J. Mar. biol. Ass. India, 1963, 5 (1): 133-136

MARINE BIOLOGICAL AND OCEANOGRAPHIC INSTITUTIONS OF THE WORLD

VII. THE WOODS HOLE OCEANOGRAPHIC INSTITUTION, WOODS HOLE, MASS., U.S.A.

By THE DIRECTOR

W. H. O. I., Woods Hole

'Today, man must learn how to understand and use the vast resources of the oceans in all their depth and scope, through ways undreamed of by the great explorers of the past.

'Our goal over the years has been to observe, describe, measure and understand all the phenomena within the earth's waters, as well as in the atmosphere above and the earth below.'

The Woods Hole Oceanographic Institution was chartered in 1930 as a private, non-profit organisation devoted to the exploration and study of all aspects of the world's oceans. Since the science of Oceanography is actually a composite of a number of scientific disciplines, members of the Institution's Research Staff include specialists in the fields of physics, chemistry, biology, meteorology, mathematics, geology, electronics and geophysics.

The Institution employs around 500 people year round in all categories—scientists, technicians, fleet personnel, and maintenance—making it the largest private employer on Cape Cod. Total operating budget for fiscal 1962 was around $ 7,500,000.

The scientific work of the Institution is divided into six departments, each with a department chairman—Physical Oceanography, Applied Geography, Applied Oceanography, Geophysics, Theoretical Oceanography & Meteorology, Chemistry & Geology, and Biology. This year around 85 investigators with research staff appointments are in residence at Woods Hole, some of them during the summer months only. The Director of the Institution is Dr. Paul M. Fye.

Some of the investigations currently underway include participation in the biology, physical oceanography and meteorology programmes of the mutli-nation Indian Ocean Expedition; participation in the international oceanographic study of the equatorial Atlantic Ocean; co-operation with the U.S. Geological Survey in a five-year geological study of the eastern U.S. continental shelf; co-operation in some aspects of the Mohole Project; a long-range study of the growth and distribution patterns of tunas and other large fish; studies relevant to the disposal of radioactive wastes in the oceans; studies of the acoustical properties of the oceans, and many more. Support of scientific projects comes from numerous sources chiefly the Navy and the National Science Foundation.

Physical facilities ashore include three large laboratory buildings, one of which was opened this year, docks and numerous auxiliary buildings. The fleet includes six vessels, five of which are capable of sustained ocean cruises. They are: *ATLANTIS* II, a 210-foot ship especially designed for oceanographic research work, delivered in January of this year; *ATLANTIS*, a 142-foot steel-hulled ketch, the first vessel operated by this Institution and now used primarily for the training of student oceanographers; *CHAIN*, a 213-foot former Navy salvage ship; *CRAWFORD*, a 125-foot Coast Guard cutter; *GONSOLD*, a 99-foot ex-cargo vessel; *ASTERIAS*, a 40-foot flounder dragger. In the air the Institution operates a Heli-Courier and a four-engine C54Q, both of which are adapted for oceanographic work.

Aside from actual science, the Institution also conducts a growing educational program that includes four formal summer courses for advanced science students, a predoctoral and postdoctoral fellowship program and a program for summer fellows. In addition, around 100 students are employed each summer and assigned to regular research projects. The facilities of the Institution are also available to visiting investigators who come to Woods Hole in pursuit of particular problems within the realm of oceanography.

The Institution's Contribution to the International Indian Ocean Expedition

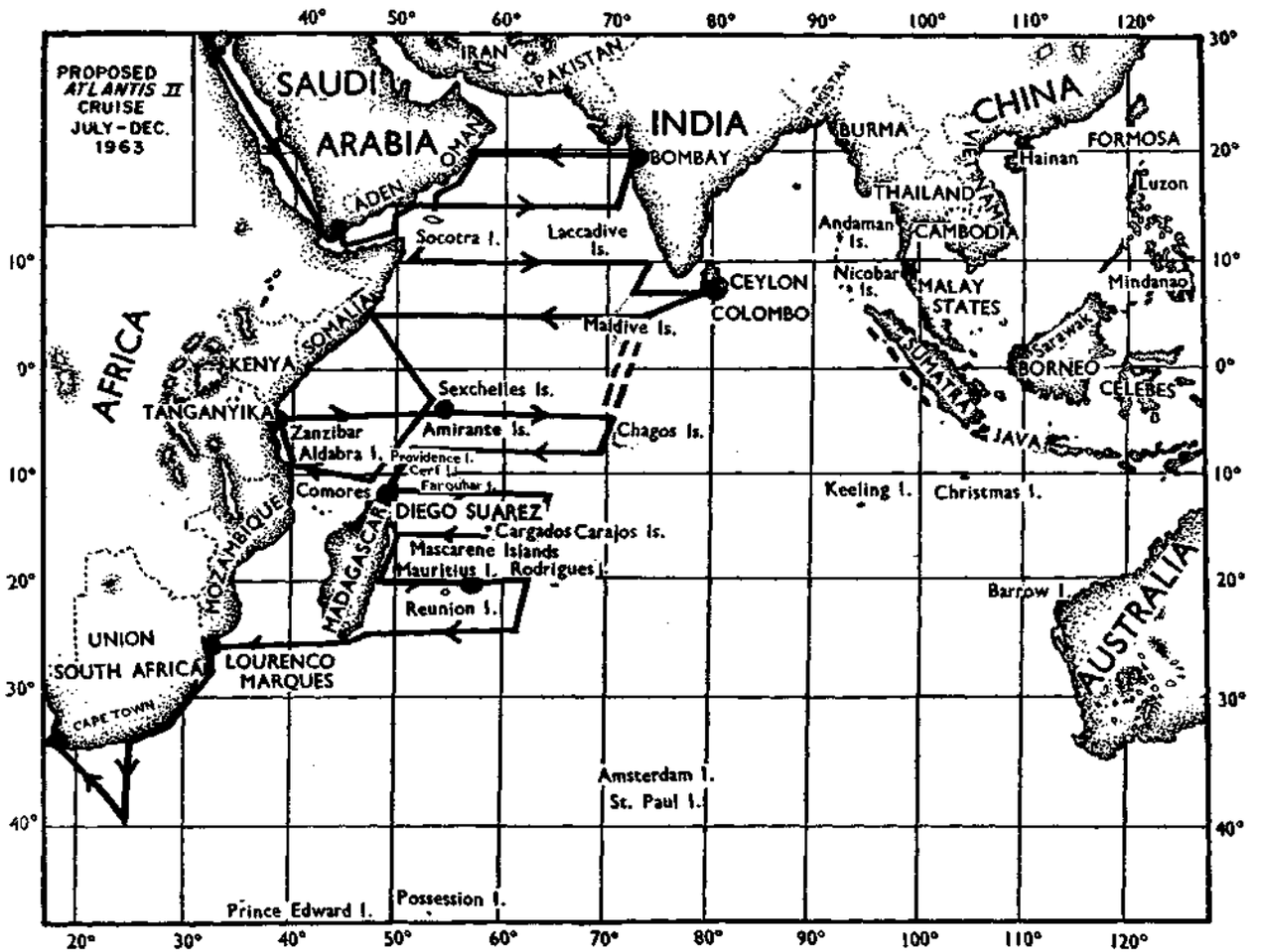
The International Indian Ocean Expedition involves many countries and many ships over a period of several years. The six-month cruise of *ATLANTIS* II, as a part of this Expedition, will call upon a number of allied disciplines in the all-embracing science of oceanography, and at various times a number of nationalities will be represented on board.

The most outstanding feature of the Indian Ocean is its seasonal circulation pattern—the wet monsoon of Northern Summer and the dry winter monsoon—which is unique in the world oceans. *ATLANTIS* II will make many inter-related studies of this phenomenon, some in co-operation with the British vessel R.R.S. *DISCOVERY* II.

Sea and air are bound together by the most obvious and the most subtle links, and scrupulous attention must be paid to air temperature and winds, both by radio-sonde balloon and ship-borne instruments, as well as to probing the surface waters with the in situ salinometer, surface temperature/salinity, recording, and bathythermograph. Current measurements will be made with current meters, deep-floating Swallow buoys, and parachute drogues, the latter being particularly useful in determining the extent and flow of the Somali current, a monsoon phenomenon sometimes flowing over a deeper opposing current.

