OBSERVATIONS ON THE SEAWARD MIGRATION OF THE SO-CALLED INDIAN SHAD, *HILSA ILISHA* (HAMILTON).

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(Plate IX.)

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Hilsa is undoubtedly one of the most important edible fish of the country, whether from the point of view of the numbers caught or in view of the esteem in which it is held by the fish-eating population. Unfortunately our knowledge of the bionomics of this species is very limited and what little is known is very confused and often contradictory. Further, this information is not easily available, and we have, therefore, thought it advisable to preface our observations with a detailed summary of the subject.

SUMMARY OF EARLIER LITERATURE.

Hilsa, also known as the Indian Shad, was in the 18th and even in the beginning of the 19th century generally known as the Sable Fish in Calcutta[1], but this popular name has long since fallen into disuse,—the popular names at present in vogue are *Ilish*, *Ilisha* or *Hilsa* in Bengal and Orissa ; *Ilihi* in Assam ; *Palasah* in Telegu-speaking areas ; *Oolum* or *Ulum* in the Tamil-speaking areas ; *Nga-tha-louk* in Burma ; and *Pulla*, *Pala* or *Palo* in Sind. The species was first described and figured by Russel (1803, p. 78) from Vizagapatam where apparently it was taken in the foreshore waters of the Bay of Bengal. Dr. Russel remarked :

" This fish is known at Calcutta under the name of Sable fish, and highly esteemed. At Vizagapatam it had passed unnoticed, like many others left to the lower ranks of the people. On its appearance, by my request, in the way of experiment at my brother's table, it was recognised by him as a Bengal acquaintance ; and allowed by all to be a rich and luscious fish, with much of the herring flavour.

" On questioning the fishermen why it had never been brought before to the Chief's table, they replied, ' It was not a gentlemen's fish ; the multitude of small troublesome bones utterly disqualifying it.' I found it however well known to the Portuguese race, who used it sauced, or prepared with tamarinds.

[1] Day (1873, pp. 22, 23) and following him Gupta (1908, p. 92) state that it is also known as the Sable fish in Madras. Our account is based on the definite contemporary statements of Russel (1803, p. 78) and Hamilton (1822, p. 243) that Sable Fish was the name by which this species was known amongst the English in Bengal.

" In some respects it resembles the Shad, or *Clupea Alosa*, but differs in shape, has no spots, and the branchial membrane has only six ossicles."

Russel's work in view of its faulty nomenclature is not, however, recognised, and the next account of the fish was published by Francis Hamilton (formerly Buchanan) (1822, pp. 243-246) under the name *Clupanodon ilisha*. Hamilton discussed the similarities and differences of his species with the Shad and Russel's *Palasah* and remarked :

" Excepting in wanting teeth, the *Ilisha* has the most strong resemblance to the *Shad*, (*Clupea alosa*) and there is reason to suspect that the Indian and Latin names may be radically the same. The *Ilisha* frequents the Bay of Bengal and the large salt water estuaries of the Ganges, and in the rainy season ascends the larger rivers to spawn. I have seen it as high as Agra and Kanpur, but so high up it is very rare. At Patna on the Ganges, and Goyalpara on the Brahmaputra, it is pretty common, but rather poor and exhausted."

He was apparently the first author to refer to the occurrence of this species both in the sea and estuaries, and its ascending into the fresh-water rivers of the Gangetic system during the rainy season for spawning purposes to places as high up as Agra and Cawnpore.

Cuvier and Valenciennes (1847, p. 433) in describing the species under the name *Alausa palasah* stated that

" M. Dussumier, qui a vu ce poisson frais, le décrit comme ayant le dos verdâtre, et tout le reste du corps argenté. Il en a rapporté deux beaux individus, longs de seize pouces, et pris tous deux dans le Gange, où cette espèce est très-abondante en août ; elle remonte le fleuve jusqu'à Chandernagor, et peut-être beaucoup plus haut."

They also remarked that the species was apparently the same which Russel (1803, p. 77, pl. 198) had figured under the name *Palasah* and owing to its having been taken at Bombay by M. Dussumier and at Pondicherry by M. Belanger, they believed that the species probably occurs in the sea all round the Peninsular India. They referred to the probable identity of the species with *Clupanodon ilisha* of Hamilton (1822, p. 243, pl. xix, fig. 73), even though the number of rays in the dorsal and anal fins, according to the descriptions, differed in the two species.

Francis Day (1873 *a*, pp. 22, 23) designated the species as *Clupea palasah* and described its habits as follows :

" *** The *migratory herrings* are those which ascend large rivers from the sea for the purpose of breeding in fresh water, the most important of which is the shad, *Clupea palasah*, known also as the Hilsa or Ilisha, the Palasah of the Telingis, the Ulum of the Tamils, the Pulla of the Indus, the Nga-tha-louk of the Burmese, and the sable fish of the Europeans in Madras. There seem to be two classes of this fish which ascend the large rivers : those below one year of age, and which do not appear to breed, or if they do, it is at the very end of the year, or commencement of the succeeding one ; secondly, there are those which breed at the commencement of, or during the monsoon. In the Cauveri and Coleroon these fish ascend with the first burst of the S. W. monsoon, and continue doing so the four succeeding months, but in diminished quantities, some evidently being later breeders or younger fish. In the Kistna, which has a great velocity, the freshes commence in June and continue until the end of October, after which the river subsides, but it does not become fordable until the middle or end of January. A few of these fishes arrive at the end of September, but it is not until the middle of October and the two following months that their main body appears to ascend, whilst they disappear by April. It is only when the rapidity with which the Kistna flows during the freshes commences to subside that they arrive in large numbers. In the neighbouring river, the Godaveri, which has a less rapid current than the Kistna, the fish ascend earlier, being most numerous from July to September, when the fishermen believe they migrate to the Kistna. In the Hoogli they continue ascending throughout the S. W. monsoon, and many are found to be still full of roe in September. Mr. Blanford has observed them at Mandalay in Upper Burma at the end of the year. In Sind, this fish ascends from the sea about February for the purpose of breeding in the river, from which it again descends to the salt-water about the end of September or commencement of

October, after which none, even young, can be found. They are only taken in *dhánds*, stagnant pieces of water or canals, due to some accidental cause or unnatural obstruction having obliged them to turn aside from their natural breeding grounds. The main body of these fish swarm up the large rivers of India and Burma generally as soon as the S. W. monsoon commences, but not always at the same period, such apparently at times being dependant upon the rapidity of the current and other causes. That it is not solely due to the presence of rain-water is shown by the Indus and Irrawadi; in the former, the floods are mainly caused by melted snows at this period, whilst in the Irrawadi these fish push on to Upper Burma[1], to which country the S. W. monsoon scarcely extends, and there the inundations are also due to melting snows. One reason why periods of floods are selected as those for breeding, appears to be due to their being practically acquainted with the fact, that at these times the shallows are covered with water, rendering ascent practicable, consequently they now come up to deposit their ova, which is always done in the rivers, never in tanks or canals."

Further on he added (Day, App: Sind—p. xxxi) that the Commissioner of Sind had reported that *Pulla* in the Indus are restricted to a particular season, from March until September, and come up from the sea to spawn. Earlier (p. 66) he had referred to the peculiar method of the fishing for this fish as adopted in Sind where the fishermen float down on a gourd or a hollow earthen pot and catch the fish by means of a purse net[2].

In his report on the Marine Fisheries of India (1873*b*) Day recorded the occurrence of extensive fisheries of *Hilsa* at Gwadar on the Baluchistan coast (App. p.i) and at Chandipore on the Balasore coast (App. pp. cxxi, cxxii) and remarked (pp. 24, 25):

"In my fresh-water fishery report I have adverted to the enormous ascents of hilsa (*Clupea palasah*) up all the large rivers for breeding purposes, mostly during the south-west monsoon (June and subsequently), and it is a most important circumstance that they are almost invariably as plentiful in one season as they were in the preceding year, provided no impediments in the rivers exist entirely barring their ascent. If one examines the varieties of fish taken along the sea-coast throughout the year, these hilsa will be found extending their range to wherever food is plentiful; they will only be missed during the breeding season, and even then young ones will be present. This would appear to show that they never migrate any great distance from the shore. In fact this fish is not so capricious in its arrival as are the more marine forms. Thus a periodical supply of food is afforded to people far inland unless man in his greed impedes or entirely arrests their ascent by means of fixed engines and weirs, and so annihilates the supply."

In a later work Day (1878, p. 640) summed up the habits of the fish as follows:

"The main body of these fish swarm up all the larger rivers of India and Burma, generally as soon as the monsoon commences, whilst an important matter appears to

[1] We have not been able to find any connected account of the *Hilsa* fishery in Burma though casual references to it are made in *Reports on Inland and Sea Fisheries in the Thongwa, Myaungmya, and Bassein Districts and the Turtle-Banks of the Irrawaddy Division*, pp. 73, 85, 130, 177 (1911).

[2] The following account of the fishing of the *Hilsa* in the Indus by spearing by Sebastien Manrique [*Travels of Sebastien Manrique*, 1629-43 (Ed. Luard and Hosten, London), Vol. II, pp. 230, 232, 1927] in the seventeenth century may be noted here. In describing the voyage down the river to Bakhar it is stated: "We sailed on peacefully in this way, keeping careful watch at night, finding as we advanced on our road an abundance of good cheap provisions in every place we anchored at. In some places, where the stream was shallow, we met many fishermen, who furnished us with most excellent shad very cheaply.... .They dispense with the encumbrance of nets and assistants as they go out fishing on large earthen vessels with the circumference of ten to twelve palms in breadth, flattened at the rim, and open at the top in a big, circular aperture just of a size to receive the front of a man's stomach, which being pressed into it checks the ingress of the water. It thus serves as a safe receptacle for the fish as well as a steady base and support for the fisherman, who lies upon it directing his earthen ship with his legs, his hands being busy with the spear, piercing the scaly swimming fishes.... .This abundance of fish was most welcome to us Christians travelling there, since it was then Lent." From this it appears that the fish swim very near the surface, as it would not be possible to spot them at any depth in the muddy water of the river.

be the rapidity of the current. The numerous Indian rivers spanned by weirs, destitute of fish passes, is causing enormous injury to these fisheries. Almost fruitless to deposit their eggs below these structures when between the sea and their spawning beds, whilst they are unable to pass them, their partial or even entire extermination in such rivers appears to be merely a question of time."

and quoted almost verbatim his earlier observations on the seasons during which the *Hilsa* were found to ascend the rivers in different parts of India. Day (1889, pp. 376, 377) in the *Fauna* was more definite about the *Hilsa* swarming up the large rivers, generally as soon as the monsoon commences, and added that the rapidity of the current affects the time of migration of this fish. In the Indus they ascend in March and April, when the river is swollen by the melting of Himalayan snow. They have been observed in the Irrawaddy in Burma as high as Mandalay in October.

