DISTRIBUTION OF CORAL REEFS IN THE GULF OF MANNAR AND PALK BAY AND THEIR EXPLOITATION AND UTILIZATION

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ABSTRACT

Running parallel to the shore in the Gulf of Mannar along the Indian coast are situated 21 islands of limited extent between Lat. 8°47' N—Long. 78°12' E and Lat. 9°15'N—Long. 79°14'E. These islands are extensive in the depth and quantity of the coral reefs around them. In addition to these islands, coral reefs exist also around the Rameswaram Island, the largest island in this series, which is all but contiguous with the mainland but for a short span of 2 km from Thonithurai to Pamban. Here the reefs start from NNE of Rameswaram shore and run around Devil's Point parallel to the shore and extend up to Mandapam in Palk Bay where they end.

The corals of these localities are being quarried for industrial purposes. The Tuticorin type of boats with a small crew of fishermen operate for breaking the corals during the months of October to May in the Gulf of Mannar and May to September in the Palk Bay. The bulk of the stones quarried now are from the islands north of Nallatanni tivu. The collection and utilisation of coral stones in the carbide industry and in the lime manufacture are detailed and the economics of the coral stone fishermen are given. The annual rate of removal of coral stones at the present level of exploitation seems to warrant a detailed survey of the exploitable coral resources in the area now exploited and the enforcement of a scheme for rational exploitation of the coral stones.

INTRODUCTION

The Gulf of Mannar appears to be a unique zone with regard to the variety of fishing activities and in respect of the general fishing potential. Fishermen living in the villages and hamlets along the coast of the gulf eke out their livelihood by landing considerable quantities of fishes by brisk fishing all the year round with different types of craft and tackle combinations in different localities. In addition to these, the nature of the sea-bottom in the inshore

area of this zone supports certain fishing occupations which are not met with in most other zones of the Indian coast. These are the chank fishing, pearl oyster fishing and coral quarrying, of which the last is of particular interest to us, because not much information is available about the coral stone quarrying. The fishermen find a steady income in bringing coral stones or coral blocks broken by them from the shallow areas adjoining the many small islands between Tuticorin in the south and Pamban at the head of the gulf.

Coral reefs exist along the Palk bay side also bordering Mandapam and along the northern shore of the Rameswaram Island. Exploitation is resorted to by the gulf fishermen from this area also.

The corals are eventually used in industrial sector, especially in calcium carbide production. Mandapam and Tuticorin are two of the important bases for the collection and stacking of these coral stones, although near by villages also form bases for occasional dumping. In addition to the massive corals , enormous quantities of water-worn fragments of *Acropora* spp. which are washed ashore and accumulate along the beach of the islands are also collected and transported to the mainland for making lime for domestic use. For this purpose live coral is not desired, neither are the massive corals considered good, as they are much more expensive in fuel to calcine thoroughly than the fingerlike fragile fragments, locally known as *challi*. Corals, like shells, thus possess economic importance, as a source of lime, wherever they are available in quantity. Whereas the lime and carbide industry consume all but a few of the quantity of massive corals brought ashore, there is always a less but steady demand for the *challi*.

Coral quarrying was a part-time job for many fishermen a few years back, whenever they did not go out for fishing. In many cases people who go out for troll-line go prepared for coral breaking work also, should they fail to get good catches. With the tempo of exploitation increasing with the demand from the industrial sector the coral-stone quarrying has become a full-time occupation. The largest contingent of 41 boats exclusively doing this work to meet the industrial requirements operate from Mandapam area landing the corals at Mandapam itself. In addition there are nearly 20 boats in Tuticorin which are employed in coral stone fishing industry.