Evaporation, precipitation and solar radiation will be studied; wave height, the flux of heat from the ocean floor, and sound velocities will be measured. Several hundred hydrographic stations, sampling from surface to bottom, will be spaced out over the whole track of the cruise, the water to be analysed for temperature, salinity, oxygen and phosphorus content.

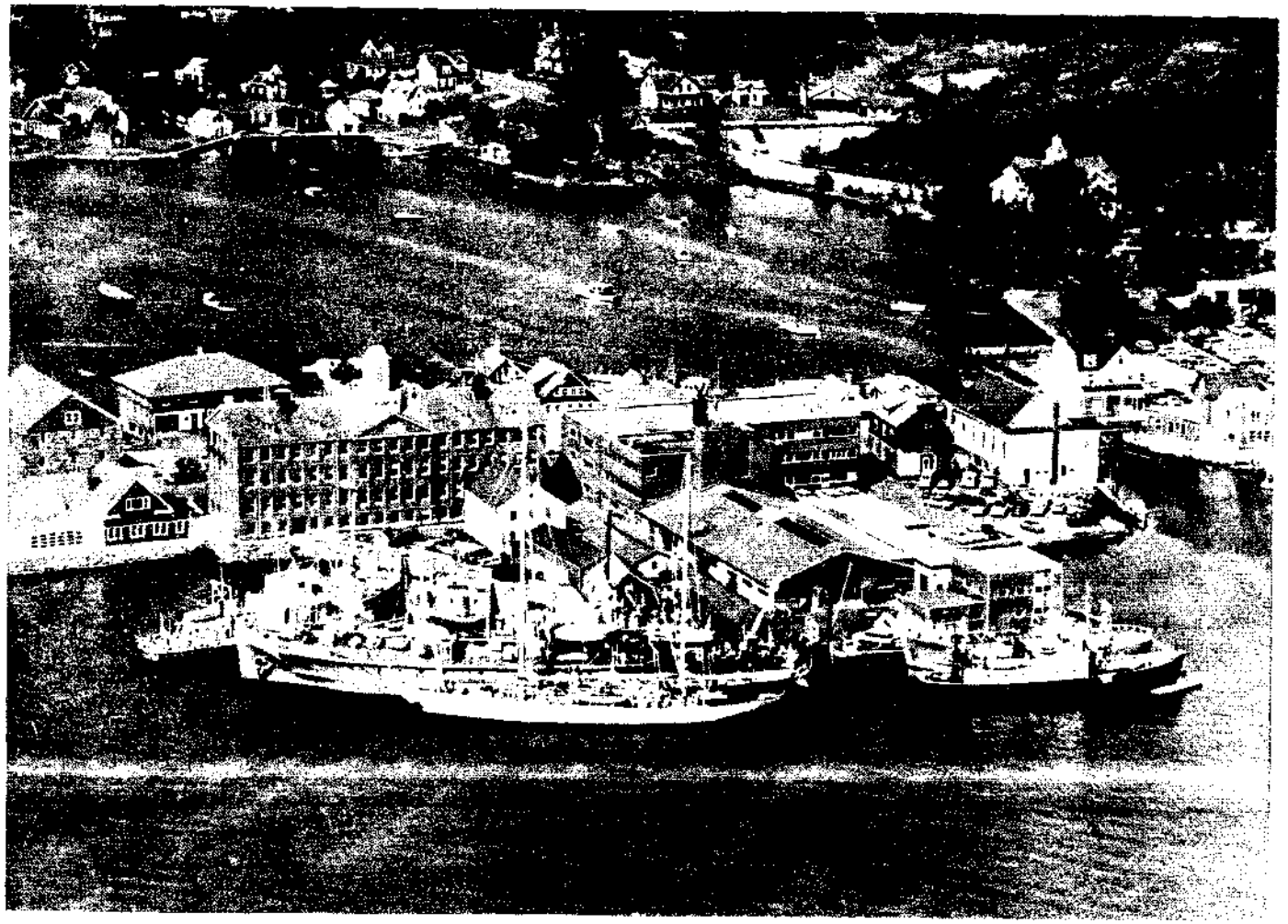
Continuous echo-sounding will chart the sea bottom, and chemical and biological investigation and plankton tows will help to add to the store of information of fisheries installations bordering on the Indian Ocean.



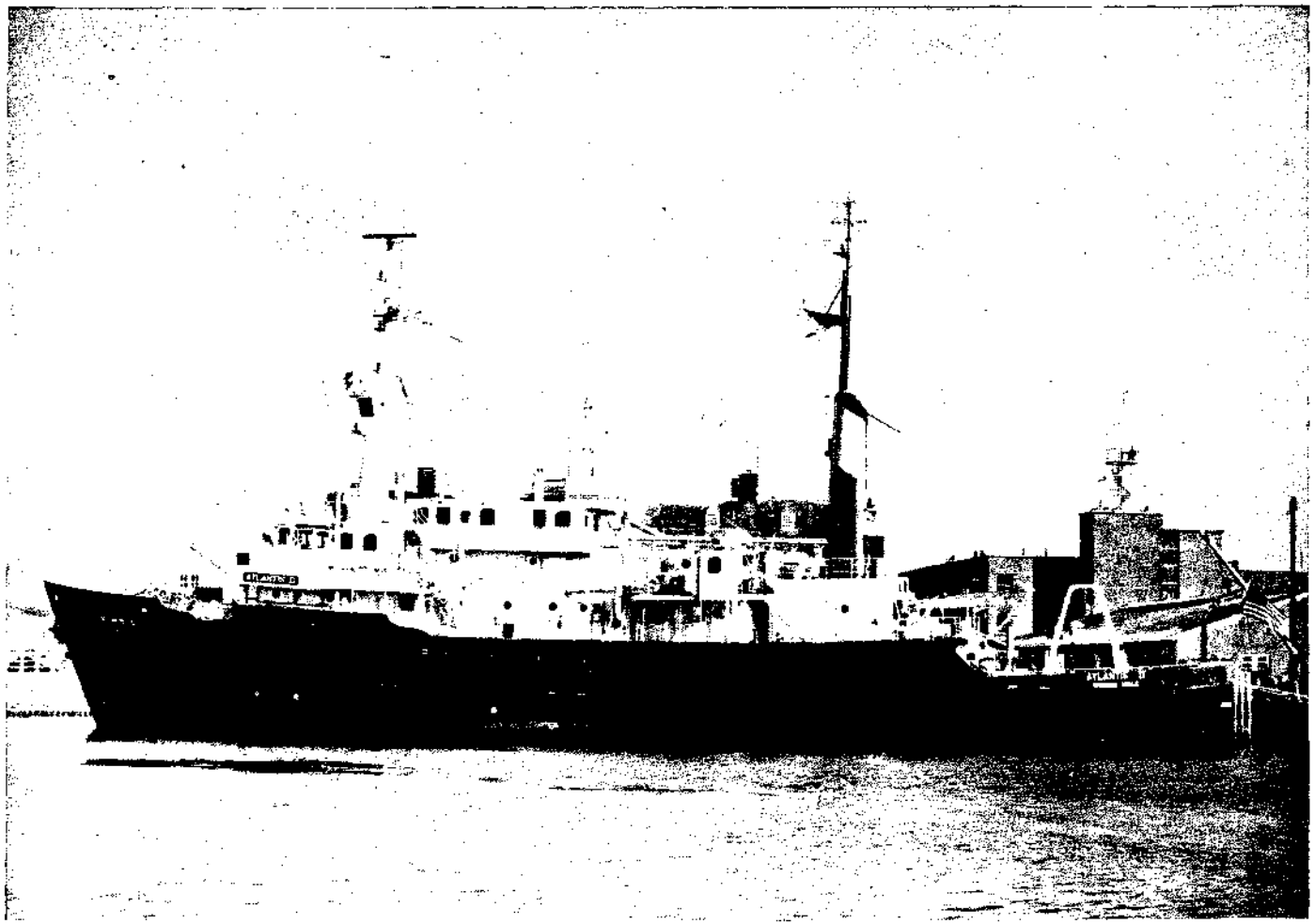
Text-Fig. Proposed Cruise of *ATLANTIS* II, July-December 1963.

This will not be the first visit to the area by a Woods Hole Oceanographic Institution vessel. In the Summer of 1958 the original *ATLANTIS* worked in the Red Sea, the Gulf of Aden and Arabian Sea. Also, in the Spring and Summer of 1963, a Woods Hole four-engine aircraft especially fitted out as a flying meteorological observatory, will be working high above the surface vessels.