Günther, it may be incidentally noted, had described *Clupea palasah* as separate from *Clupea ilisha*, the former from the River Ganges and the latter from " the Indian Ocean and Archipelago ", and it was not till Regan's (1917, p. 304) studies on the Clupeoid fishes in 1917 that the exact position of the species was cleared. Regan found that it was necessary to separate *Hilsa*-like Clupeoid fishes of the Indo-Pacific waters into a new genus, *Hilsa*, and stated that Günther's *Clupea ilisha* was the same as *C. kanagurta* of Bleeker, which is widely distributed from Zanzibar to Malay Archipelago, while *Clupanodon ilisha* Hamilton corresponds to *Alausa palasah* of Cuvier and Valenciennes, *Clupea palasah* of Günther and *Clupea ilisha* of Day. This species also is widely distributed, but its range is restricted from the Persian Gulf to Burma.

The work on *Hilsa* in Bengal started with the recommendation of Sir K. G. Gupta in his final report on the Fisheries of Bengal and was continued by the Fisheries Department for the two provinces of Bengal and Bihar and Orissa up to 1923 when the Bengal Fisheries Department was abolished. The work on *Hilsa* in these two provinces and in Eastern Bengal and Assam during this period was summarised by Hora (1938, pp. 147-158), and it is only necessary for us to refer to a few further records in connection with the *Hilsa* which are not included in it.

Day (1873*b*, App. pp. cxxi, cxxii) in his Report on the Sea Fish and Fisheries of India and Burma remarked :

" When I was at Balasore in 1868, I found that the hilsa forms a portion of the fish taken throughout the year, excepting during the time they are ascending the rivers to breed : while in the rivers north of Midnapore the young hilsa were being taken in thousands. Consequently, if weirs are to be erected across the large rivers without gaps or fish passes, permitting neither the old fish to ascend to their breeding grounds nor the young to descend to the sea, the species must of a necessity be exterminated, as it only breeds in fresh water."

He also described the mode of fishing at Chanderpore (=Chandipore) by means of fixed stakes and noted :

" Here I saw a good number of hilsa captured, and the fishermen assured me that they are always present, except during the south-west monsoon, when they ascend the large rivers to breed. I took a full sized one out of season, and another half-grown one that appeared very healthy, therefore it may fairly be concluded that were this species of fish destroyed the coast fishery must suffer,"

In the Gazetteer for Balasore District (O'Malley, 1907, p. 14) also recorded that extensive *Hilsa* fishing is carried out in the sea along the coast :

" The fishermen are particularly keen in their pursuit of the *hilsa*, and a flotilla of sea-going craft will sometime drift along together for days, awaiting the approach of a shoal of that fish. When the shoal arrives, they at once fill their boats, steer straight for shore, and convert their haul into *sukhuā* or sun-dried fragments of fish—a favourite relish with the Oriyas. Besides the *hilsa* the most common sea fish are the *bekti* and *telia*, and the delicious *tapsi* or mango fish is found in the tidal waters of the Subarnarekhā and Burābalang."

We have since found (*vide infra*, p. 535) that this fishery is even today carried on the same lines as detailed by Day and O'Malley. It is unfortunate that whereas in the unpublished records of the Bengal Fisheries Board there are references to the find of *Hilsa* at Balasore, apparently no importance was attached to this find of the *Hilsa* in the sea round this area, and no further investigations in connection with it were carried out by the Fisheries Department. Similarly there are references in the same records to the occurrence of extensive foreshore fisheries for *Hilsa* in the eastern part of the Bay of Bengal, but apparently this line of investigation also was not pursued by the Fisheries Department. The work of the Bengal Fisheries Department in connection with the *Hilsa*, extending from 1907 to 1919, may roughly be summarised as consisting in the recognition of the fish as a true anadromous species and the organisation of research in locating its spawning grounds ; this work was carried on with a view to the artificial propagation of the species and establishing hatchery stations. In 1919, however, doubts were expressed by Prashad (1919, p. 4) regarding the true anadromous nature of *Hilsa* in view of the fact that the species is found in the Gangetic Delta and even some of the upper reaches of the rivers almost throughout the year, while the young of the species, about 6 inches long, locally known as *Jatka*, were found in some of the rivers in Eastern Bengal. Since that date young *Hilsa* of various sizes have also been collected from the river Hooghly and other rivers of the Ganges system, and as has been shown by Hora and Nair (1940, pp. 35-50), *Hilsa* reside almost throughout the year in the rivers, or in the lower reaches in the estuaries, in the Gangetic Delta, and rarely go out to sea. The breeding season of the fish has been found to extend almost throughout the year, though the peak period occurs during the rainy season. The young of the species migrate down into the estuaries wherefrom, it is surmised that they later migrate out into the sea. Another discovery of great interest by these authors is that the young of *Hilsa* flourish and continue to grow to the adult size in the freshwater settling tanks of the Water Works at Pulta, but apparently the fish in these tanks do not breed.

In a recent official publication the work of the Madras Fisheries Department on *Hilsa* has been summarised as follows :

" Along with actual operations in the Hatchery, a study of the fish in the rivers was made and a search for its young and eggs carried out. After the subsidence of the flood the occasional occurrence in the months of October and November of young Hilsa measuring 2 to 4 inches in the Cauvery and its channels was observed and recorded during 1914-1921. In 1925-26 when the Hilsa hatchery was transferred to the Kistna and Godavari, the field studies were extended to those rivers. In 1933-34 a study of the fishery in the lower reaches of the Godavari showed the existence of Hilsa in the river throughout the year.

" Considerable progress was made in Hilsa investigations in the Cauvery, Kistna and Godavari by 1935-36 which has thrown much light on the life-history of this important food fish. From all these investigations, it has been proved (1) that Hilsa take two years to grow to the adult size, (2) that the fish spend the first two years of their life in the lower reaches of rivers and go to the sea only in the third year, and (3) that when they leave the river, they do not go far into the sea but move about in shoals in the shallow flats close to the river mouths. Recently these tentative conclusions have been found to hold good for Hilsa in the Ganges also. In tanks watered by the Cauvery, yearling Hilsa ranging in size from 2 to 4 inches along with adult specimens were discovered in 1935 while the examination of specimens from the lower reaches of the Godavari which unlike the tanks of the Cauvery delta are perennially open to the sea also showed similar growth-stages more or less, *viz.*, half and full-grown fish. The latter on dissection proved to be virgin fish. The two sizes could belong only to two successive seasons and so the age of the fish before they migrate to sea was proved to be two years. The fish-curing yards close to the mouths of all the 3 rivers obtain only adult sized Hilsa, from the sea when they approach the rivers for their breeding migrations upstream and subsequently when they leave the rivers. Their appearance and behaviour and range of size at sea have also been studied.

" The facts ascertained offered a satisfactory explanation of the unexplained absence of the fish on the West Coast of Peninsular India, *viz.*, that the short rivers of the West Coast do not offer to Hilsa the facilities for two years' sojourn and growth to adult stage. The period they spend at sea and whether they breed more than once in rivers and the age limit of the fish remain yet to be discovered and can be ascertained only by marking experiments. Proposals to mark Hilsa was deferred by Government in 1931 but last year Government have indicated their intention to sanction my proposals."

EARLIER RECORDS OF THE OCCURRENCE OF *Hilsa* IN THE SEA.

As the main fishery of *Hilsa* depends on its migration into fresh waters, little attention seems to have been paid to the seaward journey and marine life of the species. However, it will be seen from the summary of the earlier literature given above that Russel's specimens of *Palasah* were apparently taken in the foreshore waters of the sea at Vizagapatam. According to Cuvier and Valenciennes, Dussumier obtained examples of the species at Bombay and Belanger at Pondichery. Hamilton had also recognised the fact that " The Ilisha frequents the Bay of Bengal and the large salt water estuaries of the Ganges ", whence it ascends the larger rivers to spawn. In the recent scientific literature there are two definite records of the capture of *Hilsa* from the sea in Madras waters. Nayudu (1920, p. 129) in his statistical analysis of an inshore fishing experiment at Madras during 1919 stated that *Hilsa* was caught only twice during the year as noted below :—

	Lb.	Rs. A. P.
" 1919, April	4	0 4 0
1919, August ..	365	31 8 0
	369	31 12 0

" The following table furnishes the data of their appearance and the quantity caught :—

1919, August 7	First caught off Mylapore by the local fishermen in their Vala Valai. They measured 12″ to 15″ in length, one of which 13·5″ long had just developing ova.
1919, August 9	238 were caught in our Chala Vala and drift nets.
1919, August 10	145 were caught in our Chala Vala.
1919, August 11	Only a few were caught.

"They were never seen again till October 4th, when a few were caught by local men.

"August to September seems to be the spawning season for Hilsa. All the five specimens examined on 9th August 1919 were females with about half-matured ova and these specimens measured 11·5" to 14" long. Evidently these being anadromous, were from the shoals that were on the look out for any river mouths through which to ascend higher up for spawning."

The second record is to be found in the Administration Report of the Madras Fisheries Department for 1930-31 (Raj, 1932, p. 32), where it is stated that:

"From the records of Palk Bay fish-curing yards recently scrutinized in connexion with the bulletin on fish that is under preparation, it was found that shoals of hilsa visit the Bay annually from November to May when a regular sea fishery takes place. This discovery that hilsa fisheries occur also in the sea (Palk Bay) from November to May after the fish have left the rivers therefore offers unique opportunities for investigating their movements, growth, and migration in the sea, regarding which nothing is at present known."

In February-March 1939, a party of the Zoological Survey of India in the course of their investigations on the fauna of the Balasore Coast at Chandipore found extensive catches of *Hilsa* in *Ber* fishery and a number of specimens were collected and brought to Calcutta. This confirmed Day's and O'Malley's earlier observations referred to above (*vide supra*, p. 533).

The *Hilsa* fishery along the Balasore Coast seems to be fairly extensive as is shown by our observations recorded below (*vide infra*, pp. 537-541).

In the "Statesman" of the 7th September, 1938, Mr. Stanley Howard contributed a note on "The Hilsa", and *inter alia* made the following observations on the marine life of the species:—

"During the monsoon the adult fish ascend the Hooghly and travel as far as Patna and Benares from the sea for the purpose of spawning. The spawn is deposited from about the middle of July to the middle of September, and rivers continue to be the home of these fish until the middle of October when the fish return to the sea. Having deposited their spawn the older fish, or what remains of them, having finished their work die out at sea.

"The young fish after about two months stay in the sea, add considerably to their size and weight, and towards the end of December they return to the estuaries (Sunderbans) in shoals. The fish at about this time are about 7 to 9 inches long and in search of new feeding grounds.

"It is at this time that I have caught them about two miles out at sea, when they have been on their way to the richer feeding grounds of the Sunderbans."

In his account of the foreshore fishing in the eastern part of the Bay of Bengal, Mojumdar (1939 *b*, p. 219) stated that:

"Amongst the sea fishes, the *hilsa* holds an important position even in the fisheries of the coastal region. During the winter season from November to February large shoals of this fish appear in the coastal waters of the Bay."

In an earlier article entitled "Culture of Hilsa", Mojumdar (1939*a*, pp. 294, 295) had given the following as the special characteristics of the coastal *Hilsa*:—

"Though the hilshas of the inland rivers have never been marked to jump up into the air it is a distinctive quality with those[1] of the Eastern coast of the Bay. The people going in country boats hazard a risk if they chance to be in or near a shoal of hilshas as these may jump in and cause the boats to sink.

