

"It is resolved, therefore, that, with the consent of the Governments concerned, such investigations, conducted in various countries, be co-ordinated through the

appointment of a joint committee of chemists and malariologists resident in these countries."

B. A. RAO.

The Cape Crawfish Industry of South Africa with Some Observations on the Prawn and Crab Fisheries in India.*

By B. Chopra, D.Sc.

(Zoological Survey of India, Calcutta.)

THE recently started series of Fishery Bulletins of the Department of Commerce and Industries of the Union of South Africa, of which No. I was published in February last year, offers an excellent opportunity for taking stock of the conditions in reference to prawn and crab fisheries in India. In the present note after reviewing the report on the Cape Crawfish Industry of South Africa, a short account of somewhat similar fisheries in different parts of India is given and a few suggestions are offered for developing the fisheries along scientific and commercial lines, as is done in South Africa and several other countries.

The crawfish industry has been in existence in South Africa for a long time past, but it is only during recent years that it has been established on a firm footing. The publication by Messrs. Cecil Von Bonde and J. M. Marchand of a pamphlet entitled "The Natural History and Utilisation of the Cape Crawfish, Kreef, or Spiny Lobster, *Jasus (Palinurus) lalandii* (Milne Edwards) Ortmann" as Fishery Bulletin No. I of the Department of Commerce and Industries, Fisheries and Marine Biological Survey Division, of the Union of South Africa, shows on what sound lines the industry is being run under the helpful and vigilant guidance of the Fisheries Department.

The report is divided into two parts, the first dealing with the natural history of the crawfish and the second on its utilisation. The importance of a scientific study of the species on which the industry is based is clearly brought out in the report. Questions connected with reproduction, life-history, ecdysis, food, migration, etc., etc., have not only a purely scientific value, but the application of the knowledge acquired by their study to the various processes of the industry is of a fundamental importance.

The first chapter of the report deals with the taxonomic position of the crawfish and thirteen other allied species occurring in South Africa. It is unfortunate that the authors have called the Cape crawfish by the zoological name of *Jasus (Palinurus) lalandii*. *Jasus*, as the systematists know, is the name that Jeffrey Parker gave in 1883 to a subgenus of *Palinurus* having certain characters on which Spence Bate later (1888) founded his genus *Palinosystus*. The latter name was, therefore, so to say, still-born and *Jasus* has thus for a long time been recognised as a subgenus of *Palinurus*. Some authors, like de Man,¹ for instance, consider *Jasus* as a distinct genus, of the same rank as *Palinurus*. The correct name for the "Kreef" would, therefore, be either *Palinurus (Jasus) lalandii*, or (if the authors consider the characters on which *Jasus* is based to be of generic importance—a view that is generally held now) *Jasus lalandii*, but in no case can *Palinurus* be considered a subgenus of *Jasus*. It may also be mentioned here that Lamarck has generally been credited as the author of the specific name *lalandii*, but as this appears to have been only a manuscript name, the authors of the report are quite justified in ascribing it to Milne-Edwards², who was the first to publish it with a proper description. Another point of some systematic importance is that according to de Man *Panulirus fasciatus* of Fabricius 1798, should be known by Herbst's specific name of *polyphagus* 1796; the authors have used the former name in the report.

The anatomy of the crawfish is briefly described in simple language, and the distinguishing characters between the two sexes are clearly brought out. The process of reproduction is also briefly referred to, and the hatching period is stated to last from

¹ de Man, *Siboga Exped. Rep.*, 1916, 39 a², part 3, 31-32.

² Milne-Edwards, *Hist. Nat. Crust.*, 1837, 2, 293-294.

* Published with the permission of the Director, Zoological Survey of India,

three to five months. It is of interest to note that a female crawfish may carry as many as 200,000 eggs in a single brood.

The chapter on development and metamorphosis is of special interest in spite of the fact that there are still wide gaps in our knowledge of the complete life-history of the crawfish. The importance of studying the complete cycle is strongly stressed; its practical utility is apparent in view of the fact that "the aquarium experience gained makes it possible to rear young fish with success until they have passed the 'danger zone' and can be liberated in the open sea, there to counterbalance any depletion of the sea caused by fishing". From an examination of the smallest females "in berry" it is concluded that though rarely specimens having a carapace length between one and two inches may be mature, it is oftener that examples between two and three inches are found to be carrying eggs. From evidence gained under aquarium conditions it is believed that the berried season lasts from two to three months.

Moulting being a necessary concomitant of growth, the information given under the chapter on ecdysis is both interesting and useful, but it must be stated that the published data for arriving at the rate of growth, *viz.* .2 inch per year, are rather meagre. The smaller fish moult oftener than mature individuals, which cast off their skin at a more or less definite season each year, the season sometimes differing even in adjoining localities.