Itinerary of *ATLANTIS* II includes Monaco, Aden, Bombay, Colombo, Zanzibar, the Seychelles, Diego Suarez, Mauritius, Lourenco Marques, Cape Town and Barbados, British West Indies (Text-Fig.).



An aerial view of the Woods Hole Oceanographic Institution, Woods Hole, Mass.



ATLANTIS II, the Institution's newest research vessel, has accommodation for a scientific party of 25. It will spend the last six months of 1963 participating in the International Indian Ocean Expedition.

NOTES

ON HELMINTH PARASITES FROM THE MADRAS COAST

There have been several contributions on the helminth fauna of the Indian region, in earlier years, by British and American workers such as Leiper, Southwell, Maplestone, Lane, Buckley, and Chandler, most of them having been of medical or veterinary significance. Those relating to parasites of marine hosts and of fishery importance, especially in the peninsular section of the country were made by Southwell and a few others. Marine biology and Fisheries have always held an important place in the economy of India, a country with a long coast line and three seas around it. While the parasitic fauna of terrestrial and fresh water animals could be explored and experimented upon at any of the institutions located inland, organisms occurring in the sea should necessarily be studied at centres in close proximity to the sea.

In the Department of Zoology, University of Madras, marine biological studies have been conducted for many years, and at least two important contributions made on the trematode and cestode parasites of fishes. Subhapradha (1948, 1951a, 1951b, 1955a, 1955b), surveyed the cestodes, larval and adult, and some Monogenea of the economic fishes of the Madras Coast, and Ramalingam (1952) studied the trematode fauna, especially the monogenetic ones. The latter worker (Ramalingam, 1957) continued his studies on the monogenetic trematodes, at the Central Marine Fisheries Research Station, Mandapam, South India, and included developmental studies on some digenetic trematodes also in his thesis. No further work of this kind has since been undertaken here.

The author conducted her investigations at the University Zoology Department, Madras, for a period of three years (1958-1961), the choice of the subject having been naturally guided by these earlier studies. It was no doubt significant that the digenetic trematodes were inadequately known, and no hosts other than the fish examined. As the animal communities in the ocean exhibit an intricate food chain, it was decided to search for larval and adult parasitic helminths in the rich planktonic and dredge collections, teleosts, elasmobranchs, and birds.

Numerous invertebrate and vertebrate hosts were examined for helminth parasites, and it was observed that quite a proportion among them harboured none at all, while others were parasitized with larval and adult digenetic trematodes, cestodes and a nematode, besides an acanthocephalan, most of them from hosts of coastal distribution. The acanthocephalan, however, was from an Eagle, a bird of prey, expect to consume fish also.

The helminths, examined in living or preserved condition, were representative of: (*a*) the trematode families Allocreadioidea, Hemiuridae, Acanthocolpidae, Prosthogonimidae, Echinostomatidae, Heterophyidae and Cyclocoelidae, of invertebrates, fish and birds; (*b*) cestodes, one of undetermined identity from *Squilla*, tetraphyllidean and trypanorhynchan larvae from invertebrates and fish, larvae of a Diphyllidean in gastropods and decapods, and a Proteocephalid from a teleost; (*c*) Acanthocephala, one from the Booted Eagle; and (*d*) Nematoda, a juvenile

Gnathostome from gastropod. They were identified with already described species, or as new ones, as listed below against their hosts :

1.	Allocreadioid metacercaria	.. *Pleurobrachia globosa.*
2.	Hemiurid metacercariae	.. *P. globosa* and *Beroe* sp., *Eucheilota* .. sp., *Phialucium multitentaculata, Cytaeis tertastyla,* and *Sarsia* sp.
3.	*Lecithochirium trichiuri* n. sp.	.. *Trichiurus haumela.*
4.	*Acanthocolpus* sp., and *A. luhei*	.. *Chirocentrus dorab.*
5.	*Prosthogonimus roberti* n. sp.	.. *Gallinago gallinago.*
6.	*Stephanoprora yamagutii* n. sp.	.. *Larus argentatus.*
7.	*Galactosomum puffini*	.. *Sterna fuliginosa.*
	Galactosomum linguiforme n. sp.	.. *Larus argentatus.*
	Galactosomum witenbergi n. sp.	.. do.
	Galactosomum sp., (juvenile)	.. *Matuta victor.*
8.	*Cyclocoelum* sp. (No. 1)	.. *Tringa glareola.*
	Cyclocoelum sp. (No. 2)	.. *Gallinago gallinago.*
9.	Cestode larva (?)	.. *Squilla holoschista.*
10.	Tetraphyllidean larvae	.. *Trichiurus haumela, Megalops, Harpa, Oliva, Meretrix casta, Matuta victor, Pleurobrachia globosa, Eucalanus pseudattenuatus.*
	Trypanorhynchan larvae	.. *Chirocentrus dorab, Trichiurus haumela, Trachynotus* sp., *Pteroplatea micrura.*
11.	*Echinobothrium* sp. (larva)	.. *Bullia* sp., *Murex* sp., *Matuta victor.*
12.	*Gangesia macrones*	.. *Macrones gulio.*
13.	*Centrorhynchus golvani* n. sp.	.. *Hieraaetus pennatus.*
14.	*Echinocephalus* sp.	.. *Hemifusus pugilinus.*

Experimental infections with fish hosts to follow the development of the juveniles obtained were intended even at the outset, and indeed commenced. But, the maintenance of marine fishes for a sufficient length of time without facilities for continuous circulation of sea-water was found to be difficult, and only a few unsuccessful feeding experiments were conducted. A detailed morphological and taxonomic study of these parasites have been made, but biological and ecological aspects of the infections have not been ignored. New species of trematodes and an acanthocephalan have been described, new hosts of known species reported, and new locality records included. The occurrence of larval and juvenile parasites in various marine invertebrates has been revealed for the first time, and this attempt has been most productive of valuable observations.

The ctenophore, *Pleurobrachia globosa,* has been found to be a host of two kinds of metacercariae and tetraphyllidean larvae ; the decapod *Matuta victor* of

Galactosomum sp., tetraphyllidean larvae, and *Echinobothrium* sp. ; the stomatopod *Squilla* of an unidentified cestode larva ; and molluscs of tetraphyllidean larvae and a nematode. Teleosts harboured adult trematodes, tetraphyllidean and trypanorhynchan larvae, and Elasmobranchs were heavily infected with adult cestodes. Birds of piscivorous habits, *Larus*, *Sterna* and *Gallinago*, demonstrated pure and mixed infections of heterophyid and echinostomatid trematodes, besides cyclocoelids and acanthocephala. These infections, when correlated, would lead to a better understanding of the life-cycle and transmission of some of the helminths. Planktonic organisms such as medusae, ctenophores, copepods and chaetognaths serving as food for fishes would convey these parasites to them ; larvae in lamellibranchs, gastropods and crustaceans would develop in teleosts and other fishes ; and those of smaller fishes in Elasmobranchs and ichthyophagous birds. The amazing variety of intermediate hosts of parasitic helminths in Madras has thus been brought into focus.

A detailed account of these studies was presented by the author (Anantaraman, 1961) which also incorporated observations dealing with (a) the histochemistry of the vitellaria in cestodes of the Tetraphyllidea, Trypanorhyncha and Lecanicephala ; (b) the *in vitro* survival of cestode larvae and a filarid ; and (c) experiments on a tetraphyllidean larva to study volume change and conductivity in dilutions of sea water. The Allocreadioid metacercaria from the ctenophore *Pleurobrachia globosa*, the cestode larva from the nervous system of *squilla holoschista*, and the tetraphyllidean larva in the copepod *Eucalanus pseudattenuatus* have been described in three publications (Anantaraman & Krishnaswamy 1958, Anantaraman, 1959a, 1959b), and the data on volume regulation in tetraphyllidean larvae are embodied in a paper to be published shortly (Anantaraman 1963). Individual accounts of other parasites listed above may be awaited.

I express my indebtedness to the Government of India and the University of Madras for a Research Scholarship, to Prof. C. P. Gnanamuthu of the Zoology Department, Madras University, for directing the work and an abiding interest in its progress, and to my husband Prof. M. Anantaraman of the Department of Parasitology, Madras Veterinary College, for critical discussions and counsel.

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ON THE OCCURRENCE OF THE PELAGIC MOLLUSC, *CARDIAPODA PLACENTA* (LESSON) IN THE ARABIAN SEA

Ten specimens of *Cardiapoda placenta* (Lesson) were obtained from the plankton collections made from R. V. *VARUNA*, in and around the Laccadive Sea as per details given in Table I.