"The surface moving habit is also another important feature of the sea-hilshas. The fishermen take advantage of this. In some places they are 'skimmed off' the water

[1] Mr. Mojumdar distinguishes three kinds of s a *Hilsa*. Among a sample sent to us we have found specimens of *Hilsa toli* (Ham.), locally known as *Chandana Hilsa*, besides *Hilsa ilisha* (Ham.). It is not certain, therefore, which species of the Clupeidae has this jumping habit.

by nets. In others they are driven to khals (branch rivers) and such means are improvised with nets to prevent their return to the sea. Thousands of hilshas are caught at a single 'drive off'. A cloudy day in the Dala time (when water level is comparatively on the ebb-side in a fortnight) makes favourable conditions for the hilsha fishing during the winter months.

"These are quite in contrast with those of the inland rivers, where they move at a depth sometimes of 30 to 40 cubits under water though on a cool or drizzling day they may come within 4 to 5 cubits from the surface."

Enquiries made from various sources confirmed the observations of Howard and Mojumdar about the existence of extensive fisheries of young *Hilsa* during winter months along the coasts of Bengal. It may now definitely be stated that *Hilsa* of about 9 to 10 inches in length make their appearance, usually in shoals, in October-November every year in the foreshore of the Bay even down to Cox's Bazar. The appearance of the young *Hilsa* in the foreshore waters is undoubtedly for feeding purposes and not, as stated by Mojumdar (1939*b*, p. 219) on the authority of local fishermen, to "liberate eggs" From the sizes of these specimens it can be inferred that they are hardly one year old (Hora and Nair, p. 40) and the majority of them must, therefore, be the progeny of the individuals that spawned either during April-May or July-August.

PROBABLE EXTENT OF THE SEAWARD MIGRATION OF *HILSA*.

There is a popular belief among the fishermen of Bengal (*vide* De, 1910, p. 18; Finlow, 1933, p. 5) that sea is the home of *Hilsa*, but little research has so far been carried out to verify this statement. As a result of an investigation into the *Hilsa* fishery in 1933-34 in the Godavari from the Dowlaishweram anicut to the sea by the Madras Fisheries Department, it was found that fish of varying sizes were present throughout the year and that young *Hilsa* up to $8\frac{1}{4}$ inches in length reside in the lower reaches of the river and do not go out to the sea. The same department through a series of observations carried over a number of years came to the conclusion—

"(1) that Hilsa take two years to grow to the adult size, (2) that the fish spend the first two years of their life in the lower reaches of rivers and go to the sea only in third year, and (3) that when they leave the river they do not go far into the sea but move about in shoals in the shallow flats close to river mouths and their neighbourhood." (Raj, 1937, p. 38).

The Madras Fisheries Department is undertaking marking experiments to trace the wanderings of *Hilsa* in the sea, and this is no doubt the most effective method to elucidate the problem. From the observations recorded above it seems clear that young *Hilsa*, less than one year old, do not always reside in the lower reaches of rivers, but move about in shoals along the Bengal and Balasore coasts. However, we agree with the findings of the Madras Fisheries Department that they do not go far into the sea. We have the following reasons for supporting this view :—

1. The Bengal Government Steam Trawler "Golden Crown" made several cruises in the west coast to places from Pilot Ridge light vessel to south-west of Puri and in the east coast in the neighbourhood of Elephant Point and East Channel light vessel, but it is noteworthy that no *Hilsa* was found among the extensive catches of the Trawler (*vide* Jenkins, 1911, p. 55). The trawling was carried out in waters mostly

over 10 fathoms in depth, and the absence of *Hilsa* in any of the catches seems to indicate that in their seaward migration *Hilsa* do not wander out in waters over 10 fathoms in depth.

2. A Pilot vessel is always stationed at Sandheads, off the mouth of the Hughli River. Over a decade ago both the vessels, which take this duty in turn every month, were equipped with a beam trawl for such marine investigations as the exigencies of their service would permit them. The members of the Bengal Pilot Service have been enriching the collections of the Indian Museum with large numbers of zoological specimens from this area, but no specimen of *Hilsa* was ever found in their catches. In connection with our recent investigations a special request was made for information regarding the period of occurrence of *Hilsa* at the Sandheads. We were informed that no *Hilsa* fish has ever been caught by the Pilot vessels at the Sandheads.

The area of the Sandheads roughly lies in 21°N. 88°E., and, according to Chopra (1933, p. 26), the salinity of the surface water on 18th-19th October, 1932, varied between 16·175 and 20·990 and that it showed tendency to rise and fall with the tides.

These observations, inadequate and inconclusive as they are, lend support to the views of the Madras Fisheries Department that *Hilsa* do not go far into the sea.

INVESTIGATIONS AT CHANDIPORE, BALASORE COAST.

Reference has been made above (*vide supra*, p. 535) to the fishery of *Hilsa* at Chandipore on the Balasore coast and to a number of specimens collected by a party of the Zoological Survey of India in February-March, 1939. Chandipore is situated in 21° 27′ N. and 87° 2′ E. on the sea-coast about 9 miles east of Balasore and 2 miles from the mouth of the Burhabalang river. There is a long level beach along the sea face, and the sea is extremely shallow for a great distance out. The records of the Bengal Fisheries Inquiry show that about the middle of November young of *Hilsa* " size length 2 inches and under ", known as *ela* or *pila*, are to be found in catches at Balasore. In paragraph 168, it is stated that—

" Hilsa is caught in mál nets throughout the season. They are generally found in shoals, some small, some quite big."

In connection with *Hilsa* investigations we visited Chandipore towards the end of April 1939, but the weather was too rough for fishing and no specimens were secured. About the middle of July 1939, an enquiry was made from the Collector of Balasore regarding details of *Hilsa* fishing in July both in the sea and in the river Burhabalang at Chandipore. In reply we were informed that there was at the time no *Hilsa* fishing at Chandipore, but " Hilsa fishing is done from the latter part of July till the end of August near Talpada in Police Station Soro of this district. There is a P. W. D. inspection bungalow there and the Hilsa fishing is done in the sea from the 11th day of the moon till the 3rd day after the full moon, *i.e.*, during the spring tide[1] and again during ebb

[1] It is worthy of remark that in East Bengal (Mojumdar, 1939, p. 295) and the Sunderbans (information supplied by Mr. Stanley Howard) *Hilsa* fishing is done during the neap tide periods. Probably this is due to the methods of fishing employed in the two areas, but the matter requires further elucidation.

tide from the 11th day after the full moon." Accordingly a party was sent to Talpada on the 27th July for about a week, but owing to unfavourable weather no fishing for *Hilsa* was done and, in consequence, the party did not make any direct observations on the fish. Further attempts were made to obtain *Hilsa* from the sea at Talpada during the rainy season, but without success. Reports were, however, received of extensive catches of *Hilsa* during the spring tides during August, September and October. We were able to visit Chandipore later on the 26th November, the day of the full moon, and stayed there for 4 days. On the day of our arrival we purchased 148 specimens of *Hilsa*. The majority of the specimens, 103 in number, were about 24 cm. in length (Table I). The smallest specimen was 11·9 cm. and the largest 38·4 cm. In view of the earlier observations on the growth of *Hilsa* (Hora & Nair, 1940, pp. 40, 41) it can be surmised that, with the exception of a few specimens, almost all the examples were one year old or under. The gonads were not properly developed so it was not possible to distinguish the sexes by naked eye. Though at present no reliable deduction about age can be made from the number of rings on the *Hilsa* scales, it may be stated that two rings could be detected on the scales showing thereby two periods of cessation of growth in one year old *Hilsa*. The edges of the scales showed the " A " phase, indicating that the growth had stopped about November. This was borne out by the fact that in all the specimens the alimentary canal was empty.

Owing to the approach of bad weather, the nets were removed from the night of the 26th and thus no further observations could be made. On the 29th November, one large *Hilsa*, 45·6 cm., was purchased. It was a spent female, but the ovaries were highly vascular indicating that they were about to mature again. Most of the scales of this specimen showed 3 rings, while 4 rings were present in the case of a few. " A " phase had started at the edge of the scales.

Though we were not able to visit Chandipore again, we were fortunate to secure the helpful co-operation of Rai Sahib Tarun Chandra Ghosh, Superintendent, Collector's Office, Balasore. He undertook to send us a few specimens preserved in formalin every now and then. The material thus obtained has yielded the following data :

On the 11th December, Rai Sahib Ghosh informed us that " No *Hilsa* is expected to be caught during the ensuing new moon tide as the sky is overcast with clouds now and the fishermen who generally fix their nets from today will not do so." On the next full moon day, 26th December, 1939, 44 specimens of *Hilsa* collected at Chandipore were received. They ranged in length from 19·6 to 45·8 cm. (Table II). When arranged in 20 mm. difference groups they showed two majority groups, namely, 9 specimens between 20 and 21·9 cm. and 8 specimens between 34 and 35·9 cm. It is significant to note that the fish must have been feeding actively at this time, as their stomachs contained copepods, small molluscs and sand grains[1]. In cases where the stomach was empty, the intestine contained some pulpy matter. The edges of the scales,

[1] From the presence of sand grains in the stomach, it does not necessarily follow that the fish feeds at the bottom. Owing to tidal action, sand grains are sometimes held in suspension and swallowed along with planktonic organisms which form the food of *Hilsa*.

except in the case of a few individuals, showed the growing phase. The scales had two to five rings and the number did not depend upon the size of the individuals.

The next consignment of 24 specimens of *Hilsa* was obtained from the Burhabalang River at Balasore on the 11th January, 1940. Balasore is situated about 16 to 17 miles from the sea by the river route as against about 8 miles by road. All the specimens were relatively larger, their lengths varying from 25·8 to 47·5 cm. with an average length of 35·5 cm. (Table III). All the fish were feeding copiously, their stomachs being distended with filamentous algae, copepods and polyzoa. The scales showed the growing phase at the edge and a considerable number of the specimens had 3 rings on their scales. The gonads were not ripe in any of the specimens.