Areas of Exploitation of Coral Blocks

Gulf of Mannar

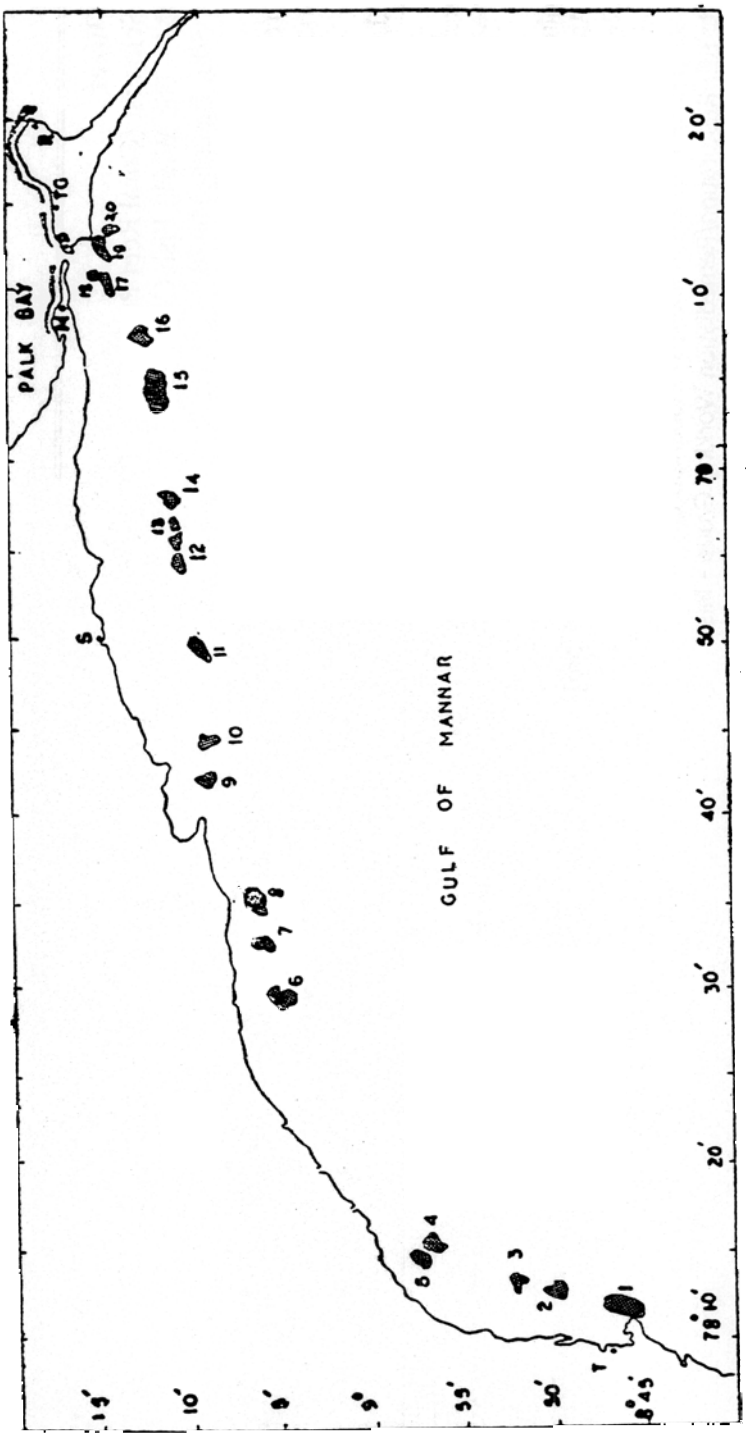
Lying at an average distance of 8 km from the shore and running parallel to it are situated 20 islands of limited extent between 8°47'N Lat—78°12'E Long and 9°15'N Lat—79° 14'E (Map 1). These islands are (starting from Tuticorin, proceeding northwards):—

No.	Name of island	Approx. distance in km. from the previous island	Location
1.	*Hare Island (Pandyan tivu)**	0	Lat. N 8 47'—78 12'E Long
2.	Van tivu	5	.. 8 50'—78 13' ..
3.	Karsewar tivu	3	.. 8 52'—78 13' ..
4.	Karai challi tivu	8	.. 8 57'—78 14' ..
5.	Velangu challi tivu	6	.. 8 56'—78 15' ..
6.	Upputanni tivu	19	.. 9 05'—78 30' ..
7.	Puzhukuni challi tivu	3	.. 9 06'—78 35' ..
8.	Nallatanni tivu	3	.. 9 06'—78 35' ..
9.	Anaipaar tivu	14	.. 9 09'—78 42' ..
10.	Valliamunai tivu	17	.. 9 09'—78 44' ..
10a.	Poovarasanpatti tivu		.. 9 09'—78 49' ..
11.	Appa tivu	9	.. 9 09'—78 49' ..
12.	Talayari tivu	9	.. 9 11'—78 54' ..
13.	Valai tivu (2 islands)	5	.. 9 11'—78 56' ..
14.	Mulli tivu	1.5	.. 9 11'—78 56' ..
15.	Musal tivu	9.5	.. 9 12'—79 05' ..
16.	Manauli tivu	6.5	.. 9 13'—79 07' ..
17.	Pulli tivu	8	.. 9 14'—79 11' ..
18.	Pullivasal tivu	8	.. 9 14'—79 11' ..
19.	Krusadai tivu	0.5	.. 9 15'—79 12' ..
20.	Shingle tivu	1.5	.. 9 15'—79 14' ..