The present collection is a new record for the Arabian Sea and extends the distribution of the genus *Cardiapoda* and the species *C. placenta* to this region.

Family : CARINARIIDAE.

Genus : *Cardiapoda* d' Orbigny 1836.

= *Carinaroida* Souleyet 1852.

The genus *Cardiapoda* was created by d' Orbigny (1836) to receive the *Carinaria*-like heteropods with a much thinner cutis, a pedunculate visceral nucleus, and a shell too minute to cover the whole of the latter. Later, the genus was recorded from the tropic and subtropic seas by Souleyet (1852), Smith (1888), Vayssiere (1904), Tesch (1906, 1910, 1949), and Bonnevie (1920).

Tesch (1949), after a review of all the earlier records, came to the conclusion that all the hitherto described species of *Cardiapoda* could be brought under the two species : *C. placenta* (Lesson) 1830, and *C. richardi* Vayssiere 1904.

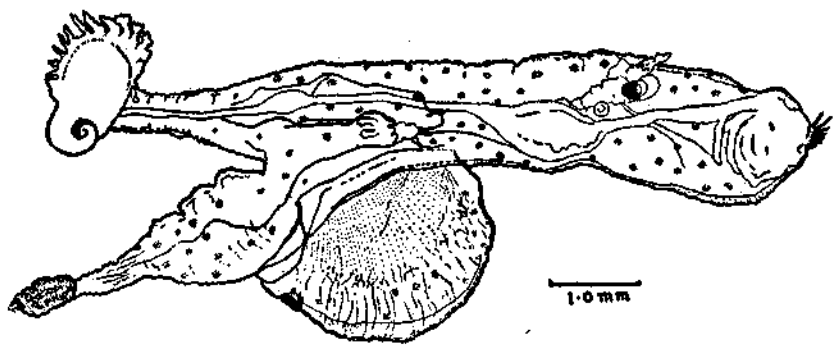

FIG. *Cardiapoda placenta* (Lesson)

The characteristic number of twenty or more separate gills was observed in the bigger specimens although in some of the smaller ones the number of separate gills was fewer than twenty.

The largest of the specimens measured 22 mm. and the smallest, 6 mm. in length from the anterior most end to the posterior border of the visceral nucleus.

An interesting feature is their paucity in plankton collections. This is especially evident in that the Challenger Expedition (Smith, 1888) and the Michael Sars Expedition (Bonnevie 1920) could collect only a single adult specimen each, the Voyages of ' Hirondelle' and ' Princesse Alice ' collected only two (Vayssiere, 1904) and the

TABLE I

Details of collection of *Cardiapoda placenta*

S. No.	Station Number	Position		Date	Time	Depth of Haul m	Depth at the Station m	Type of Net	No. of specimens
		Lat. N.	Long. E.						
1.	1329	11° 22′	73° 46′	28-11-62	18.35-21.00	30	2050	½m. diameter 'Mosquito' net.	1
2.	do.	do.	do.	do.	do.	50	do.	do.	2
3.	1340	11° 22′	70° 00′	30-11-62	07.50-11.10	50	4300	do.	1
4.	1342	11° 58′	70° 00′	do.	15.25-17.30	200-0	4240	1 m. diameter net	2
5.	1344	12° 34′	70° 00′	do.	21.50-00.50	30	3250	½ m. diameter 'Mosquito' net.	2
6.	1347	12° 47′	70° 47′	1-12-62	09.55-11.55	100	2370	do.	1
7.	1351	12° 53′	72° 00′	do.	21.15-24.00	50	1440	do.	1

Percey Sladen Trust Expedition to the Indian Ocean (Tesch, 1910) could collect only five specimens. However, the Siboga Expedition (Tesch, 1906) and the Dana Expedition with the assistance of Danish merchant vessels (Tesch, 1949) were able to obtain them in fairly good numbers.

A study of the distribution of the genus *Cardiapoda* in the Indian Ocean shows that the species *C. richardi* is reported only rarely, whereas the species *C. placenta* has been collected a few times from the Indo-Malayan waters, and from the West Coast of Sumatra to the waters neighbouring the Amirante group of islands and Madagascar. The present record extends the distribution of *C. placenta* to northern waters and to the Arabian Sea.

I am grateful to Dr. R. Raghu Prasad, Deputy Director, for helpful criticism of the manuscript, and to Shri P. C. George for guidance.

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ON THE ASSOCIATION BETWEEN THE FISH, *CARANX MALABARICUS* CUV. & VAL. AND THE SIPHONOPHORE, *PORPITA PACIFICA* LESSON

Several instances of association between young fish and jellyfish are found in the literature. In India, Panikkar and Prasad (1952) reported on an association between the young of *Caranx kalla* Cuv. & Val. and *Rhopilema hispidum* Maas. Jones (1960) reported about the young *Seleroides leptolepis* (Cuv. & Val.) forming a vanguard with *Acromitus flagellatus* (Stiasny). The present instance, however, depicts the association of young caranx with a siphonophore.

The specimens were collected about twenty-five miles off Karwar while on board the Research Vessel *VARUNA* on 30-3-1962, at about 2.30 p.m. Many round, disc-like, biscuit coloured organisms were found floating near the vessel and they were recognized as siphonophores. A closer observation revealed that each of the siphonophores had a small fish moving with it (Fig. I). Instances where more than one fish associated with a siphonophore or *vice versa* were not found. Two siphonophores which came very close to the vessel were taken on board. They were

identified as *Porpita pacifica* Lesson and were 31.0 and 27.0 mm. in diameter including the soft marginal rim. Unfortunately the fish of one siphonophore managed to escape. The other which was caught, measured 27.0 mm. in length. It was light yellow in colour with black first dorsal and ventral fins and black vertical bands. This was found to be the young one of *Caranx malabaricus* Cuv. & Val.

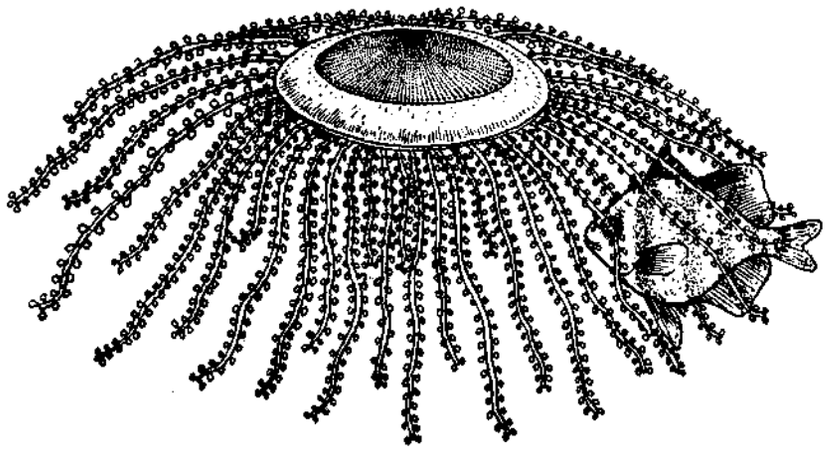

FIG. 1. A diagrammatic representation of the association between *Porpita pacifica* and *caranx malabaricus*.

The siphonophores (one with the young fish and the other without the fish) were kept alive in separate jars, for observation. The fish was found taking shelter underneath the siphonophore often gently brushing the tentacles and coming to no harm from it. The fish was also observed swimming round the siphonophore and when alarmed darting underneath for shelter. The fish was then removed from its partner and kept alone in a jar. It was completely restless, violently dashing against the sides of the jar in its frantic search for the siphonophore. This continued even when the fish was kept free from outside disturbances. But when released to the jar in which the siphonophore was floating, it rushed and found refuge under the float. The two siphonophores were then kept together in the same jar to see whether the fish will choose the other one as its associate. Surprisingly enough, the fish showed strong affinity to its existing ally and refused to take refuge under the other even when forced away from it.

The significance of this association seems to be protection to the fish. But how the siphonophore is benefited by it has to be found.

Here I wish to express my sincere gratitude to Dr. R. Raghu Prasad, Deputy Director, Central Marine Fisheries Research Institute, Mandapam Camp, for the help given in the revision of the manuscript.