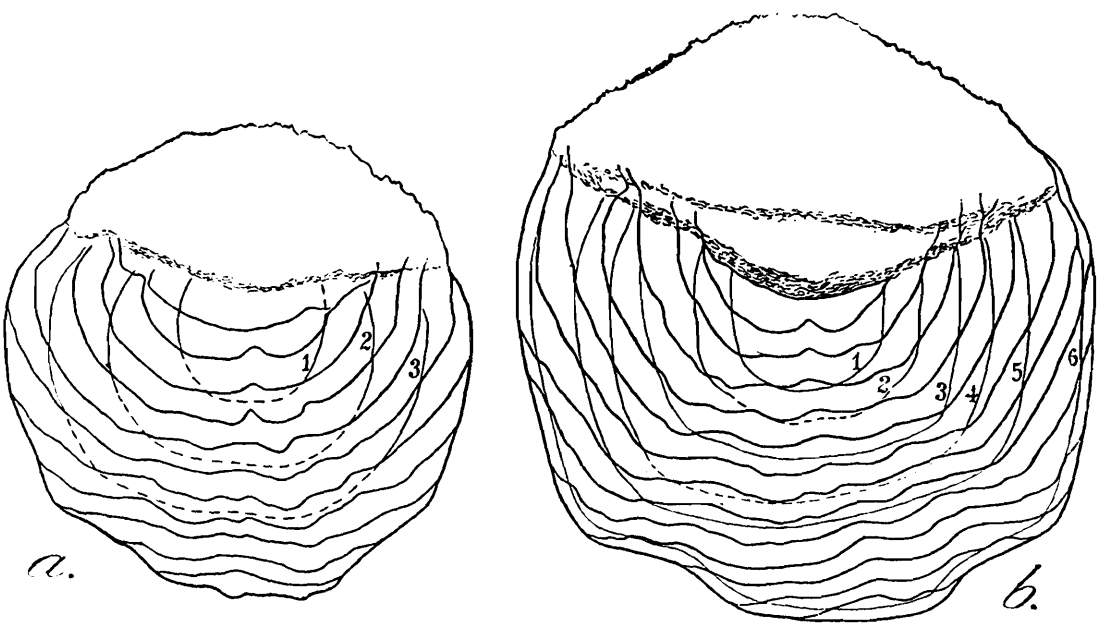
Towards the end of January (full moon) and middle of February (new moon) large number of *Hilsa* were caught at Chandipore in the mouth of the river. A consignment of 21 specimens, sent on the 1st February, 1940, comprised large-sized specimens of an average length of 36·9 cm. (Table IV). Their stomachs contained polyzoa, copepods and algae, and with the exception of a few specimens, the scales showed the growing phase. The collection contained 7 specimens with 3-ringed scales and 7 specimens with 5-ringed scales. The smallest specimen, 19·5 cm. long, had only one ring, while the scales of one specimen had 6 rings.

The intensity of *Hilsa* fishing increased during February and a consignment of 67 specimens caught in the sea on the 25th February was sent to us. These specimens ranged in length from 25 to 30 cm. (Table V), and, with the exception of a few, the alimentary canal was empty. The intestine of some fish contained sand particles and pulp. The scales showed a minimum growth stage.

On the 10th March, 1940, a sample of 22 *Hilsa* was obtained from Chandipore; they ranged in length from 28·2 cm. to 43·2 cm. (average length 34·8 cm., Table VI) and their stomachs contained polyzoa and copepods. Most of the specimens had 3 rings on their scales and the edges of scales showed that growth had just started after a period of minimum growth. This inference is possible from the fact that in most specimens some scales show a stoppage of growth while others show a growing phase.

Owing to nor'- westers and later the flooding of the country following the heavy monsoon the fishermen were unable to catch fish and we did not receive any specimen from Chandipore during April to July, 1940. Ten specimens caught from the sea by means of the floating nets and ranging in length from 39·1 to 44·5 cm., average length being 41·4 cm. were, however, received on 26th August. Their stomachs were distended with algae, sand and a few copepods. All the specimens were females but the gonads were not much developed. The scales were marked with 4 to 8 rings (one with 4, eight with 6 and one with 8 rings). Most of the scales showed a growing phase, while only a few lateral scales of some individuals showed stoppage of growth. It is of interest to note that in all scales there was a ring close to the periphery of the scale showing thereby that stoppage of growth had taken place recently.

On the 3rd September we were informed that the *Hilsa* fish were being caught in large numbers both at Chandipore and Talpada. On



Two scales of *Hilsa ilisha* (Hamilton) showing varying number of rings of growth; the exact significance of these rings is still obscure : × *ca.* 4½.

a. Dorso-lateral scale of a specimen 352 mm. in length purchased from the Calcutta market and stated to have been imported from Goalundo on the Padma River. It shows three growth rings which are quite marked at the sides, but become indistinct towards the apex.

b. Dorso-lateral scale of a specimen 408 mm. in length obtained from the sea at Chandipore on the 26th August, 1940. It shows six growth rings ; the second and fourth are indistinct towards the apex.

the 5th September a lot of 10 specimens from Talpada was sent, these ranged in length from 34·4 cm. to 48·2 cm., their average length being 42·5 cm. Seven of the specimens were females with ripe ovaries while the gonads of the other three were decomposed. Their stomachs were distended with copepods, polyzoa and large quantities of sand. The scales showed 5 to 8 rings. In 5 specimens all the scales showed a growing phase while in the remaining a few scales were marked with the " A " phase. In all cases the outermost ring was just next to the pheriphery.

The observations recorded above indicate that (*i*) *Hilsa* in all stages of growth[1] from the 12 cm. size is found in the sea at Chandipore and Talpada, (*ii*) the November examples are generally less than one year old, and (*iii*) the cessation of feeding and in consequence of growth takes place in November, and towards the end of February and possibly during May-June ; during the intervening months the fish feeds and grows. Though with the information available at present it is not possible to interpret the exact significance of the scale rings of *Hilsa*, we believe that they are formed not at regular intervals, but whenever the conditions of life become unfavourable. The growth phase, equally with the rings, is of irregular occurrence ; this is clear from the fact that feeding is resorted to at any time of the year, whether in the sea, the estuaries or the fresh-water rivers, both before and after the sexual migrations. More extensive studies of the scales correlated with size,

[1] The records of the Bengal Fisheries Inquiry show that young *Hilsa* of 2 inches and under were found at Chandipore in the middle of November (*vide supra*, p. 537).

condition of gonads, stomach contents, seasons of capture and the habitats would alone make it possible to interpret the exact significance of the rings, but we offer this tentative interpretation as a working hypothesis. We are fully aware that sufficient data are not available at present to elucidate precisely the seaward wanderings of *Hilsa*, but the observations made are offered as suggestions for further investigations on this very important food fish. Though for a full elucidation of the life-history of *Hilsa*, marking experiments are absolutely essential, we feel that a great deal of work is possible by an intensive study of the foreshore fishery of this species along the Balasore and Bengal coasts.

SUMMARY.

A summary of the earlier literature on *Hilsa* fishery is given and attention is directed to the records of the occurrence of *Hilsa* in the sea. Evidence is adduced to show that after leaving the rivers the fish do not go far into the sea but move about in shoals in the estuaries and along the foreshores. An account of the *Hilsa* investigations carried out at Chandipore on the Balasore coast is given and the tentative conclusions are reached that (*i*) *Hilsa* in all stages of growth from 12 cm. size is found in the sea at Chandipore[1], (*ii*) that the November examples at Chandipore are generally less than one year old, and (*iii*) that the cessation of feeding, in consequence of growth, takes place during November and February, and possibly during May-June also.

LIST OF REFERENCES.

Chopra, B., 1933.—Further Notes on Crustacea Decapoda in the Indian Museum. III. On the Decapod Crustacea collected by the Bengal Pilot Service off the mouth of the River Hughli. Dromiacea and Oxystomata. *Rec. Ind. Mus.* XXXV, p. 26.

Cuvier, G. and Valenciennes, A., 1847.—*Histoire Naturelle des Piossons* XX, p. 433.

Day, F., 1873*a*.—*Report on the Fresh Water Fish and Fisheries of India and Burma*, pp. 22, 23.

Day, F., 1873*b*.—*Report on the Sea Fish and Fisheries of India and Burma*, pp. 24, 25 and App. pp. i, xxxi, cxxi, cxxii.

Day, F., 1878.—*The Fishes of India* II, p. 640.

Day, F., 1889.—*The Fauna of British India including Ceylon and Burma, Fishes* I, pp. 376, 377.

De, K. C., 1910.—*Report on the Fisheries of Eastern Bengal and Assam*, p. 18.

Finlow, Robert S., 1933.—*Director of Agriculture's Note on the Scheme for the Reorganisation of a Fishery Department in Bengal*, p. 5.

Gupta, K. G., 1908.—*Reports on the Results of Enquiry into the Fisheries of Bengal and into the Fishery Matters in Europe and America*, p. 92.

Hamilton, F., 1822.—*An Account of the Fishes found in the River Ganges and its Branches*, pp. 243-246.

[1] From the occurrence of *Hilsa* at Talpada and other places also it seems probable that *Hilsa* are present all along the foreshore in the shallower waters of the Bay of Bengal.

Hora, S. L., 1938.—A Preliminary Note on the Spawning Grounds and Bionomics of the so-called Indian Shad, *Hilsa ilisha* (Ham.) in the River Ganges. *Rec. Ind. Mus.* XL, pp. 147-158.

Hora, S. L. and Nair, K. K., 1940.—Further Observations on the Bionomics and Fishery of the Indian Shad, *Hilsa ilisha* (Ham.) in Bengal Waters. *Rec. Ind. Mus.* XLII, pp. 35-50.

Howard, S., 1938.—*The Statesman*, Town Edition (7th September, 1938).

Jenkins, J. T., 1911.—Report dated the 24th December 1909 on the Marine Fishery Investigations of the Bengal Government Steam Trawler " Golden Crown " 1908-09. *Collection of Papers dealing with the Fishery Survey of the Bay of Bengal*, p. 55.

Luard, C. Eckford, and Hosten, H., 1927.—*Travels of Fray Sebastien Manrique, 1629-1643* II, pp. 230, 232.

Maxwell, F. D., 1911.—*Report on Inland Fisheries in the Thongwa, Myaungmya and Bassein Districts*, pp. 61-196.

Mojumdar, C. H., 1939*a*.—Culture of Hilsa. *Modern Review*, pp. 294, 295.

Mojumdar, C. H., 1939*b*.—Foreshore Fishing in the Eastern Part of the Bay of Bengal. *Science and Culture* V, p. 219.

Nayudu, M. Ramaswami, 1920.—A Statistical Analysis of an Inshore Fishing Experiment at Madras, 1919. *Madras Fisheries Department Administration Report for 1918-19*, p. 129.

O'Malley, L. S. S., 1907.—*Bengal District Gazetteers, Balasore*, p. 14.

Prashad, B., 1919.—*Annual Report of the Department of Fisheries, Bengal and Bihar and Orissa for the year ending 31st March 1919*, p. 4.

Raj, B. Sundara, 1932, 1937.—*Madras Fisheries Department Administration Report for the year 1930-31*, p. 32; 1935-36, p. 38.

Regan, C. Tate, 1917.—A Revision of the Clupeoid Fishes of the Genera *Pomolobus, Brevoortia* and *Dorosoma*, and their Allies. *Ann. Mag. Nat. Hist.* (8), XIX, p. 304.

Russel, Patrick, 1803.—*Descriptions and Figures of Two Hundred Fishes collected at Vizagapatam on the Coast of Coromandel*, pp. 77, 78.

TABLE I.

Measurements of Hilsa ilisha *(Ham.) caught at Chandipore on 26th November, 1939.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
1	119 mm.	31mm.	8	202 mm.	53 mm.
2	142 mm.	39 mm.	9	204 mm.	56 mm.
3	158 mm.	44 mm.	10	205 mm.	54 mm.
4	160 mm.	44 mm.	11	205 mm.	54 mm.
5	196 mm.	51 mm.	12	206 mm.	53 mm.
6	201 mm.	52 mm.	13	206 mm.	56 mm.
7	202 mm.	54 mm.	14	207 mm.	52 mm.