Excepting Krusadai tivu all these islands are uninhabited, only watchmen, some camping fishermen and grazing cattle being found on them. Most of the islands are small, less than 5 sq km. The islands themselves are made up fundamentally of a rigid calcareous framework of inter-locked and enmeshed skeletons of dead corals. Fringing these islands on all sides in the shallow waters are coral reefs with both massive or nodular and ramose corals. Such are especially the reefs forming the long chain stretching from Valinokam point to Pamban. These islands are considered to be very extensive in the depth and quantity of corals occurring. The coral reefs stretch as a low sloping beach deepening fairly evenly at the rate of about two metres in 3 km. It is only these reefs, lying in the shallow area, which the fishermen break to get their coral stones. The genus mostly exploited happens to be *Porites*. The owners of these islands, either the Government of Madras or in one or two instances private individuals, lease the right of collection. The port authorities levy Rs. 0.25 per cubic metre of coral brought by the fishermen from the coral beds. At present the Madras Government have leased 2 or 3 islands to private industrialists and the

* With the proposed Tuticorin Harbour construction this has been made one with the mainland and hence ceases to be an island.

** tivu means island.



MAP. 1. — Showing the islands in the Gulf of Mannar and the coral reefs in Palk Bay, 1. Hare Island (Pandyan tivu) 2. Van tivu 3. Karsewar tivu 4. Kerni challi tivu 5. Velangu challi tivu 6. Upputanni tivu 7. Puzhukuni challi tivu 8. Nallatanni tivu 9. Anaipaar tivu 10. Valliamunai tivu 10a. Poovarasanpatti tivu 11. Appa tivu 12. Talayari tivu 13. Talai tivu (2 island) 14. Mulli tivu 15. Musal tivu 16. Manauli tivu 17. Pulli tivu 18. Pullivasal tivu 19. Krusadai tivu 20. Shingle tivu T. Tuticorin M. Mandapam P. Pamban TG. Thangachimadam R. Rameswaram S. Sethukarai.

private owned islands are also exploited on payment of seigniorage on each boat load of corals removed.

Palk Bay

The coral reefs in the Palk Bay start from Munakkad as a wall-like formation 1-2 m broad and run east up to Tonithurai for a distance of nearly 5.5 km. Here the width of the reef attains more than 300 m. The reef again starts from Pamban light-house beacon very near the shore and runs east to Thangachimadam, Ariyankundu, widening as it reaches Devil's Point, Olaikuda, and ends wth Agnitheertham (Rameswaram). Except for a small gap of 1 km off Thangachimadam the reef thus extends all along the northern shore of the Rameswaram Island. These beds were exploited for 4 years, from 1960 to 1964, by individual boats. But the Government have stopped this now. Although these beds are said to be doubly productive, exploitation is uneconomical due to the transport difficulties in the island.

Method of Quarrying

The fishermen engaged in this profession are mostly drawn from Tuticorin, Vedalai and Kilakarai. The boats used by them are of Tuticorin type, both 20 cubic m or 22 cubic m capacity. Usually 5-6 fishermen go out for the work. This number varies depending on the place of operation and its distance from the base of operation. Tuticorin-based boats carry with them sufficient food and water to last for 2 or 3 days, whereas the boats operating from Mandapam, Vedalai and Sethukarai return within 24 hours with the load of stones. For breaking the coral blocks the fishermen use only iron crowbars.

The best season for them to exploit the coral reefs is from October to May, i.e., the northeast monsoon period when the weather is fair in the Gulf of Mannar and water fairly clear around the islands. However, during the calm days of the rest of the year also, they do attempt coral breaking. During the southwest monsoon period the boats stationed at Mandapam move over to the Palk Bay side of the village and operate there, as and when necessary. Boats at Tuticorin do not stretch out that far as it would be uneconomic for them.