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A. NOBLE

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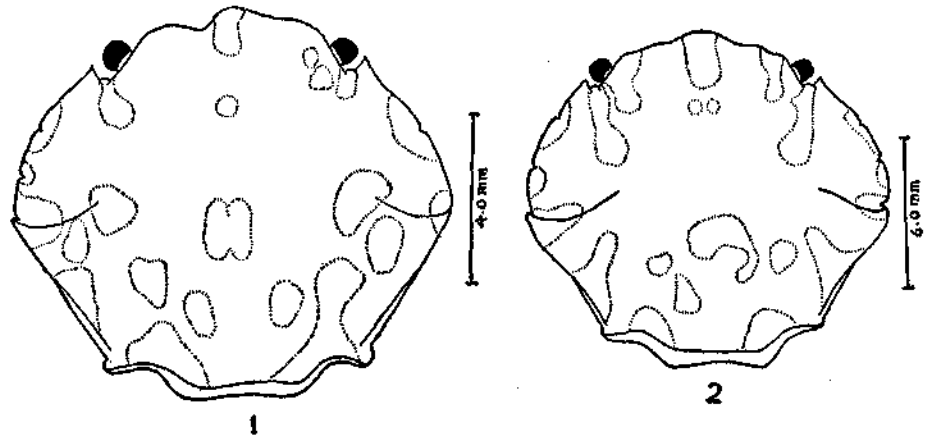
ON SOME ABNORMALITIES IN *LISSOCARCINUS ORBICULARIS* DANA (CRUSTACEA-PORTUNIDAE) FROM MINICOY

Lissocarcinus orbicularis Dana, which has a very wide distribution from South Africa and Red Sea to Japan and Hawaii, has already been recorded from the Laccadive and Maldive Islands by Alcock (1899) and Borradaile (1903). Borradaile has also observed its commensalic mode of life when he collected specimens from the tentacles of *Holothuria nigra*. Edmondson (1954) recorded the species as a commensal on *Holothuria atra* also.

The specimens under discussion in this note were collected by one of us (P.T.T.) during his stay in the Island in the year 1961. The occurrence of such commensalism appears to be very rare at least in this Island, since of the hundred and more specimens of holothurian dissected, only two specimens of crabs were obtained. They were all found inside the basal enlarged part of respiratory tree of the holothurian.

The purpose of the present note is to bring out the abnormalities observed in the two female specimens with us, which we are inclined to believe to be only abnormalities rather than variations within the species. Of the two females, one is ovigerous measuring 9.5 mm. in length and 10.0 mm. in breadth and the other measuring 12.0 mm. in length and 14.0 mm. in breadth. Apart from the variations in the colour pattern of the carapace, they also exhibit some distinct abnormalities (Figs. 1 & 2) in the number and size of the antero-lateral lobes of cara-



1 2

pace. In typical examples, antero-lateral border of carapace is divided into five unequal lobes (last being small) by faint sutures or clefts. In the present specimens, the antero-lateral border is divided into 2 to 4 lobes. In the larger female the antero-lateral border of right side is distinctly divided by clefts into four lobes of which first is the broadest whereas on the left side second antero-lateral lobe is the broadest. In the smaller ovigerous female, antero-lateral border of right side is divided into two lobes of subequal size whereas that of left side is divided into four lobes of which first is the broadest.

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NOTE ON AN ABNORMALITY IN THE PENAEID PRAWN *METAPENAEUS MONOCEROS* FABRICIUS

Abnormalities extending more or less to hermaphroditism have been observed in the Decapoda by several authors. A number of the pandalid prawns are normally protandrous hermaphrodites. Among records of nonfunctional hermaphrodites either with internal organs only affected or with both internal and external modifications, the observations of Hay (1905) in the crayfish *Cambarus* sp., Ridewood (1909) in *Homarus vulgaris*, Marshall (1902) in the Norway lobster *Nephrops norvegicus*, Matsumoto (1955) in the crab *Potamon dehaani*, Gordon (1957) in the lobster *Homarus gammarus* and Hartnoll (1960) in the spider crab *Hyas coarctatus*, may be mentioned.

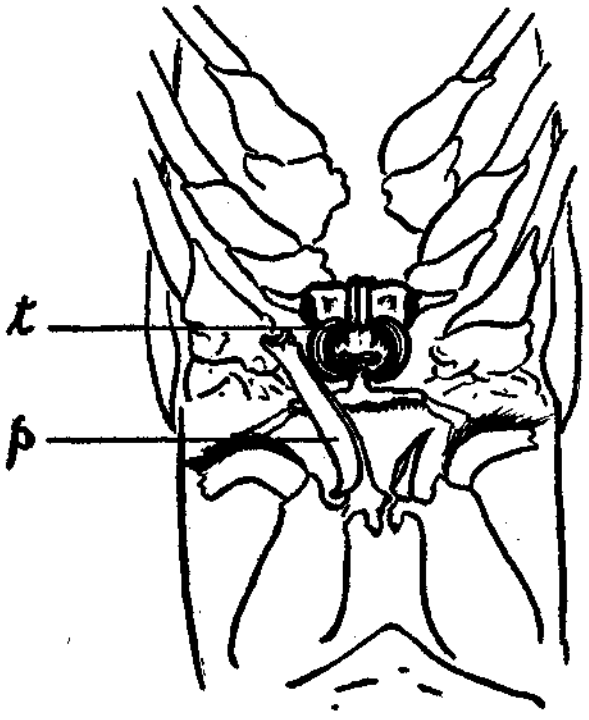

FIG. 1. Ventral view of the posterior region of the cephalothorax and the anterior of the abdomen of *Metapenaeus monoceros*. t—thelycum. p—petasma.

While examining penaeid prawns from the offshore catches off Cochin the author came across an unusual abnormality suggestive of hermaphroditism, externally though, in a specimen of *Metapenaeus monoceros* Fabricius. The specimen measuring 158 mm. in total length and 42 mm. in carapace length is one among 16,870 numbers of the species examined from samples from both backwater and offshore commercial catches during the past 10 years. It was collected from the offshore catches on 27th October, 1960 from a depth of 15 fathoms off Cochin.

The abnormality is shown in fig. 1. The specimen has the secondary sexual character of the male, namely petasma, in addition to the sexual features of the female. On dissection it was found to have only the female gonad fairly well developed with the ovary in the late maturing stage. No evidence of the male gonad could be noticed. Apparently except for the petasma it is a normal female specimen in all other respects.

Even the petasma is not fully developed in proportion to the size of the specimen. Although the specimen is of adult size the petasma is not of the actual adult size and shape. The left half is not as much developed as the other half. Other secondary sexual modifications of the adult male such as the notched proximal end of the merus of the last leg bounded anteriorly by large hook-like spine and posteriorly by a lobule of the ischium are also wanting.

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A NOTE ON THE PRAWN FISHERY OF KUTCH

The estimated annual average marine fish production in Kutch for the last four years is about 1250 m. tons, of which nearly 60% is constituted by the prawns.* There is no information available on the prawn fisheries of Kutch. The account given by Srivatsa (1953) relates mainly to a general survey of the prawn fisheries with particular reference to the Saurashtra coast of the Gulf of Kutch. Lacumb (1960) has dealt with the prawn fishing industry of Kutch from the economic point of view. Hence investigations on the biological aspects of the prawn fisheries of Kutch with reference to the annual fluctuations, composition of the catch, growth, migration, maturity and food of the commercial species are in progress at the Central Marine Fisheries Research Unit, Kandla, since May 1959.

The present note deals with the composition of the catch along the Kutch coast. The following centres, commencing from the inner to the outer regions of the Gulf of Kutch have been chosen for observation :— Cherowari, Kandla, Tuna-

* Through the courtesy of the Directorate of Fisheries, Gujarat.

Sangadh, Lunei (Mundhra) and Modhwa (Mandvi). The areas of fishing in Kutch are restricted to the foreshore waters taking advantage of the strong tidal flow. The prawns that are caught are chiefly members of the Penaeidea and the species that occur are listed below :

Metapenaeus monoceros.
Metapenaeus brevicornis.
Metapenaeus sp.
Penaeus indicus.
Penaeus carinatus.
Penaeus canaliculatus.
Parapenaeopsis sculptilis.
Parapenaeopsis stylifera.
Acetes sp.

Of these *M. monoceros*, *M. brevicornis*, *P. indicus* and *P. sculptilis* are of importance in the catches. Among the caridean prawns are *Leander* spp., *Hippolysmata* sp. and *Palaeomon* spp.

One of the interesting results of a preliminary study of the composition of the prawn fishery at the different centres along the Kutch coastline is that the different species have definite areas of occurrence as will be evident from the species composition of the annual catch given in the Table.