TABLE I—*contd.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
15	207 mm.	54 mm.	46	216 mm.	56 mm.
16	208 mm.	52 mm.	47	216 mm.	55 mm.
17	208 mm.	50 mm.	48	217 mm.	58 mm.
18	208 mm.	52 mm.	49	218 mm.	55 mm.
19	209 mm.	54 mm.	50	218 mm.	58 mm.
20	209 mm.	55 mm.	51	218 mm.	59 mm.
21	211 mm.	53 mm.	52	218 mm.	55 mm.
22	211 mm.	55 mm.	53	218 mm.	57 mm.
23	211 mm.	54 mm.	54	220 mm.	55 mm.
24	211 mm.	53 mm.	55	221 mm.	58 mm.
25	211 mm.	56 mm.	56	221 mm.	59 mm.
26	212 mm.	55 mm.	57	221 mm.	55 mm.
27	212 mm.	56 mm.	58	221 mm.	58 mm.
28	212 mm.	52 mm.	59	221 mm.	61 mm.
29	212 mm.	55 mm.	60	222 mm.	57 mm.
30	212 mm.	57 mm.	61	222 mm.	56 mm.
31	213 mm.	54 mm.	62	223 mm.	56 mm.
32	213 mm.	54 mm.	63	223 mm.	59 mm.
33	213 mm.	54 mm.	64	223 mm.	59 mm.
34	213 mm.	57 mm.	65	223 mm.	55 mm.
35	214 mm.	55 mm.	66	223 mm.	55 mm.
36	214 mm.	56 mm.	67	223 mm.	56 mm.
37	214 mm.	55 mm.	68	223 mm.	57 mm.
38	215 mm.	57 mm.	69	224 mm.	56 mm.
39	215 mm.	55 mm.	70	224 mm.	58 mm.
40	215 mm.	54 mm.	71	224 mm.	55 mm.
41	215 mm.	55 mm.	72	224 mm.	58 mm.
42	215 mm.	56 mm.	73	224 mm.	61 mm.
43	215 mm.	57 mm.	74	224 mm.	58 mm.
44	216 mm.	56 mm.	75	224 mm.	63 mm.
45	216 mm.	58 mm.	76	225 mm.	59 mm.

Table I—*contd.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
77	225 mm.	60 mm.	108	235 mm.	62 mm.
78	225 mm.	59 mm.	109	235 mm.	55 mm.
79	225 mm.	57 mm.	110	235 mm.	58 mm.
80	225 mm.	54 mm.	111	235 mm.	56 mm.
81	226 mm.	59 mm.	112	235 mm.	59 mm.
82	226 mm.	61 mm.	113	235 mm.	59 mm.
83	226 mm.	56 mm.	114	236 mm.	58 mm.
84	226 mm.	61 mm.	115	236 mm.	61 mm.
85	226 mm.	58 mm.	116	236 mm.	57 mm.
86	227 mm.	59 mm.	117	236 mm.	64 mm.
87	227 mm.	57 mm.	118	237 mm.	64 mm.
88	228 mm.	58 mm.	119	238 mm.	57 mm.
89	228 mm.	57 mm.	120	238 mm.	58 mm.
90	228 mm.	58 mm.	121	238 mm.	62 mm.
91	228 mm.	54 mm.	122	239 mm.	62 mm.
92	229 mm.	60 mm.	123	239 mm.	58 mm.
93	231 mm.	58 mm.	124	241 mm.	61 mm.
94	231 mm.	60 mm.	125	242 mm.	63 mm.
95	231 mm.	62 mm.	126	242 mm.	62 mm.
96	231 mm.	59 mm.	127	243 mm.	59 mm.
97	231 mm.	59 mm.	128	244 mm.	61 mm.
98	232 mm.	60 mm.	129	244 mm.	61 mm.
99	232 mm.	56 mm.	130	245 mm.	63 mm.
100	232 mm.	53 mm.	131	246 mm.	62 mm.
101	233 mm.	55 mm.	132	246 mm.	64 mm.
102	233 mm.	58 mm.	133	246 mm.	63 mm.
103	234 mm.	61 mm.	134	247 mm.	64 mm.
104	234 mm.	58 mm.	135	248 mm.	64 mm.
105	234 mm.	59 mm.	136	249 mm.	65 mm.
106	234 mm.	56 mm.	137	251 mm.	66 mm.
107	234 mm.	57 mm.	138	251 mm.	62 mm.

TABLE I—*concld.*

Serial No.	Length.	Height.	Serial No.	Length.	Height.
139	253 mm.	66 mm.	144	258 mm.	64 mm.
140	253 mm.	63 mm.	145	261 mm.	66 mm.
141	256 mm.	63 mm.	146	262 mm.	66 mm.
142	257 mm.	65 mm.	147	271 mm.	73 mm.
143	258 mm.	66 mm.	148	384 mm.	105 mm.

TABLE II.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 26th December, 1939.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	196 mm.	53 mm.	Digested pulp and few tiny molluscs.	2	Stop in growth.
2	204 mm.	51 mm.	Copepods.	2	Growing phase.
3	205 mm.	52 mm.	Sand grains and copepods	2	Growing phase in majority, few show stop in growth.
4	206 mm.	51 mm.	Digested pulp.	1	Growing phase.
5	212 mm.	55 mm.	Few copepods, sand particles and tiny molluscs.	2	Ditto.
6	212 mm.	66 mm.	Some digested pulp in the intestines.	No clear marks.	Some scales show growing phase while few show stop in growth.
7	214 mm.	56 mm.	Few copepods, digested pulp and sand grains.	No clear marks.	Growing phase.
8	215 mm.	54 mm.	Sand and digested pulp.	2	Stop in growth in majority, few show a growing phase.
9	216 mm.	58 mm.	Sand and copepods.	2 Not quite clear.	Growing phase.
10	219 mm.	59 mm.	Copepods.	2	Ditto.
11	221 mm.	58 mm.	Plenty of copepods and few small molluscs.	2	Ditto.
12	222 mm.	55 mm.	Copepods, small molluscs and sand.	2	Growing phase in majority, few show stop in growth.
13	225 mm.	58 mm.	Digested pulp.	2	Growing phase.
14	231 mm.	59 mm.	Few copepods and sand grains.	2	Stop in growth in majority, few in a growing phase.
15	234 mm.	62 mm.	Stomach empty; pulp in intestines.	3	Growing phase.
16	235 mm.	60 mm.	Half digested copepods and few small molluscs.	2	Growing phase in majority, few shew stop in growth.

TABLE II—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
17	238 mm.	64 mm.	Sand and copepods.	2	Growing phase.
18	242 mm.	59 mm.	Copepods and sand.	2	Ditto.
19	251 mm.	69 mm.	Plenty of sand grains, small molluscs and pieces of crustaceans.	4	Ditto.
20	251 mm.	63 mm.	Ditto.	2	Growing phase in majority, few show stop in growth.
21	252 mm.	58 mm.	Few copepods.	1	Growing phase.
22	262 mm.	65 mm.	Few copepods and digested pulp.	2	Growing phase in majority, few show stop in growth.
23	271 mm.	75 mm.	Stomach full of copepods; small molluscs and pulp in intestines.	2	Ditto.
24	271 mm.	69 mm.	Digested pulp.	3	Stop in growth.
25	285 mm.	85 mm.	Copepods and sand.	4	Growing phase.
26	328 mm.	78 mm.	Copepods.	3	Ditto.
27	336 mm.	82 mm.	Copepods and sand particles.	4	Ditto.
28	336 mm.	81 mm.	Plenty of copepods and digested pulp.	4	Ditto.
29	338 mm.	79 mm.	Plenty of copepods and sand.	4	Ditto.
30	342 mm.	82 mm.	Ditto.	3	Ditto.
31	342 mm.	86 mm.	Copepods and small molluscs.	4	Ditto.
32	345 mm.	82 mm.	Bits of copepods and half digested pulp.	3	Stop in growth in majority, few show a growing phase.
33	345 mm.	78 mm.	Plenty of copepods and sand.	3	Growing phase.
34	348 mm.	84 mm.	Copepods and sand.	4	Stop in growth in majority, few show a growing phase.
35	348 mm.	82 mm.	Few copepods and pulp.	3	Growing phase.
36	349 mm.	82 mm.	Full of copepods; small molluscs and pulp in intestines.	3	Ditto.
37	357 mm.	84 mm.	Full of copepods.	4	Ditto.
38	370 mm.	82 mm.	Digested pulp.	4	Growing phase in majority, few show stop in growth.
39	375 mm.	94 mm.	Copepods, sand and few small molluscs.	3	Stop in growth.
40	378 mm.	89 mm.	Copepods.	4	Growing phase.
41	401 mm.	102 mm.	Full of copepods.	4	Ditto.
42	408 mm.	105 mm.	Copepods, sand and few small molluscs.	4	Ditto.
43	412 mm.	103 mm.	Plenty of sand, small molluscs and copepods.	4	Ditto.
44	458 mm.	115 mm.	Sand and copepods.	5 Not quite clear.	Ditto.

TABLE III.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Balasore on 11th January, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	258 mm.	68 mm.	Plenty of algae and copepods and polyzoa.	3	Growing phase.
2	265 mm.	72 mm.	Ditto.	1	Ditto.
3	265 mm.	75 mm.	Plenty of algae and copepods.	3	Ditto.
4	272 mm.	76 mm.	Plenty of algae, copepods and polyzoa.	2	Ditto.
5	280 mm.	77 mm.	Plenty of algae and copepods.	3	Ditto.
6	293 mm.	84 mm.	Ditto.	2 Not quite clear.	Ditto.
7	307 mm.	75 mm.	Digested pulp.	2	Ditto.
8	311 mm.	90 mm.	Plenty of algae and copepods.	2	Ditto.
9	318 mm.	84 mm.	Alimentary canal empty.	4	Ditto.
10	329 mm.	97 mm.	Plenty of algae, copepods and digested pulp.	2 Not quite clear.	Ditto.
11	331 mm.	78 mm.	Ditto.	2	Ditto.
12	336 mm.	88 mm.	Ditto.	4	Ditto.
13	358 mm.	80 mm.	Ditto.	3	Ditto.
14	365 mm.	100 mm.	Plenty of algae, copepods and polyzoa.	4	Ditto.
15	379 mm.	91 mm.	Ditto.	4	Ditto.
16	397 mm.	124 mm.	Ditto.	4 Not quite clear.	Ditto.
17	402 mm.	110 mm.	Ditto.	3	Stop in growth or 'A' phase.
18	410 mm.	102 mm.	Ditto.	3	Growing phase.
19	423 mm.	101 mm.	Plenty of algae and copepods.	3	Stop in growth or 'A' phase.
20	428 mm.	108 mm.	Plenty of algae and copepods and polyzoa.	3 Not quite clear.	Growing phase.
21	435 mm.	121 mm.	Algae copepods and digested matter.	3	Ditto.
22	445 mm.	122 mm.	Ditto.	3	Ditto.
23	449 mm.	129 mm.	Ditto.	5	'A' phase just started.
24	475 mm.	128 mm.	Plenty of algae, copepods and polyzoa.	3	Growing phase.