Regarding the food of the crawfish the authors are of the opinion that the "nut-cracker" jaws "have probably been provided for the breaking open of the shells of mussels and such like creatures". It will be interesting to know if this view is based on any actual observations in nature or even in aquaria. Sea weeds also form a part of the natural food of the crawfish.

The crawfish lives on the sea bottom between low-water mark and 20-25 fathoms line, and prefers a rocky bed with abundance of weeds, etc. An interesting point in this connection is that the fish is abundant on the west coast, and scarce on the east. This, as the authors point out, is no doubt due to the fact that the water along the Atlantic coast is considerably colder than that of the Indian Ocean washing the east coast.

In the absence of satisfactory results having been obtained from tagging experiments the authors have refrained from

expressing any definite views on the question of migration, but it is interesting to note that one marked crawfish had travelled 13½ miles in 11 days, thus suggesting that there may be some definite migratory movements. It is hoped the new tagging methods that have been evolved after a series of experiments may prove more successful. There is no fixed proportion between the two sexes, and a dominantly male population in a particular area to-day may change into a dominantly female population to-morrow, but as such areas are generally contiguous, normal mixing of the sexes takes place without much difficulty.

The second part of the report dealing with the utilisation of the crawfish for commercial exploitation is of absorbing interest both to the scientist and to the people engaged in the industry. As is usual in such cases the history of the crawfish industry in South Africa is a tale of failures by the early pioneers paving the way to success which the present companies have achieved.

The process of canning is described in detail and the precautions taken in avoiding contamination, etc., are mentioned. That these precautions are thoroughly efficacious and that the product of the South African canned crawfish industry is entirely reliable is shown by the fact that "one large company last year paid out the sum of seven shillings and six pence in repayment of bad and damaged tins"; this sum roughly represents .0003 per cent. of their total output. Unfortunately there have been some serious lapses also, but the whole process of canning is being thoroughly investigated with the help of an eminent chemist.

The value of the canned crawfish industry to South Africa runs into lakhs of pounds. Approximately £ 350,000 have been invested in the industry; in 1932 there were in the Union of South Africa alone 13 large factories employing 2,600 men, paying out £ 104,000 in salaries and wages, and producing canned fish of the value of approximately £ 450,000. The figures for export are equally impressive; in 1933 the Union of South Africa and South West Africa exported canned crawfish to the total value of £ 382,052. In addition to canning, an industry in the export of frozen tails of crawfish has also been established. The process involved is very simple, consisting in severing the tails from freshly caught fish, cleaning and putting them in ice and then packing and transferring them to the cold-storage chambers of steamers,

Frozen tails of the value of £93,840 were exported, chiefly to France, in 1933.

The types of boats used in the industry are mentioned and their evolution from the simple open dinghy equipped for sailing or rowing to the modern motor fishing boat, especially designed and built for the crawfish industry, is described. The actual fishing is, however, still done from the dinghies.

The methods of fishing have not, on the whole, developed very much since the industry began very many years ago. A simple type of hoop-net, with an iron hoop, and twine netting is used. The net is let down and hauled up by three bridles or legs, one consisting of the hauling rope itself, and the other two of thinner twine. The bait is tied at the junction of the three bridles and the nets are let down spaced at intervals, in a suitable place in about 20 fathoms of water. The fishermen working from a dinghy haul them up occasionally, take out the fish and set them again. When sufficient fish have been collected, the load is transferred to the mother boat which is anchored close by, and the dinghy resumes the fishing operations. When the fishing is over for the day, or has to be abandoned on account of threatening weather conditions—which is very often the case—the nets are hauled in, the dinghies are either stowed on deck, or secured astern by tow-ropes, and the mother boat returns home.

The various fishing grounds along the west coast are described. Their extent, nature of the bottom and the shore, their liability to winds and swells, the abundance or otherwise of the crawfish and other necessary details, like sanctuaries and the breeding seasons, are given in detail. The sketch maps showing the boundaries of the various grounds are very helpful.

The last chapter on protective legislation shows how the idea of declaring "close season" has had to be abandoned, except in a very few selected places. The present rules for the conservation of supplies seem to be based on sound scientific principles and on experience. The laying down of the size-limit, prohibition against catching fish in berry, declaring sanctuaries, prohibiting dumping of crawfish bodies and crawfish offal in the fishing grounds and such other restrictions are all eminently reasonable and in the best interests of the industry.

The bibliography given at the end, though not very exhaustive, as in a work of this

kind it need not have been, is very useful. A. Gruvel's paper entitled "Contribution à l'étude générale systématique et économique des Palinuridae" published in *Annales de l'Institut Oceanographique* III, Fasc. 4 (1912) should, however, have found a place in the list of references. Besides giving a systematic account, the author deals with the commercial exploitation of the different species of the Palinuridae, and his notes on *Jasus lalandii* (pp. 12-14) are very useful.