The reefs are exploited during the receding tide and the work concluded when the tide comes in. While two persons get into knee-deep water and make holes on coral blocks at fixed intervals, others reconnoitre the adjacent portions and fix up the area for next operations. Once the area for optimum exploitation is fixed up they also busy themselves in breaking coral stones. They cannot afford to waste their time since the incoming tide will hamper the operations once it rises above chest level. During the low tide they break as many blocks as possible. The blocks thus broken are not removed immediately. After the work for the day is over the boat is taken to the places where the broken blocks lie and with the help of pulleys in the mast they lift the blocks into the boat. This system conserves their time and energy.

Normally each boat can carry a maximum of 5-7 cubic m of stone. The boats landing the stones at Tuticorin pay out troll-lines on their way back home for catching seer, tunnies, carangids, leather-jackets and barracuda so that this will be an additional revenue for them.

After the stones are landed ashore they are neatly stacked on the beach (Pl. I, Figs 1 & 2) in such a way as to facilitate easy check-measurement by the prospective buyers. The stones are sold by volume and not by weight. One cubic metre is purchased at Rs. 11/- at Tuticorin and Rs. 7/- to 10/- at Mandapam by the agents who in turn sell them to the industrial units at their price. The transport of coral stones from the seashore is by lorries only at Tuticorin. The stones at Mandapam area are heaped, after check measurement, near the railway goods yard (Pl. 1, Fig 3) and dumped into the lorries or the goods wagons (Pl. I, Fig 4) for transport by road or by rail.

The exploitation is at present confined to the islands north of Nallatannitivu; the islands down south are considered to be uneconomic areas due to the reefs being in deeper waters and not so extensive. Tuticorin fishermen go up to Valai tivu, a near distance of 60 km from the town and land the corals at Tuticorin itself. The operation is a little easier for those who go to this island with Sethukarai as base because of its proximity to the island. Limited exploitation has been permitted from Mandapam beds in the Palk Bay on a short-term basis for the construction of Indo-Norweigian Project fisheries buildings and jetty at Mandapam on the Palk Bay shore.