TABLE

Prawn fishery season, composition of the catch along the Kutch coast and nature of the bottom

Place	Season	Nature of the bottom	Composition
Cherowari ..	August-October	Muddy	*M. monoceros* 93.0% ; *P. sculptilis*, *Leander* sp. and *Palaeomon* sp. 7.0%.
Kandla ..	May-February	Muddy	*M. monoceros* 64.7% ; *P. indicus* 20.8% ; *Leander* sp. 8.3% ; *M. brevicornis* 4.2% ; *P. sculptilis*, *P. stylifera* and *Palaeomon* sp. 2.0%.
Tuna-Sangadh.	September-February	Muddy	*M. monoceros* 47.5% ; *P. indicus* 15.6% ; *M. brevicornis* 15.3% ; *Leander* sp. 14.5% ; *P. sculptilis* 5.8% ; *P. canaliculatus*, *P. stylifera* and *Palaeomon* sp. 1.3%.
Lunei ..	July-December	Mixed (Sandy and muddy)	*P. indicus* 48.8% ; *M. monoceros* 23.0% ; *M. brevicornis* 13.7% ; *P. canaliculatus* 5.8% ; *P. sculptilis* 3.0% ; *Metapenaeus* sp. 2.5% ; *P. carinatus* and *Leander* sp. 3.2%.
Modhwa ..	September-January	Sandy	*M. brevicornis* 27.4% ; *P. sculptilis* 18.8% ; *P. indicus* 15.5% ; *M. monoceros* 8.7% ; *Acetes* sp. 7.5% ; *P. stylifera* 7.3% ; *Leander* spp. 6.2% ; *Hippolysmata* sp. 5.4% ; *Metapenaeus* sp. 3.2%.

M. monoceros which constitutes the single largest species in magnitude in the prawn fishery as a whole is found to abound in the inner parts of the Kutch coast

i.e. from Tuna-Sangadh to Cherowari. This species gradually fades in importance in the outer half of the Kutch coast and yields place to *P. indicus* at Lunei and *M. brevicornis* at Modhwa. The differences in the species composition of the catch at the different centres is probably in association with the nature of the sea bottom. The bottom is muddy between Tuna-Sangadh and Cherowari where *M. monoceros* abounds. It is mixed, being sandy and muddy at Lunei where *P. indicus* constitutes the prawn fishery while at Modhwa the bottom is sandy and associated with this, *M. brevicornis* is the most important species of prawn occurring there. This observation supports Williams (1958) who has experimentally shown the importance of the substrate as a factor in the penaeidean shrimps distribution.

The author is thankful to Dr. S. Jones and Shri M. Krishna Menon for encouragement and criticisms.

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AN INSTANCE OF HERMAPHRODITISM IN THE INDIAN OIL SARDINE, *SARDINELLA LONGICEPS* (CUV. & VAL.)

Hermaphroditism, as an occasional abnormality, has been observed in some of the marine food fishes but as there is no record of such a condition in the oil sardine, *Sardinella longiceps*, the present finding will be of interest.

While recording routine biological observations on a sample of fish taken from the commercial *Pattenkolli* (Boat seine) returns at Vellayil (Kozhikode) fish landing place on 23-8-1960, hermaphroditism was noticed in a specimen measuring 175 mm. in total length. Externally it was distinguished as a female but anatomically it was seen that the two gonads were differing in size, shape and nature and having separate ducts not uniting distally but opening independently on the genital papilla which was muscular and not membranous as is expected in a female (George, 1959). This may be considered as a peculiarity accompanying abnormal development of the gonads. The right gonad measuring 53 mm. was in the form of an ovo-testis. For the major portion it was testis, pod shaped, globular and fleshy unlike the dorsoventrally flattened nature of a normal testis. The posterior end was not continued as vas deferens but instead the outlet was in the form of an outgrowth of 27 mm. in length, narrower at the start forming pouch-like distally and opening on the papilla by a small transparent duct. However, this outgrowth contained maturing and immature oocytes and appeared to arise from the dorsal side at the posterior one-fourth of the gonad, having a distinct wall of its own and giving an impression that a portion of ovary was superimposed on a testis (fig. 1a). On the ventral side (fig. 1b) it was seen that a thin layer of ova was spread out

from the anterior one-fourth of the gonad to the posterior one-fourth. Majority ova of this layer as well as the outgrowth measured 0.504 to 0.554 mm. in diameter. The counterpart on the left side was a partially spent ovary, 59 mm. in length, long, narrow, a bit flaccid, dark reddish in colour and showing one set of maturing ova ranging in size from 0.504 to 0.588 mm. closely followed by another group of 0.420 to 0.504 mm. size range. However, both the sets can be treated as a single batch which would have been shed under normal circumstances in the same spawning season. It is, thus, clear from the partly spent nature that the ovary had been functioning in this fish but it cannot be said with any such precision whether the testis also would have started functioning later although it was in an advanced state of maturity with sperm-filled lobules and the genital papilla was muscular as in a normal male.

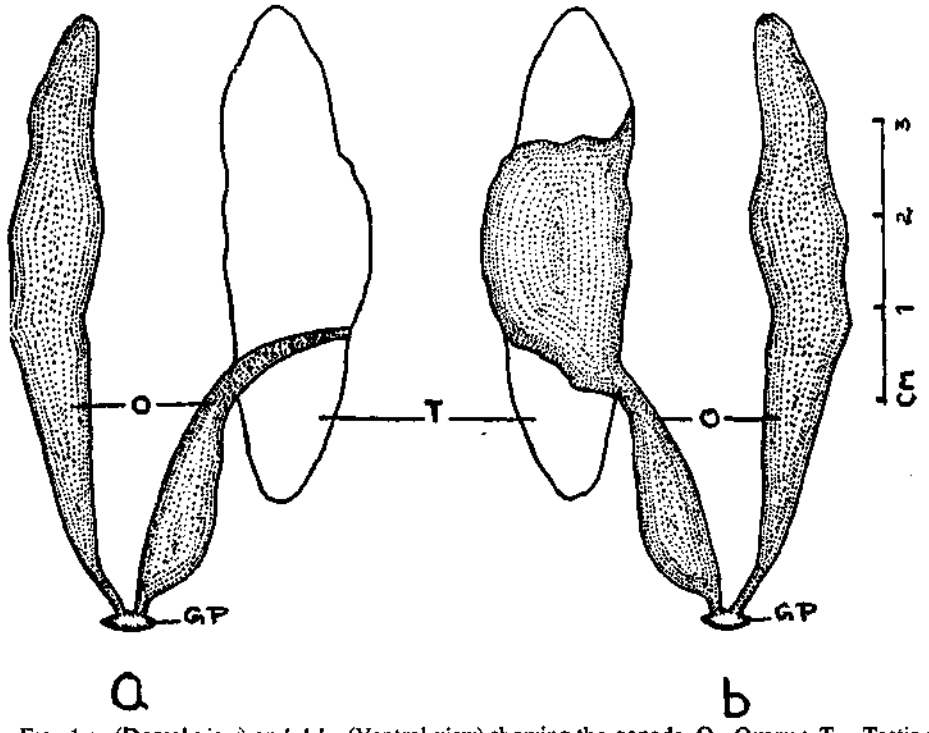

FIG. 1-a. (Dorsal view) and 1-b. (Ventral view) showing the gonads. O=Ovary ; T =Testis ; GP = Genital Papilla.

In abnormal hermaphroditism, the arrangement or the disposition of the component parts of the gonads is widely variable. Thus, in *Huro salmoides*, it is seen that the gonad, in the form of an ovo-testis, is almost equally divided into half ovary and half testis (James, 1946). In *Hilsa ilisha*, the anterior one-third of the gonad is testicular and the remainder ovarian (Chacko and Krishnamurthy, 1949). In *Cirrhina reba*, the ovary occupying a small portion of the posterior half of the gonad ensheaths the base of the anterior testicular portion. (Sathyanesan and Ranga Rajan, 1953). In *Rastrelliger canagurta*, it is reported that the left gonad is a complete ovary and the right, a complete testis (Prabhu and Antony Raja, 1959). In *Polynemus heptadactylus*, where hermaphroditism is of common occurrence, the arrangement is such that the testicular portions of either side face each

other while the ovarian portions lie away (Nayak, 1960). In *Katsuwonus pelamis*, while the left gonad consists of an anterior ovarian and a posterior testicular region, on the right side, the testis extends forwards over the ovarian portion into a tapering structure (Raju, 1960) and in the present report, it is found that in *Sardinella longiceps* only the right gonad has developed into an ovo-testis while the left has remained as an ovary. Recently, it has come to the author's notice that another hermaphrodite specimen of *Rastrelliger canagurta* has been recorded (Rao, 1962) wherein the gonads have developed into an ovo-testis on the right side and ovary on the left, exactly similar in disposition to the one described in the present case but different in other details.