TABLE IV

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 1st February, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	195 mm.	50 mm.	Few polyzoa and algae.	1	Growing phase.
2	260 mm.	73 mm.	Few polyzoa and algae and digested pulp.	2	Growing phase in majority, 'A' phase in few.
3	270 mm.	69 mm.	Plenty of polyzoa and few algae.	2	Growing phase.
4	295 mm.	85 mm.	Ditto.	2	Ditto.
5	361 mm.	90 mm.	Ditto.	3	Ditto.
6	364 mm.	99 mm.	Plenty of polyzoa.	3	Ditto.
7	366 mm.	97 mm.	Ditto.	3	Ditto.
8	372 mm.	122 mm.	Ditto. Few algal bits.	3	Ditto.
9	381 mm.	101 mm.	Digested pulp.	5	Ditto.
10	384 mm.	99 mm.	Plenty of polyzoa and copepods.	3	Ditto.
11	387 mm.	92 mm.	Few polyzoa.	3	Growing phase in majority, 'A' phase in few.
12	391 mm.	105 mm.	Half-digested pulp.	5	Growing phase.
13	396 mm.	101 mm.	Plenty of polyzoa and few algae.	3	Ditto.
14	401 mm.	110 mm.	Polyzoa and sand particles	5	Ditto.
15	404 mm.	108 mm.	Few polyzoa and digested pulp.	4	Ditto.
16	412 mm.	105 mm.	Polyzoa and algae.	5	Ditto.
17	414 mm.	113 mm.	Plenty of polyzoa.	5	Ditto.
18	422 mm.	118 mm.	Few polyzoa and copepods.	5	Ditto.
19	435 mm.	108 mm.	Few polyzoa.	6	Ditto.
20	435 mm.	109 mm.	Few polyzoa and copepods.	5	Ditto.
21	441 mm.	115 mm.	Polyzoa and algae.	4	Ditto.

TABLE V

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) cau gh at Chandipore on 25th February, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	235 mm.	57 mm.	Sand and digested pulp.	2	'A' phase just started.
2	241 mm.	54 mm.	Ditto.	2	'A' phase.
3	245 mm.	62 mm.	Digested pulp.	No clear ring marks.	Ditto.
4	255 mm.	64 mm.	Sand and digested pulp.	2 Not quite clear.	Ditto.

TABLE V—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
5	256 mm.	59 mm.	Sand and digested pulp.	2	'A' phase just started.
6	262 mm.	60 mm.	Ditto.	1	'A' phase.
7	265 mm.	64 mm.	Ditto.	2	Ditto.
8	265 mm.	63 mm.	Ditto.	2	'A' phase in majority, few scales show growing phase.
9	266 mm.	64 mm.	Ditto.	1	'A' phase just started.
10	268 mm.	65 mm.	Ditto.	2	Ditto.
11	269 mm.	65 mm.	Ditto.	3	Growing phase in majority, few scales show 'A' phase.
12	269 mm.	62 mm.	Ditto.	2	'A' phase.
13	270 mm.	65 mm.	Alimentary canal empty.	2	Ditto.
14	271 mm.	65 mm.	Sand and digested pulp.	2	Ditto.
15	271 mm.	63 mm.	Alimentary canal empty.	2	Growing phase in majority, few scales show 'A' phase.
16	275 mm.	65 mm.	Sand and digested pulp.	2	'A' phase.
17	275 mm.	65 mm.	Ditto.	2 Not quite clear.	Ditto.
18	275 mm.	64 mm.	Ditto.	3	Growing phase in majority, few scales show 'A' phase.
19	276 mm.	62 mm.	Ditto.	2	'A' phase.
20	276 mm.	64 mm.	Ditto.	3	Growing phase in majority, 'A' phase in few.
21	276 mm.	69 mm.	Alimentary canal empty.	2	'A' phase.
22	276 mm.	84 mm.	Sand and digested pulp.	2	Ditto.
23	277 mm.	64 mm.	Alimentary canal empty.	1	Growing phase in majority, 'A' phase in few.
24	277 mm.	67 mm.	Sand and digested pulp.	2	'A' phase just started.
25	278 mm.	71 mm.	Alimentary canal empty.	2 Not quite clear.	'A' phase.
26	278 mm.	65 mm.	Sand and digested pulp.	2	'A' phase just started.
27	278 mm.	67 mm.	Alimentary canal empty.	2	'A' phase.
28	279 mm.	67 mm.	Sand and digested pulp.	2	Ditto.
29	280 mm.	68 mm.	Ditto.	2 Not quite clear.	Ditto.
30	281 mm.	62 mm.	Ditto.	2 Not quite clear.	Ditto.
31	282 mm.	65 mm.	Ditto.	1	Ditto.
32	283 mm.	64 mm.	Digested pulp.	2 Not quite clear.	Ditto.
33	284 mm.	69 mm.	Sand and digested pulp.	2 Not quite clear.	Ditto.
34	284 mm.	68 mm.	Ditto.	3	Ditto.

TABLE V—*concld.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
35	284 mm.	68 mm.	Sand and digested pulp.	2	'A' Phase.
36	284 mm.	68 mm.	Ditto.	3	Ditto.
37	285 mm.	66 mm.	Ditto.	3	Ditto.
38	285 mm.	70 mm.	Digested pulp.	2	Ditto.
39	285 mm.	67 mm.	Sand and digested pulp.	3 Not quite clear.	'A' phase just started.
40	285 mm.	74 mm.	Ditto.	2	'A' phase.
41	285 mm.	68 mm.	Ditto.	3	Ditto.
42	286 mm.	71 mm.	Ditto.	2	'A' phase just started.
43	287 mm.	72 mm.	Ditto.	4	'A' phase.
44	287 mm.	68 mm.	Digested pulp.	2 Not quite clear.	Ditto.
45	287 mm.	65 mm.	Alimentary canal empty.	2	Ditto.
46	288 mm.	68 mm.	Sand and digested pulp.	4	Ditto.
47	288 mm.	67 mm.	Few copepods, sand and digested pulp.	3 Not quite clear.	Ditto.
48	289 mm.	65 mm.	Digested pulp.	2 Not quite clear.	Ditto.
49	291 mm.	67 mm.	Sand and digested pulp.	2	'A' phase just started.
50	292 mm.	70 mm.	Ditto.	2 Not quite clear.	'A' phase.
51	294 mm.	75 mm.	Alimentary canal empty.	2	Ditto.
52	295 mm.	70 mm.	Sand and digested pulp.	2	'A' phase just started.
53	295 mm.	69 mm.	Ditto.	3	'A' phase.
54	298 mm.	66 mm.	Alimentary canal empty.	2	Ditto.
55	298 mm.	71 mm.	Sand and digested pulp.	2	Ditto.
56	300 mm.	74 mm.	Ditto.	2 Not quite clear.	Ditto.
57	302 mm.	74 mm.	Ditto.	No clear ring marks.	'A' phase just started.
58	303 mm.	74 mm.	Ditto.	2 Not quite clear.	'A' phase.
59	306 mm.	75 mm.	Digested pulp.	2	Ditto.
60	308 mm.	72 mm.	Sand and digested pulp.	No clear ring marks.	Ditto.
61	311 mm.	73 mm.	Digested pulp.	3	Ditto.
62	312 mm.	71 mm.	Alimentary canal empty.	3	Ditto.
63	316 mm.	72 mm.	Sand and digested pulp.	3	'A' phase just started.
64	325 mm.	80 mm.	Sand and few copepods.	2	'A' phase.
65	336 mm.	77 mm.	Sand and digested pulp.	3	Ditto.
66	340 mm.	77 mm.	Ditto.	4	'A' phase just started.
67	367 mm.	89 mm.	Ditto.	4	'A' phase.

TABLE VI.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 10th March, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	282 mm.	71 mm.	Few copepods and polyzoa.	2	Growing phase.
2	305 mm.	79 mm.	Ditto.	3	'A' phase in majority, growing phase in few.
3	306 mm.	87 mm.	Alimentary canal empty.	3	Ditto.
4	321 mm.	75 mm.	Ditto.	3	Growing phase.
5	324 mm.	87 mm.	Sand, polyzoa and copepods.	3	'A' phase in majority, growing phase in few.
6	328 mm.	81 mm.	Alimentary canal empty.	3	Growing phase.
7	329 mm.	81 mm.	Sand, polyzoa, copepods and digested pulp.	2 Not quite clear.	'A' phase.
8	334 mm.	87 mm.	Sand, copepods and polyzoa.	4	Growing phase.
9	335 mm.	75 mm.	Few copepods and polyzoa.	3	'A' phase in majority, growing phase in few.
10	340 mm.	82 mm.	Sand, polyzoa and copepods.	4	Ditto.
11	341 mm.	81 mm.	Ditto.	3	Ditto.
12	342 mm.	87 mm.	Ditto.	3	Ditto.
13	345 mm.	91 mm.	Ditto.	3 Not quite clear.	Ditto.
14	346 mm.	81 mm.	Ditto.	3	Growing phase.
15	354 mm.	71 mm.	Copepods, polyzoa and sand.	3	Ditto.
16	354 mm.	87 mm.	Alimentary canal empty.	3	Ditto.
17	367 mm.	85 mm.	Sand, polyzoa, copepods and digested pulp.	4	Ditto.
18	373 mm.	91 mm.	Sand, copepods and polyzoa.	4	'A' phase in majority, growing phase in few.
19	386 mm.	94 mm.	Sand, polyzoa, copepods and digested pulp.	4	Growing phase.
20	412 mm.	106 mm.	Plenty of copepods, polyzoa and sand.	6	Ditto.
21	418 mm.	106 mm.	Ditto.	4	Ditto.
22	432 mm.	112 mm.	Few copepods and polyzoa.	5	'A' phase in majority, growing phase in few.

TABLE VII.

Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Chandipore on 26th August, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	391 mm.	116 mm.	Alimentary canal extended with sand, algae and copepods.	6	Growing phase in majority, 'A' phase in few.
2	399 mm.	102 mm.	Ditto.	6	Ditto.
3	400 mm.	113 mm.	Ditto.	6	Ditto.
4	408 mm.	112 mm.	Ditto.	6	Growing phase.
5	409 mm.	121 mm.	Ditto.	6	Ditto.
6	410 mm.	115 mm.	Ditto.	4	Growing phase in majority, 'A' phase in few.
7	413 mm.	121 mm.	Ditto.	6	Growing phase.
8	427 mm.	123 mm.	Ditto.	6	Ditto.
9	433 mm.	116 mm.	Ditto.	6	Growing phase in majority, 'A' phase in few.
10	446 mm.	128 mm.	Ditto.	8	Growing phase.

TABLE VIII.