The paper is illustrated with eight plates of the animal, its different parts, and larval stages, and nine sketch-maps of the fishing grounds. These are on the whole very clear and most useful.

Both zoologists and industrialists engaged on the crawfish and allied industries must feel thankful to Messrs. von Bonde and Marchand for the production of this most interesting and instructive treatise.

Now turning to the conditions prevailing in India, one cannot help wishing that industries like that of crawfish canning could be established in this country also. Vast quantities of prawns and crabs are sold in the markets of Calcutta, Bombay, Karachi, Madras and other important towns near the sea, and some quantities are sent considerable distances inland also. According to Moses³ "both in quantity and value the crustaceans are of greater importance than any kind of fish in Madras. The prawns top the list, while the crabs come next." The figures that he collected for the sale of different kinds of fishes, including prawns, etc., show that prawns, crabs and shrimps to the value of Rs. 1,35,056-14-0 were sold in the markets of Madras City in one year. The figures given by Rai⁴ for the Bombay coast are still more impressive. "Millions of pounds of prawns are caught annually. Apart from local consumption, large quantities are despatched inland, and also exported to foreign countries. The total consumption along the Bombay coast alone may be estimated at 12,000,000 lbs. valued roughly at Rs. 2,500,000. The prawn industry alone, along this coast gives employment to about 20,000 men, women and children." For the very rich prawn fisheries along the Sindh coast he estimates the annual yield roughly at Rs. 1,500,000. For Calcutta unfortunately no figures are available, but even a

³ Moses, *Madras Fisheries Dept. Rep.*, 1923, No. 6, 139.

⁴ Rai, *Journ. Bombay Nat. Hist. Soc.*, 1933, 36, 887.

casual visit to any of the important markets of the town, and especially to Chingrihatta, a large flourishing market, more or less exclusively reserved for the sale of prawns and shrimps, would convince one of the large quantities of these crustaceans which are consumed at almost all times of the year.

In spite of the vast proportions of the prawn and crab fishing industry and the great possibilities of its expansion, it is regrettable to note that practically nowhere in India are these industries being run on sound scientific lines, or even on modern commercial methods. The fishermen still employ methods that their forefathers used and the advance of science or the development of modern commercial and marketing methods are altogether unknown to them. All that is done at present, as it was no doubt being done generations ago, is that fishermen in small family groups do the fishing, either for themselves, or in many cases for the middlemen to whom they are heavily in debt, with small country boats and antiquated appliances. The catch is sold fresh, mostly through rings of middlemen, in the markets of neighbouring towns, or where facilities are available, is sent some distance inland. It must, however, be admitted that some of the simple and primitive methods and appliances used by our fishermen are at least as efficient as those employed in countries where fisheries are being more scientifically handled. In some cases where the yield is more than the requirements of the neighbouring markets, prawns are dried, or even boiled and dried, and are exported in fairly large quantities. The methods employed are of the very simplest kind, drying being done mostly in the sun, separating of the shells by trampling or by thrashing with sticks and packing for export purposes in gunny bags. In a few places in the Madras Presidency, however, through the efforts of the Fisheries Department, improved methods are being tried and gradually adopted. It is remarkable that even in spite of these, for the most part, primitive methods a large export trade in dried prawns and of their shells—the latter are used for manure—exists in a number of centres, Karachi alone having exported these commodities to the value of Rs. 11,59,797 in the year 1929-30. Similar flourishing trade exists near Calcutta, in some places in the Madras Presidency, notably on the Malabar Coast, and also on

the Chilka Lake on the Orissa Coast. Very little canning is being done anywhere at present; it was tried in Madras for a number of years, and the success, perhaps only partial, that was achieved by the Madras Government Cannery indicates that, if properly handled, a flourishing trade in the export of canned prawns could probably be set up in a number of centres along the coast.

Species like *Penaeus semisulcatus* de Haan and *Peneopsis monoceros* (Fab.) are found in abundance in suitable places all along the Indian coast and are fished in quantities to supply mostly the requirements of the local markets. These and some others are large-sized species and if organised attempts were made to do the fishing and canning, etc., on modern lines, a flourishing industry could no doubt be set up in a comparatively short time, both for supplying the local markets and also for export purposes. *Palaemon carcinus* (Fab.) also attains to a very large size and is plentiful in freshwaters and estuaries in a number of localities and could perhaps be commercially exploited on a larger scale than is being done at present. There are also several smaller species of *Palaemon*, *Leander*, *Caridina* and *Acetes* that are fished in enormous quantities all along the coast.