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ON AN EXPERIMENTAL FISHING AT 'SWATCH OF NO GROUNDS' IN THE BAY OF BENGAL

Practically no information is available regarding the fishery resources of 'Swatch of no grounds'. On 14th February 1962, an experimental trawling with Haddock type otter trawl was attempted during one of the cruises of M. V. *KALYANI*-V. a deep sea fishing vessel of the Directorate of Fisheries, Government of West Bengal. In view of the increasing importance to offshore fishing for stepping up the fish production it is considered worth reporting the results of this trawling operation.

'Swatch of no grounds' is a remarkable depression in the coastal bank which extends in a south-westerly direction from a position in about latitude 21° 24′ N, longitude 89° 34′ E where it descends steeply from depth of 20 fathoms at its shore end to 454 fathoms about the middle of its length, beyond which it sinks to 595 fathoms. It is from 6-12 miles in width and has a length of approximately 70 miles. Within a duration of 20 minutes at a distance of one mile trawling, the fathometer reading showed uneven depths ranging from 20-95 fathoms. The latitude and longitude while shooting and hauling the net were 21° 13′ N, 89° 16′ E and 21° 14′ N, 89°17′ E respectively (Fig. 1).

Although the total catch was 138.6 Kg. 24 species of fishes were found in a single haul. *Pomadasys hasta* (20.5-38.5 cm) predominated the catch constituting 32%. The large sized *Lutjanus dodecacanthus* (22-26 cm), *Parastromateus niger*

(28-32 cm), *Trichiurus savala* (50-85 cm) and *Tachysurus jella* (18.5-40.5 cm) which are all the usual commercially important marine species marketed in West Bengal together constituted 50%, of which *Lutjanus* and *Parastromateus* formed 38%. The Indian mackerel *Rastrelliger canagurta* (19.5 cm) and the Malabar travally *Carangoides malabaricus* (22.8 cm) were also recorded from the catches constituting 2%. The miscellaneous varieties constituted 16% and were represented by *Hilsa toli, Parupeneus indicus, Zebrias guagga, Argyrops spinifer, Lutianus johni, L. malabaricus, Pomadasys maculatus, Eutherapon theraps, Umbrina dussumieri, Fistularia villosa, Nemipterus japonicus, Lactarius lactarius, Priacanthus hamrur, Pseudorhombus javanicus, Uranoscopus guttatus, Minous monodactylus,* and *Eulamia melanoptera.*

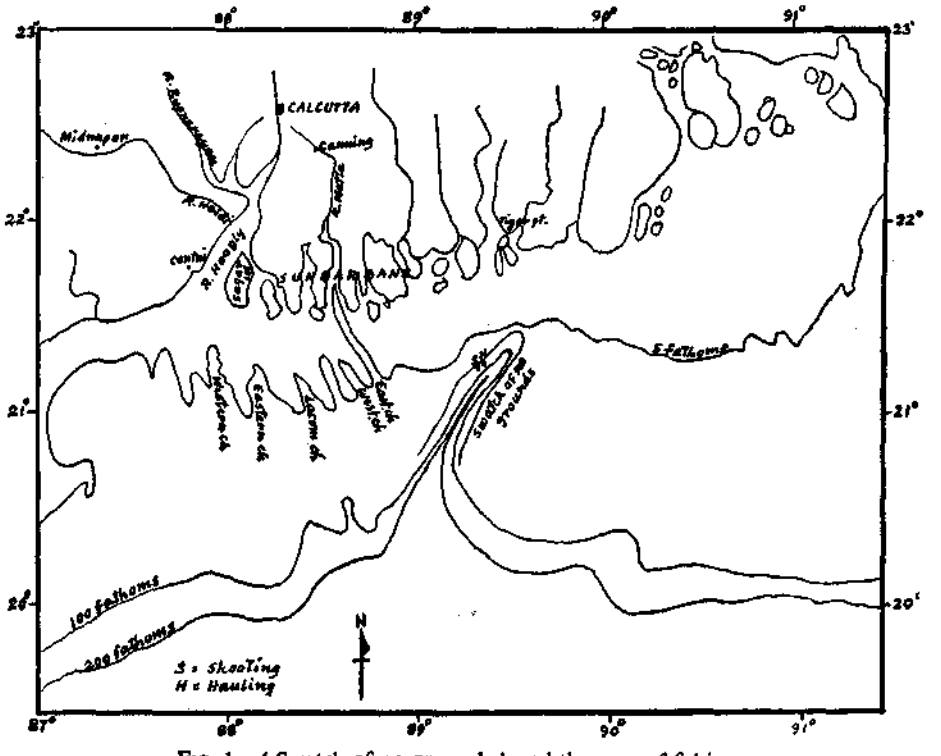

FIG. 1. ' Swatch of no grounds ' and the area of fishing.

It is generally indicated from the observations that the sizes of fishes of this region were far better compared with the catches of sand heads, off Mahanadi, Devi and Prachi rivers and off Black Pagoda and Gopalpur, where regular offshore fishing operations are being undertaken by *KALYANI* I-V. This information may be useful for a commercial exploitation of the fishing of this area in future.

We wish to thank Dr. K. C. Saha, Director of Fisheries, Government of West Bengal, for having given facilities on board. We are also thankful to Dr. S. Ramamurthy for his kind help.

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ON THE OCCURRENCE OF DUGONG DUGON (MÜLLER) IN THE GULF OF CUTCH

The presence of dugong along the Cutch and Saurashtra coast was reported by Prater (1928), Moses (1942) and Mani (1960) where it is known popularly as 'Babloo'. Jones (1959) has given a fairly detailed account of *Dugong dugon* (Müller) along the Indian coast.

Towards the end of the year 1961 I came to know of the stranding of two dugongs at Piroton island in the Gulf of Cutch. However a visit to the island was possible only on 7-1-62 when the skeletal remains of the two animals were observed on the shore close to the Piroton lighthouse. Enquiries revealed that the stranding took place sometime early in October.

On 6-3-62 a dugong got entangled in a gill net and was brought to Salaya port in the Gulf of Cutch. The presence of two well developed axial mammae as reported by the fishermen suggests that the specimen was in all probability a female. I visited Salaya on 13-3-62 by which time the flesh was removed by the fishermen for preparing oil (though they did not get much of it as they failed to boil the flesh) and the intact skeleton with caudal fluke and the skin from the ventral side was left in the tidal waters of the creek.

The following measurements were made of the intact skeleton.

Total length (approximately) from snout to fork (fluke intact)	..	272.5 cms.
Fork to tip of caudal lobe (each side)	.. ..	41.2 ,,
Length from base of caudal to tip of fluke	.. ..	65.8 ,,
Tip of snout to atlas	.. ..	38.4 ,,
Length of incisor	.. ..	4.1 ,,

Silas (1961) has drawn attention to the desirability of having more information about the occurrence of dugong in the Gulf of Cutch. The present records during the months of March and October and the previous records during July (Mani 1960) suggest that the occurrence of dugong in the Gulf of Cutch is not merely sporadic.

I am indebted to Dr. E. G. Silas, Central Marine Fisheries Research Institute, Mandapam camp, for his valuable help in preparing this note.