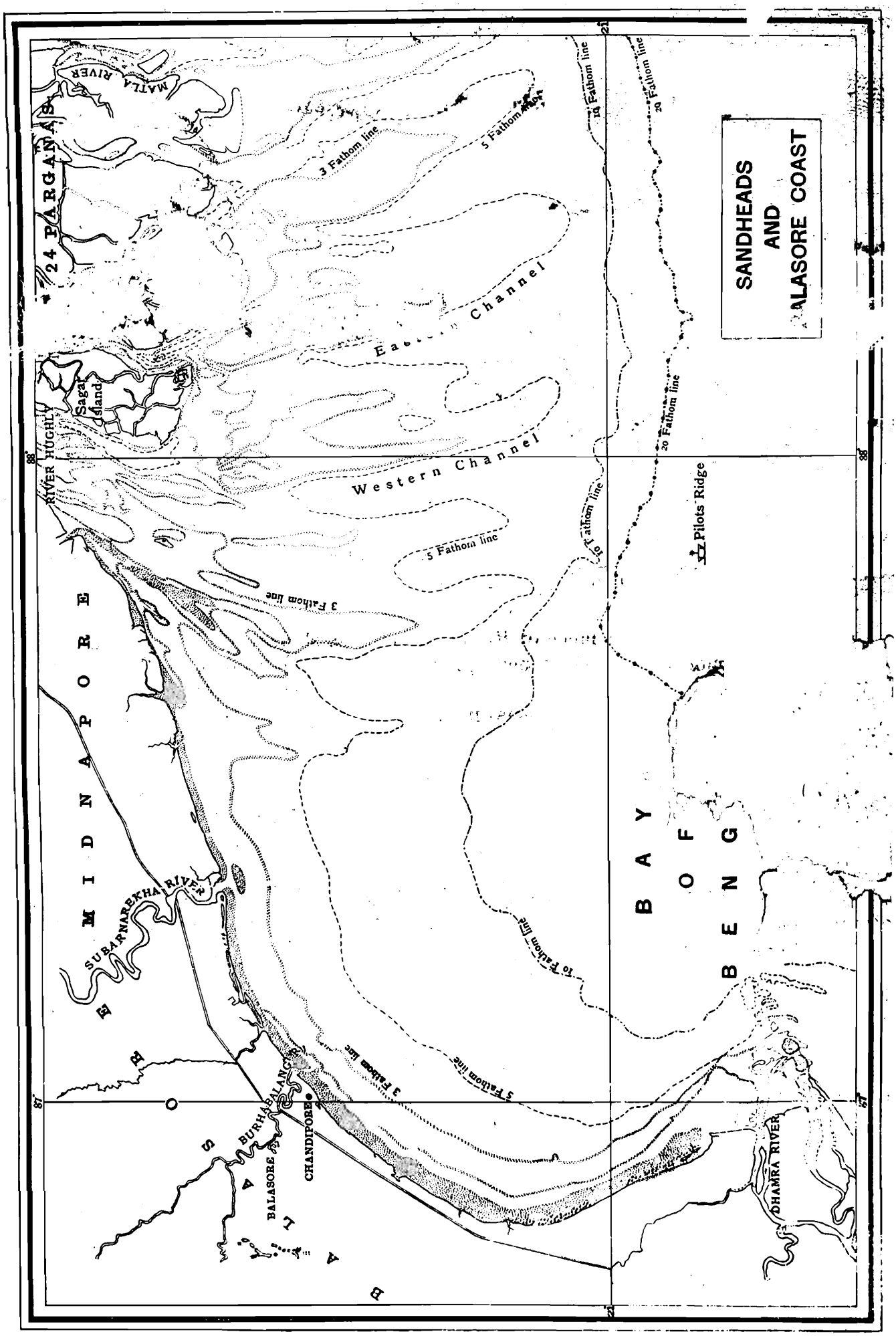
Measurements, gut-contents and scale readings of Hilsa ilisha *(Ham.) caught at Talpada on 5th September, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
1	344 mm.	103 mm.	Plenty of sand, copepods and few polyzoa.	5	'A' phase in majority, growing phase in few.
2	384 mm.	106 mm.	Ditto.	6	Ditto.
3	385 mm.	102 mm.	Ditto.	6	Growing phase.
4	413 mm.	123 mm.	Ditto.	6	'A' phase in majority, growing phase in few.
5	428 mm.	115 mm.	Ditto.	6	Growing phase.
6	444 mm.	124 mm.	Ditto.	8 Not clear	'A' phase in majority, growing phase in few.
7	449 mm.	126 mm.	Ditto.	7	Growing phase.
8	461 mm.	128 mm.	Ditto.	8	Ditto.
9	464 mm.	125 mm.	Ditto.	7	'A' phase in majority, growing phase in few.
10	482 mm.	133 mm.	Ditto.	8	Growing phase.

EXPLANATION OF PLATE IX.

A map of the Sandheads and the Balasore Coast. The five, ten and twenty fathom depth zones are indicated by different types of hatched

From the abundance of *Hilsa* shoals in the shallow flats close to the river mouths and their neighbourhood on the Bengal and Balasore Coasts and their probable absence from the area round Pilots Ridge it is surmised that this species in its seaward migration does not go far out into the sea.


SANDHEADS AND BALASORE COAST
24 PARGANAS
MATLA RIVER
Sagar Island
RIVER HUGHLI
Eastern Channel
Western Channel
3 Fathom line
5 Fathom line
10 Fathom line
20 Fathom line
Pilots Ridge
MIDNAPORE
SUBARNAREKHA RIVER
BURHABALANG
BALASORE
CHANDIPORE
DHAMRA RIVER
BAY OF BENGAL
88°
87°
21°
22°

THE *JATKA* FISH OF EASTERN BENGAL AND ITS SIGNIFICANCE IN THE FISHERY OF THE SO-CALLED INDIAN SHAD, *HILSA ILISHA* (HAMILTON).

By SUNDER LAL HORA, D.Sc., *F.R.S.E., F.N.I., Assistant Superintendent*, and K. V. KRISHNAN NAIR, *M.Sc., Officiating Gallery Assistant, Zoological Survey of India, Calcutta.*

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INTRODUCTION.

De (1910, p. 17) in his 'Report on the Fisheries of Eastern Bengal and Assam' identified the *Jatka* fish of Eastern Bengal as *Clupea fimbriata*[1] and stated that:

"The smallest of the herring family is known by the name of *jātkya*, or *khair*... is found in the estuaries as high up as Goalundo from February to April. It is ... fish, with a rather dark back and silvery sides shot with gold. It cannot be ... tanks. It is very tasty, is much prized as food, and a large number are c... net called *chāpila-jāl*. From the similarity in shape, appearance and ta... men describe it as the young of the *hilsa*. I believe that the fish describe... in the Dacca Division is identical with this fish."

Investigations carried out by the Fish... and Bihar and Orissa from 1919 to 1923 brought to light ... the young of *Hilsa*. First reference to this fact is contained ... for the year ending 31st March, 1920 (Finlow, 1920, p. 3), ... Work' it is stated that:

"Much useful work has been done by the District Fishery ... Khulna in this connection. They have collected valuable data r... ... and prevalence of the *hilsa* in their respective districts, and the ... tin... ... relating to the young *hilsa*, or *jatka* (as they are locally cal'... winter

In the next Annual Report it is stated (Evans, 1921, p. 3) that:

"The winter *hilsa* enquiry was mainly confined to collecting information about the occurrence and movement of the *jatka* in the rivers of Khulna and Dacca. It is a small *clupea* supposed to be young *hilsa*, but some doubts exist as to its identity with the *hilsa*.

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[1] According to Day (1878, p. 638), *Clupea fimbriata* is found in "Red Sea, seas of India to the Malay Archipelago. It abounds in certain years off the Malabar coast." It is distinguished from *C. ilisha* by the following salient characters:—

Clupea fimbriata.	*Clupea ilisha.*
1. Teeth on tongue and palatines.	No teeth inside mouth.
2. L. tr. 11-12.	L. tr. 17-19.
3. Length of head 5 to 5¼, height of body 4 to 4⅔ in the total length.	Length of head 4¼ to 4½, height of body 3½ to 3¾ in the total length.

[2] Through the kindness of Mr. C. H. Mojumdar we obtained specimens of *Chandana-hilsa* from the Dacca District; these belong to *Hilsa toli* (Hamilton).

Specimens of *jatka* have been sent to the Zoological Survey for identification, but the result is not yet known. This is an important enquiry in so far as it is likely to throw some light on the location of the breeding grounds of the *hilsa*. Without this knowledge it is almost hopeless to expect success in the artificial culture of this species."

Unfortunately the information collected about the occurrence and movement of the *Jatka* was not published and we have not been able to trace the material stated to have been sent to the Zoological Survey of India for identification. In the next year's Report (Evans, 1922, p. 2) reference is again made to the *Jatka*:

"It was mentioned in the last year's report that specimens of a small *clupea* supposed to be young *hilsa* and locally known as *jatka* had been sent to the Zoological Survey for identification, but no definite reply has so far been received. If the *jatka* proves to be the fry of the *hilsa* then a great advance has been made towards the discovery of the breeding grounds and this will be the first step towards the artificial culture of this species. The handling of this fish is, however, so very difficult on account of its extreme delicacy that I am inclined to think that it will take some time and a highly trained staff before success can be attained in the culture of this fish by the artificial fertilization of *hilsa* eggs by stripping the male and female as is done with the shad in America."

Later some material of *Jatka* seems to have been sent for determination to Dr. C. Tate Regan at the British Museum of Natural History, London, and it is observed by Finlow (1923, p. 2) under 'Hilsa Culture' in the Annual Report for the year ending 31st March 1923 that:

"The work under this head was practically confined to the investigation of the *jatka*, a small *Clupea*. The *jatka* has since been identified by Mr. C. Tate Regan, of the British Museum, as the young of the *hilsa*. It is remarkable that the *jatka* which is so abundant in some of the Eastern Bengal rivers, is scarcely to be found in the Hughli, although large quantities of *hilsa* are caught every year in this river during the rains. The existence of the *jatka* was therefore not known to the Department until recently. Even in *Departmental Bulletin No. 11, which contains an account of the hilsa investigation* work done up to the *hilsa* season of 1917, there is no mention of the *jatka*. Very large quantities of *jatka* are destroyed every year, and now that the relationship between the *jatka* and *hilsa* is proved, it is a matter for discussion as to whether a close season would not be advisable. There appears to be a continual diminution in the supply of *hilsa*, the price of which is constantly rising. The discovery that the *jatka* is the young *hilsa*, is the first step in the life history of the latter which has been brought to light; and of course it brings us so much nearer the possibility of artificial *hilsa* culture."

With the abolition of the Fisheries Department of Bengal in 1923, the *Jatka* enquiries came to an end. In 1933, Finlow (p. 5) again directed attention to this problem and stated that "the fingerling of the *hilsa* has been identified in the *jatka*, a small fish less than 6" long, found in the Buriganga, Lakhya and Meghna rivers in Eastern Bengal in February-March. It is probable therefore that the main spawning grounds of *hilsa* are in Eastern Bengal."