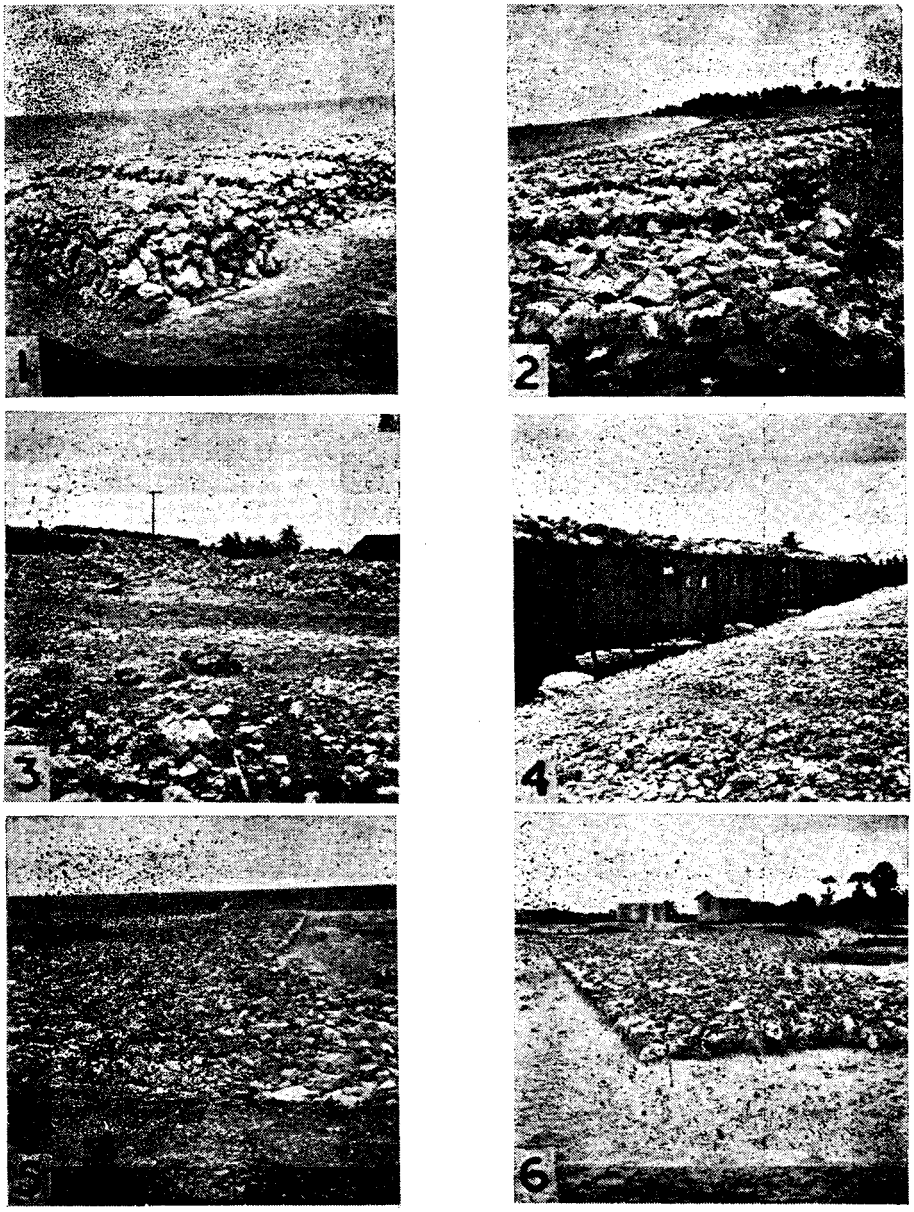
The fishermen concentrate in removing corals of *Porites* spp. Pillai (1967) lists *P. somaliensis* and *P. solida* as common in these zones. These are called *nuraikallu* in Tamil. 90% of these stones are consumed for industrial purposes in Tirunelveli District. But there are other uses to which they are put, as such. The stones are chiselled to cubes of side 20-30 cm depending on the requirements and allowed to dry up in the sun for some time before being used in erecting walls for buildings. Where finer masonary is desired these stones are cut and ground well and finished as coral bricks of convenient sizes. They are also used (Pl. I, Figs. 5 & 6) in paving the portico in the houses. Coral bricks are used in laying air strips in foreign countries, it is gathered. Coral stones are pounded and powdered to a very fine grade for use in domestic life in cleaning vessels and in floor decorations.

Corals of the genera *Favia, Favites, Goniastrea, Platygyra, Pavona* etc. are also taken by the fishermen but graded separately and marketed for house building purposes at comparatively less price. Because of this factor most of the houses in fishing villages along the gulf coast are built of these coral stones.

Economics of the Stone-quarrying Fishermen

The coral stones brought ashore, about 5-7 m^3 are sold at the rate of Rs. 11/- per cubic m. (This in turn is sold at Rs. 22/- per m^3 by the agents

PLATE I

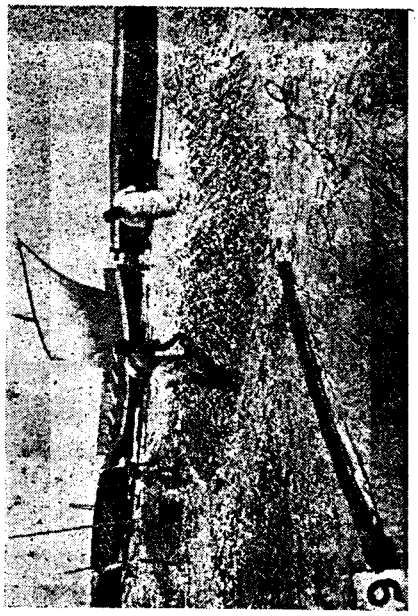


1 AND 2 Stacks of coral blocks (mainly *Porites* sp.) on shore, after being landed from nearby islands.

3 AND 4 Transport of coral stones by rail (3. corals stacked in railway yard and 4. nearby islands.)

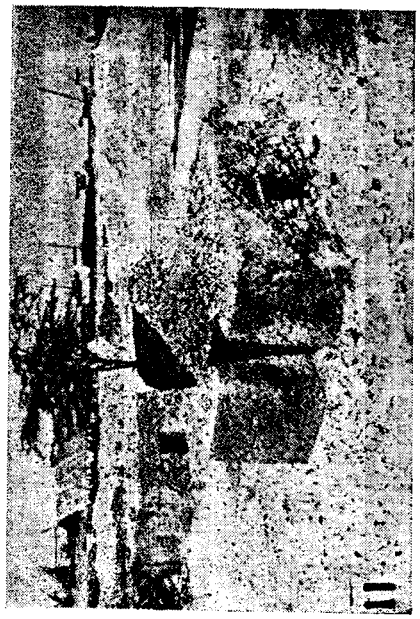
5 AND 6 Coral stones used in road making in sandy areas.