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ON A RECENT CAPTURE OF A WHALE SHARK (*RHINCODON TYPUS* SMITH) AT TUTICORIN, WITH A NOTE ON INFORMATION TO BE OBTAINED ON WHALE SHARKS FROM INDIAN WATERS

Information was received on 28-7-1961 that a large whale shark had got entangled the previous night in some nylon gill nets laid off Tuticorin, north of Thollayiram Paar. Efforts were made to tow the shark to the Tuticorin fish landing place the same day, but owing to rough weather it could be landed only in the early hours of the 29th by which time it was dead. The shark turned out to be a small female *R. typus* measuring 5.62 metres in total length. It was immediately auctioned for Rs. 385 and cut up for curing the same morning. Details of body measurements taken are given below

Total length	..	5620 mm.	Length of Pectoral from :		
Standard length	..	4200 ,,	anterior insertion	..	1000 mm.
Head length	..	1450 ,,	angle of inner base to tip	..	820 ,,
Girth of body at P_1 base	..	2800 ,,	Length of pelvic fin from anterior insertion	..	300 ,,
Width of mouth (angle to angle)	..	720 ,,	Length of first dorsal from anterior insertion	..	620 ,,
Vertical height of :			Length of second dorsal from anterior insertion	..	350 ,,
First dorsal	..	490 ,,	Diameter of orbit	..	42 ,,
Second dorsal	..	220 ,,	Inter-orbital distance	..	1100 ,,
Length of caudal fin along upper margin	..	1420 ,,	Anterior margin (mid-point) of snout to :		
Snout to :			eye	..	530 ,,
First dorsal	..	2540 ,,	spiracle	..	680 ,,
Second dorsal	..	3640 ,,	1st gill opening	..	1100 ,,
Pectoral	..	1400 ,,	Least height of caudal Peduncle	..	160 ,,
Pelvic	..	2900 ,,			
Anal	..	3800 ,,			

The three lateral ridges along each side of the body were very conspicuous and the colouration characteristic (Plate, fig. A). When cut the skin was 80 mm. thick along the dorsum and 30 mm. at the abdomen. One peculiarity noted was the alternating muscular bands running along the abdominal wall which was seen as dark patches at regular intervals.

It was not possible to weigh the entire animal, but the flesh that was cut for curing (excluding the head, fins and viscera) weighed about 850 kg. The liver which was pale brown in colour weighed 65 kg.

FOOD OF THE WHALE SHARK

From Gudger's work on the food and feeding habits of the whale shark (Gudger, 1941) it will be seen that more precise information is wanted about the food of the whale shark. It is hoped that the data given below may add to our existing knowledge.

When the viscera of the shark was exposed and the stomach slit, about 20 gallons of water gushed out, which the shark had apparently taken during its

PLATE—*Rhincodon typus* Smith. (A) Dorso-lateral, and (B) ventral view of specimen (female) caught off Tuticorin. (Photo : M. S. Rajagopalan.)

struggle in the net. A portion of the stomach contents about one-tenth in quantity was collected for detailed analysis, results of which are given below.

Total volume of stomach contents examined	696 cc.	Volume of digested remains of fish	7.4 cc.
Volume of zooplankton	603 ,,	Volume of Mollusca (bivalves).	0.3 ,,
,, of sand and shell bits.	75 ,,	,, of decapod crustaceans.	0.4 ,,
,, of algae and sea weeds.	10 ,,		

A further analysis of an aliquot portion of the zooplankton revealed the following items to be present :

	Percentage in the sample
Crustacea :	
Crustacean limbs and eyes	66.63
Calanoid Copepods	0.38
Cyclopoid Copepods	0.90
Mysids	0.38
Isopods	0.22
Amphipods	0.38
Lucifer	0.15
Decapod larvae	1.35
Mollusca :	
Bivalves	0.15
Pteropods	0.15
Chaetognatha :	
Sagitta	0.15
Digested unidentifiable matter	27.85

It is interesting to note that the portion of the stomach contents examined includes varied items such as, large quantities of zooplankton, partly digested remains of fish, crustaceans, molluscs, and small quantities of seaweeds and algae, undoubtedly suggesting an omnivorous diet. The quantity of sand, shell bits and even part of the plant matter present in the stomach could have been gulped in by the animal during its struggle in the nets which were set in relatively shallow waters of six to eight fathoms. Similarly, two copepod parasites (the like of which several were seen attached to the walls of the buccal cavity) found in fresh condition in the stomach contents could have also been inadvertently taken in.

No external parasites were seen. However, three small helminth parasites (one cestode and two nematodes) were collected from the portion of the stomach contents examined, besides a number of copepod parasites from the buccal cavity.

The whale shark was immature and the ovary undeveloped.

Need for more Information on the Whale Shark

Prater (1941) gave a list of 20 captures, strandings and sightings of whale sharks from Indian coastal waters, and one of us (E.G.S. in M.S.) has been able to gather information about the captures and strandings of at least 30 whale sharks from Indian coastal waters since then, over 50% of the additions having occurred during the last 2 to 3 years. Although much has been said about the whale shark by the late Dr. Gudger in a number of articles, our knowledge about many aspects

of the habits and biology of this shark is far from complete. For instance, only as late as 1954 has it been definitely known that the whale shark is oviparous, earlier workers having considered it to be viviparous or ovo-viviparous. Hence while reporting on the present capture of a whale shark from Tuticorin, we also take this opportunity to draw the attention of those interested to the information that could be usefully collected about the whale shark from Indian coastal waters as and when opportunities arise. This is given in the ensuing section and we appeal to readers who are able to make any further observations on the whale sharks from Indian seas, both in coastal and offshore waters to properly record their findings.

INFORMATION WANTED ON THE WHALE SHARK *Rhincodon typus* SMITH

DATA

Date ..... Locality .....
If captured, time and method of capture .....
If stranded, time .....
If stranded, injured or infected .....
If washed ashore dead, injured or infected .....
If sight record, location (Lat. & Long.).....Numbers seen.....
Any other animals seen in association with the whale shark? .....
Sex ..... Weight .....
If female, any eggs (if so number) .....
Length, width, and thickness of egg cases .....
Length of embryos (Eggs and embryos to be preserved) .....
Contents of stomach (at least sample to be preserved) .....
Any stomach, intestinal or other internal parasites .....
..... (if so to be preserved).
Any gill parasites ..... (,, ,,).
Any external parasites ..... (,, ,,).

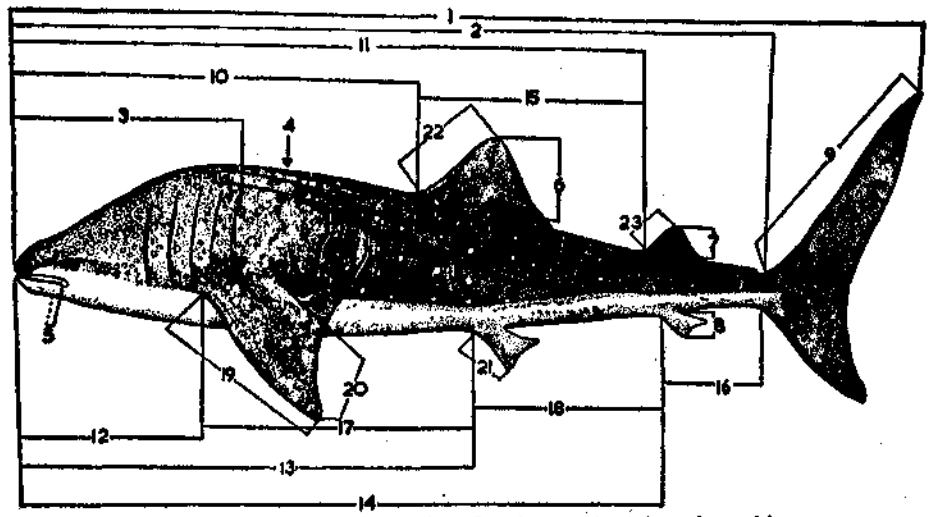

FIG. *Rhincodon typus* Smith. Lateral view showing methodology for taking measurements (Figure of fish after Bigelow and Schroeder, 1948).

MEASUREMENTS (in metric system) For methodology see figure 1 :

(1) Total length ..... (2) Standard length .....
(3) Head length ..... (4) Girth of body at .....
(5) Width of mouth from angle to angle .....

Vertical height of :

(6) First dorsal fin ..... (7) Second dorsal fin ..... (8) Anal fin .....
(9) Length of caudal fin from caudal pit along upper margin .....

Snout to :

(10) First dorsal ..... (11) Second dorsal ..... (12) Pectoral .....
(13) Pelvic ..... (14) Anal fin .....

Interspace between :

(15) First and second dorsals .....
(16) Anal and caudal .....
(17) Pectoral and pelvic origins .....
(18) Pelvic and anal origins .....

Length of pectoral fin :

(19) Along outer margin from anterior insertion .....
(20) From angle of inner base to tip .....
(21) Length of pelvic fin ..... (22) Length of first dorsal .....
(23) Length of second dorsal .....

If male :

Length of clasper from inner base of pelvic fin .....
Length of pelvic fin along its inner edge .....

ANY ADDITIONAL MEASUREMENTS AND INFORMATION AVAILABLE.....

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