The crab fishing industry of India is not so extensive or important from the point of yield as that of prawns. The commonest edible Indian crab, *Scylla serrata* (Forskall), forms the basis of very extensive fishing all along the coast. In some creeks of the Gangetic Delta it is so plentiful at certain times of the year that boat-loads of it are collected by some very simple, but rather ingenious, devices.⁵ *Varuna litterata* (Fab.) is another species that occurs all over the Delta in countless millions, but on account of its small size does not fetch much price. The Portunids *Neptunus sanguinolentus* (Herbst) and *N. pelagicus* (Linn.) are, however, large-sized species and are fished in fairly large quantities in many centres. Added to these there are some Potamonids—*Partelphusa* (*Paratelphusa*) *spinigera* (Wood-Mason) in Bengal, *Paratelphusa* (*Oziotelphusa*) *hydrodromus* (Herbst) in Madras and *Paratelphusa* (*Barytelphusa*) *jacquemontii* (Rathbun) on the Bombay side—that fulfil the needs of the local markets.

The lobster fishing industry could also

⁵ Hora, *Curr. Sci.*, 1935, 3, 543-546.

probably be established on a more paying basis than is at present the case, on the Bombay coast and perhaps in some other places also. *Panulirus ornatus* (Fab.) attains to a size of about 12 inches or more and is found in large numbers on rocky beds below the low tide marks in several places along the Indian Coast. Another species *Panulirus polyphagus* (Herbst) [= *P. fasciatus* (Fab.)] also grows to a large size, but is perhaps not quite as abundant as *P. ornatus*. Lobsters fetch a high price in the market and could probably be used for a flourishing canning industry. On account of their spiny shell they do not find a ready sale in some markets.

The first requirement for putting the prawn and crab fishing industry on a sound footing is to study scientifically the species concerned. Efforts should be made to thoroughly investigate their bionomics, character the grounds on which they flourish, study their breeding seasons, life-histories, migration and several allied problems. That even elementary principles for safeguarding the industry are ignored at present can be judged from the fact that intensive fishing is sometimes carried on even during the season when the females are breeding and it is by no means uncommon to see females in berry being openly sold in the markets. In countries where these fisheries are run on scientific lines this state of affairs could not be tolerated. In the Union of South Africa, for instance, not only is the capture and sale of any female crawfish in berry prohibited by a proclamation, but even the purchase and possession of such animals is illegal. Protective measures will have to be strictly enforced in India also, but to be useful and effective they must be based on a scientific study of the species

concerned.

Spasmodic efforts have been made in the past by some Local Governments to study some of the problems connected with fisheries, but they have had very limited benefit towards the permanent improvement of the industry. Unfortunately all these efforts have not always been in the right direction; for instance, in the words of Annandale,⁶ several years ago "when the Government of Bengal wished to prospect the marine fishery of the Bay, they got out a steam-trawler fitted for work in the North Sea and the Arctic Ocean." Ventures like this are seldom successful, and any little progress that has been made is chiefly due to the unceasing efforts of some of the Fisheries Departments. Probably the best organised Fisheries Department in India at present is that of the Madras Government and the successive Directors of this Department have done very valuable work for the improvement of the fishing industry in general; that connected with crabs and prawns also has been receiving a certain amount of attention. In a country like India, however, with vast coastal and inland fisheries several departments like that at Madras are needed. But as the fundamental problems of fisheries are everywhere more or less similar, some central co-ordinating organisation could make the work of these departments considerably easier and lighter by taking up some of the important scientific problems connected with their work. If a body like the Imperial Council of Agricultural Research could be induced to extend its activities to the investigation of some of these problems, a great deal of good would be done to this struggling, but potentially very valuable, industry.

⁶ Annandale, "A Naturalist's view of the Chilka Lake", *Calcutta Review*, 1915, p. 14.

Lithium Fluoride as Lens Material.

PROF. Donald C. Stockbarger of the Massachusetts Institute of Technology announced before the recent meeting of the American Physical Society in Baltimore the preparation of optically perfect lithium fluoride crystals, over 3 inches in diameter. This discovery is considered to constitute a very important development in the field of optics.

Lithium fluoride crystals possess the ability to transmit light waves from high in the infra-red region, through the visible band and extending into the invisible ultra-violet region. This range of transmissibility is not possessed by any other known sub-

stance. According to a staff correspondent of the *Christian Science Monitor* (November 30, 1935), Prof. Stockbarger, at the meeting of the American Physical Society, produced motion picture reels showing his laboratory work.

The lithium fluoride is first powdered, then melted in a platinum crucible in a specially designed electric furnace provided with a device for temperature control. After the fluoride has melted, the melt is seeded with a tiny crystal of lithium fluoride and the cooling is allowed to take place slowly. Lithium fluoride crystallises in cubic formation and can be cut and polished easily.