PLATE II



7. Tuticorin type of boat landing *Challi* ashore. 8. Heaps of *Challi* ready for disposal.
9. Check measurement by a prospective buyer. 10. General view of the lime kilns in Tuticorin. Those in view are double kilns, round type.

PLATE III



11. Square type lime kiln with the *Challi* heaped in it ready for burning. 12. *Challi* stacking in progress in a square type double kiln. 13. Calcining in progress. 14. At the end of calcining process.

to the industrialists). This works out at Rs. 77-00 per boat of 6 people for 2 days and Rs. 5-50 per day per head. This rate is the same as given by Silas (1967). He calculated at Rs. 3-50 per head for 1967, assuming that 9 people go in a canoe, which factor varies. If more people go in the same boat the average earning per head scales down.

Estimate of the Coral stone landings

In Mandapam area it has been estimated that daily 40 tonnes of stones are moved by railways and 25 tonnes by road, during the months of October-May. This would mean an out-put of 15,000 tonnes for 8 months and for the rest of the months a minimum of 5,000 tonnes is sent. At Tuticorin the landings are calculated to be 5,000 tonnes annually. Thus it may be seen that a modest estimate of 25,000 tonnes of stones are exploited from the Gulf of Mannar and Palk Bay regions. In terms of volume of stones removed annually it may amount to 60,000 cubic m.

The above figures are tentative and are based on the available information to the best of our knowledge since no official or authentic records are available for calculating the same.

Utilization of Coral for Lime Burning

Collection of coral fragments—'Challi'

The worn-out fragments *'Challi'* are exclusively used for lime burning These are collected from knee-deep water by means of iron mops and dumped into the boat as such—a comparatively less arduous task than coral quarrying. Later they are brought to the mainland (Pl. II, Fig. 7) and heaped to facilitate check measurement (Pl. II, Figs. 8 & 9). Prior to 1950 one canoe load cost Rs. 2/- to Rs. 3/-. But the prevailing market rate is higher.

On an average 3 canoe-loads of *Challi* are brought ashore per day and each canoe lands at the most 7 m^3 of coral bits. This would mean that 650 m^3 *challi* per month or 7,800 m^3 per year are landed at Tuticorin. At present one boat-load of stone fetches anything between Rs. 30/- and 35/-, depending on the quantity brought. The current market price is Rs. 5.25 per m^3. Thus annually the fishermen derive an income of about Rs. 41,000/- at Tuticorin alone.

Economics

It has been worked out that the fishermen are away for an average of 48 hrs per trip from the shore and 3 people go out on a trip, excluding the urchins taken along with them. The earning per boat per trip works out to Rs. 36-75 (for 7 m stone @ Rs. 5.25 m). This represents earnings for 2 days and hence will make Rs. 18-00 per day. Of this amount the boat owner gets 1½ shares and others get 1 each. Invariably the boat owner also happens to be one of the members of the crew. So he gets his share for that too. Thus

the amount is divided in the ratio, 3:2:2:2. In this case out of 9 shares the two fishermen get 2 each and the owner gets 5 shares. The earnings work out at Rs. 10/- per day for the owner and Rs. 4/- each for the fishermen.

The coral fragments purchased by lime kiln owners are taken in baskets and put in kilns and calcined. Depending on the size of the kilns 4-5 canoe-loads of *challi* are charged at a time for burning in different kilns. This quantity takes many days to calcine. The owner reckons to burn 4 charges per month.

