shore two miles south of Talaivilla.

Passed in Council the Nineteenth day of November, One thousand Eight hundred and Ninety.



by the collector shall be the warrant for examination and shipment of such chanks.

6. Every person who shall export chanks from this Island except from any port mentioned in schedule A, or from any port appointed by the Governor in Executive Council under section 4, or contrary to the requirements of section 5, shall be guilty of an offence punishable with simple or rigorous imprisonment for a period not exceeding six months, or with a fine not exceeding one hundred rupees, or with both.

7. If any chanks subject to the payment of any sum due as royalty in respect of exportation shall be laden or water-borne or be laden on board any ship before due entry shall have been made and warrant granted, or before such chanks shall have been duly cleared for shipment, or if such chanks shall not agree with the bill of entry, the same shall be liable to forfeiture together with the package in which they are contained.

8. It shall not be lawful for any person to use any dredge or other apparatus of a like nature for the purpose of fishing for or collecting chanks, and every person using any dredge or other apparatus of a like nature for such purpose shall be guilty of an offence punishable with simple or rigorous imprisonment for a period not exceeding six months, or with fine not exceeding one hundred rupees, or with both; and every dredge or apparatus of a like nature so used as aforesaid shall be forfeited.

9. It shall not be lawful for any person to fish for, dive for, or collect chanks, bêche-de-mer, coral, or shells in the seas within the limits defined in schedule B hereto and every person who shall fish for, dive for, or collect, or who shall use or employ any boat, canoe, raft, or vessel in the collection of chanks, bêche-de-mer, coral, or shells in the said seas, shall be guilty of an offence punishable with simple or rigorous imprisonment for a period not exceeding six months, or with fine not exceeding one hundred rupees, or with both; or

every boat, canoe, raft, or vessel so employed as aforesaid, together with all chanks, bêche-de-mer, coral, or shells unlawfully collected, shall be forfeited.

Provided that nothing in this section contained shall prevent any person from collecting coral or shells from any portion of the said seas in which the water is of the depth of one fathom or less.

Provided also that it shall be lawful for the Governor in Executive Council from time to time or at any time, by notification in the *Government Gazette*, to alter the limits defined in schedule B hereto, or exempt any portion or portions of the seas within the said limits from the operation of this Ordinance.

10. (1) Any chank, bêche-de-mer, coral, shell, boat, canoe, raft, vessel, dredge, or apparatus liable to forfeiture under this Ordinance may be seized by any officer of the customs or police, or by any headman, or by any person appointed for that purpose in writing by the

government agent of the province or the assistant government agent of the district within which such seizure is made, and when seized shall be conveyed to the custom-house nearest to the place of seizure and there detained until the court having jurisdiction in the matter has determined whether the same shall or shall not be forfeited.

(2) If any such officer, headman, or person shall neglect to have any chank, bêche-de-mer, coral, shell, boat, canoe, raft, vessel, dredge, or apparatus seized by him conveyed to such custom-house within a reasonable time, he shall be guilty of an offence and liable to a fine of one hundred rupees.

11. (1) Every prosecution under this Ordinance may be instituted in the police court of the division in which the offence was committed or where the offender is found, and such court may by its order declare and adjudge any chank, bêche-de-mer, coral, shell, boat, canoe, raft, vessel, dredge, or apparatus seized and detained under this Ordinance to be forfeited, and such forfeiture may be in addition to any other punishment hereinbefore prescribed, anything