Lime kilns

All the coral stone lime kilns in Tuticorin are concentrated in the area north of where the Puckle channel connects with the sea. The foreshore here is extensive and is dotted with innumerable lime kilns both functional and defunct. This area is quite suitable for the work since the boats can easily land the coral stones right near the kilns and road transport is thus avoided. The land belongs to the Government and is given on lease to a few who have monopolised this industry. The lessee pays Rs. 35/- per annum to Government for a large kiln and Rs. 25/- per annum for a small kiln. The largest lime kilns built of coral and mortar are found in Tuticorin only. Others in Pinnakayal, Kayalpatnam, Tharuvaikulam and other places are small ones and mainly shells are burnt. There are 23 double kilns (Pl. III, Fig. 11) and 22 single unit kilns (Pl. II, Fig. 10) in Tuticorin. No particular size is preferred. But generally they are either square-walled (Pl. III, Figs. 12 & 13) or round-walled, single or double units (Pl. III, Fig. 14). The principle of operation is the same in all types. Some useful information is given below about the size and dimensions of lime kilns for purpose of comparison.

	Single Unit (in metre)		Double Unit (in metre)	
	Square wall	Round wall	Square wall	Round wall
Length	2.6	2.8	6.5	6.5
Breadth	2.6	—	3.6	—
Height	1.3	1.7	1.7	1.7
Wall: thickness	0.3	0.3	0.6	0.6
Diameter of opening	1.3	1.3	1.7	1.7
Diameter of ventilators	0.5	0.5	.82	1.0

(The mouth opening is wide at the top and narrows down to the base like a funnel, the diameter at the bottom being about 3/4 of the opening above).

The fuel used for burning is *Acacia* wood. Also in great demand is the coal brought by the local divers from the steamer anchorage. While unloading coal from steamers into the lighters a considerable quantity of coal falls

into the sea, which is recovered by divers and sold clandestinely. The price for this varies from Rs. 20/- to Rs. 22/- per *lasthiri* (one *lasthiri* in the local parlance means 3.5 cubic feet of coal). The coal is dried and broken into small bits. After spreading one layer of *challi* inside the kiln, a layer of coal powder is spread over it, and so on. The fragments which are calcined with this coal gives more whiteness to the lime (and hence costs Rs. 3-50 per *lasthiri*) than the wood-burnt or charcoal-burnt lime (which coasts Rs. 3/- per *lasthiri*). It is said that about 2/3 of the total coral material is recovered as useful for lime. The rest becomes powdery.

General Remarks

The Gulf of Mannar is the only area in the south Indian penunsula where continuous stretches of coral reefs occur near shore (except for a small strip in the Palk Bay side of Mandapam and Rameswaram Island). The exploitation of the coral reefs has assumed a new dimension with its great potential for establishing industrial bases. This exploitation of the reef should be commensurate with the growth rate and the ability for possible repopulation of the exploited species so that the danger of denuding the islands, which act as a front line natural barrier against the fury of wind and erosion, does not pose serious problems. The annual rate of growth of coral has been found to be very slow.

Observance of 'close season', 'close area' and judicial exploitation of the stock etc. are called for even at this stage. The uniqueness of the Gulf of Mannar as the well known collection ground and a 'Paradise of Zoologists' is mainly because of the reef fauna. The disturbance to animal communities and their environment resulting from the coral stone breaking is undesirable as far as the biologists are concerned. A balance will have to be struck between the interests of the industrialists and the interests of the scientists before it is too late. No correct evaluation of the total exploitable coral stones available in the area seems to have been attempted so far. It is learnt that some of the interested parties made a rough survey of the resources before embarking on the industries based on coral stone availability. A preliminary underwater survey of the areas in and around many of the islands has also been undertaken recently. But these are not enough. It is hoped that more detailed and accurate surveys will be made in the years to come, in order to enable us to know the quantity of corals that could be exploited for industrial purposes without being detrimental to the safety of the islands.

Acknowledgements

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REFERENCES

PILLAI, C. S. GOPINADHA. 1967. 'Corals' Souvenir, 20*th anniversary. Central Marine Fisheries Research Institute*:121-124, pls. 2.

HORNELL, J. 1916. The utilization of corals and shells for lime burning in the Madras Presidency. *Madras Fish. Dept. Bull.*, 8:105-125.

SILAS, E. G. 1967. Tuna fishery of the Tirunelvely coast, Gulf of Mannar. *Proc. Symp. Scombroid Fishes.* 3:1083-1118.