In 1938, one of us (Hora, 1938, pp. 147-158) announced the discovery of the spawning grounds of *Hilsa* in the Bengal waters, but no attention was then paid to the extensive fishery of *Jatka*. Commenting on this article, Jenkins (1938, p. 252) wanted the identity of *Jatka* or *Jatkya* to be cleared up. Following this suggestion we (1940, pp. 42, 43) made investigations in East Bengal in February 1939 through Mr. M. N. Datta, who visited Barisal, Patuakhali, Galachipa, Chandpur, Narayangurj and Goalundo. Though no definite information was obtained about *Jatka*, it was ascertained that *Hilsa* breeds extensively in East Bengal and that there are in places extensive fisheries of young *Hilsa*. These investigations were continued in 1940 through the help of the district authorities and Mr. Mojumdar who had made observations on *Jatka* in his article "Culture of Hilsa" (p. 293). As the full signification of

the association between the *Jatka* and the *Hilsa* fisheries has not yet been realised, we give below some observations on the material received from different sources during March-April, 1940.

Identity and Bionomics of the *Jatka* Fish of East Bengal.

Early in January 1940, the Collectors of Faridpur and Noakhali and the Sub-Divisional Officer, Narayangunj, were requested to collect and forward *Jatka* fish as soon as they appear in the rivers of their respective areas. The first consignment of *Jatka* was received in Calcutta on the 15th February from the Circle Officer, Lakshmipur, Noakhali District. In the forwarding note it was stated that much trouble was experienced in procuring the material as that was not the season for the *Jatka* fish. The fish were received in two lots, 12 preserved in salt were the young of *Hilsa*, while of the 7 preserved in formalin 1 was young *Hilsa* and the others young of *Gudusia chapra* (Ham.). On making further enquiries regarding the precise habitat of the specimens, the following valuable information was received :—

" Since the beginning of January I made constant efforts to procure the fish called *Jatka*. I informed the Fishery Society at Bhowaniganj and requested all the presidents and members of the Union Boards in my Circle to help me in the matter and I supplied them with a copy of the description of the fish *Jatka* sent by you. After the lapse of more than a month came the collection I sent—one found as *Chapra* from Char Ramani Mohan and the other ' young Hilsa ' from Raipur. The latter specimens were purchased from Raipur Bazar and were reported to have been caught in Meghna nearby with a long net set not far off from the bank. The former, namely *Chapra*, was caught with a kind of fencing made of split up bamboos pitched on the edge of the Char during the flow tide and the fish is caught when the water goes down from inside the fencing.

" The ' young Hilsa ' is known to the local people by the name *Jatka*. *Chapra* is called by some to be *Jatka*. But majority of the people call *Chapra* to be *Chapila*. There is no such division of opinion with regard to the name given to ' young Hilsa ', namely *Jatka*. Both the forms go up the river. *Jatka* is said to occur in greater quantity than now sometime towards the end of Falgoon (February-March) and beginning of Chaitra (latter half of March) but the quantity will never be so great as to fill a tin."

The young *Hilsa* from Lakshmipur (Table I) were from 85 to 141 mm. in length, average size 114 mm., and were marked with series of black spots on the sides which are so characteristic of the juvenile stages of *Hilsa*. The length of head was contained from 4·0 to 4·3 times and the depth of body from 3·5 to 3·9 times in the total length. An examination of the stomach-contents of these examples showed that they were feeding heavily. In every individual the intestine was filled with a green pulpy matter which seemed to comprise half digested algae of a filamentous type. Copepods and bits of algae were also present in the stomach. A fair quantity of sand grains was also found in the alimentary canal. The edges of the scales, except in a few lateral scales of one individual, showed that growth was taking place.

The second consignment of *Jatka* (Table II) was sent by the Sub-Divisional Officer, Narayanganj, on the 16th March, 1940. It comprised 30 specimens of young *Hilsa* ranging in length from 116 to 165 mm., average length being 143 mm. All the specimens were marked with black spots on the sides. The length of head was contained from 3·9 to 4·3 times and the depth of the body from 3·6 to 4·1 times in the total length. An examination of their stomach-contents showed that they had been feeding heavily. In some specimens the stomach and intestine were very much distended. In specimens with an empty stomach the intestine

contained a pulpy matter. Bits of algae of the *Spirogyra*-type as well as those of a light brown colour formed the bulk of the gut-contents though copepods were also found in good numbers. Sand grains in fair quantities were also present. The edges of the scales with the exception of a few lateral scales in two specimens showed the growing phase.

On the 29th March, 1940, the Sub-Divisional Officer, Goalundo, sent a consignment of 29 specimens of *Jatka* (Table III) and stated that these had been procured by the Thana Officer, Goalundo Ghat. All of these proved to be young *Hilsa* ranging in length from 86 to 163 mm., with an average length of 107 mm. The length of head varied from 4·0 to 4·5 times and the depth of body from 3·7 to 4·1 times in the total length of the fish. The specimens were marked with black spots, and had been feeding mostly on algae. Copepods also formed a small part of their food. The edges of the scales showed a growing phase.

Through the kindness of Mr. Mojumdar, three consignments of *Jatka* (Tables IV, V and VI), all of which proved to be young *Hilsa*, were received on the 20th March, 11th April and 14th May respectively. The March lot comprised 20 specimens, ranging from 95 to 142 mm. in length, with an average length of 122 mm. The length of head was contained from 4·0 to 4·2 times and the depth of the body from 3·6 to 4·1 times in the total length. The specimens were mostly without any spots or had only one anterior spot. Most of the specimens had been feeding mainly on diatoms, but copepods, algae and sand particles were also present in the stomach in fair numbers. The edges of the scales in the majority of specimens showed a growing phase, but in a few specimens some of the lateral scales showed the beginning of the stoppage phase.

On making enquiries regarding the relative abundance and the methods of fishing of *Jatka*, Mr. Mojumdar informed us that *Jatka* move in shoals against the current and are caught in very large numbers by means of a small meshed seine net locally known as *Berjal* which is about ½ mile in length, 20 to 25 cubits in breadth. He also observed that shoals of *Jatka* prefer parts of the channel where the current is somewhat stronger.

On the 10th April, Mr. Mojumdar sent 41 *Jatkas* from Dacca and observed, " It is really a pity that such promising fry are killed and disposed of, say a score for a pice or two " He also stated that " Since I wrote to you last, *Jatka* came in the market in good numbers for a day or two. And the *Hilsha* supply which generally ceases, in normal years, by this part of the season, is continuing on, though the quantity has undergone a decrease." All the specimens proved to be young of *Hilsa*, ranging from 91 to 122 mm. in length, with an average length of 113 mm. The length of the head is contained from 3·8 to 4·5 times and the depth of the body from 3·4 to 3·9 times in the length. The food consisted mainly of diatoms, but a small quantity of copepods was also present. No algae were found among the stomach-contents, and the intestines were practically empty. Though in about 30 per cent. of the specimens the edges of all the scales showed a growing phase, in a great majority of scales on the sides the growth had ceased.

On the 18th April, Mr. Mojumdar informed us that " Jatka supply is showing a tendency towards increase in the local markets at the preser t

time" Again on the 13th May, Mr. Mojumdar procured a few specimens and observed that " Supply of Jatkas in Dacca markets has undergone a great decrease at the present time. The supply was big for 15 days approximately from the date I sent you the second consignment" This final consignment of *Jatka* comprised 8 young *Hilsa* ranging from 118 to 143 mm. in length, average length being 129 mm. The length of the head was contained from 4·1 to 4·3 times and the depth of body from 3·4 to 3·8 times in the total length. Most of the specimens possessed one lateral spot while a few were devoid of any markings. In three specimens the stomach was empty but the intestine contained some pulpy matter. Some of the lateral scales showed stoppage of growth while the others were in a growing phase. In the remaining specimens the stomach was full of algae and copepods. The intestine contained greenish pulp and all the scales showed a growing phase.

The *Jatka* season ended with the May lot and according to the information supplied by Mr. Mojumdar, the *Hilsa* season at Dacca commenced from the 8th June, when large-sized fish became available in the local markets.

From the foregoing account there is not the slightest doubt that *Jatka* represent the young of *Hilsa*. Of the 138 specimens examined, the smallest, 85 mm. in length, was obtained at Lakshmipur in February, while the largest specimen, 164 mm. in length, was received from Narayangunj. From the evidence already adduced about the rate of growth of *Hilsa* (Hora & Nair, 1940, pp. 36-41), it may be surmised that *Jatka* represent 2 to 5 months old young of *Hilsa*. If this surmise is correct, the *Jatka* individuals must be regarded as the progeny of the late breeders who had not yet gone down to the sea and were, prior to their ascent up-river, feeding in the estuaries. Though there is no definite evidence to show the actual direction of the movements of the shoals of *Jatka*, the fact that they appeared at Lakshmipur in February, at Narayangunj and Dacca about the middle of March and at Goalundo about the end of March is very significant and shows that the shoals probably move from the estuaries upstream. In this connection attention may be directed to the following observations of Mr. Stanley Howard (1938) :

" The young fish after about two months stay in the sea, add considerably to their size and weight, and towards the end of December they return to the estuaries (Sunderbans) in shoals. The fish at about this time are about 7 to 9 inches long and in search of new feeding grounds."

The object of this up-river migration of *Jatka* is feeding and our studies of their stomach-contents fully bear out this contention. Prashad, Hora and Nair (1940, p. 540) have already observed that young *Hilsa* at Chandipore stop feeding towards the end of February and presumably at this time plankton food is scarce in the sea. Impelled by this scarcity of food in the sea the young invade rivers in shoals to reach their inland feeding grounds. The edges of the scales also show that the fish grows during the *Jatka*-phase of its life. Only in April and May the growth is somewhat retarded. During February and March algae constitute the bulk of the food while during the nor'-westers (March-April) diatoms form the bulk of the food. In May algae begin to predominate again. The variation in the number of lateral blotches generally depends upon the size of the *Jatka*, and in our opinion does not constitute a character

of specific or racial value. Hamilton's drawing of *Clupanodon ilisha* (pl. xix, fig. 73) shows 5 lateral spots and presumably represents a young *Hilsa*. Day (1878, p. 640) had also observed that young *Hilsa* possess lateral blotches.

SIGNIFICANCE OF *JATKA* IN THE FISHERY OF *HILSA*.

The question of the bearing of the destruction of the young *Jatka* on the main fishery of *Hilsa* may next be considered. In this connection attention may be directed to observations made by one of us (Hora, 1938, p. 156) regarding the establishment of hatcheries for *Hilsa*. It was then stated that :

> " In view of the fact that after the floods millions of young *Hilsa* are caught from the river Hooghly, it seems that there is no need at present to augment the numbers of this fish through artificial fecundation. There would, however, seem to be an urgent necessity to preserve the natural stock by prohibiting the catching of young *Hilsa* through legislation during the months of October and November."

In October and November very young specimens of *Hilsa* up to about 50 mm. in length are caught while migrating down-stream to the estuaries. In the estuaries and on the foreshore young ones of 7 to 9 inches are caught in large numbers during the cold months of November to January. Afterwards when these young move up-stream for feeding purposes, there are extensive fisheries of *Jatka* in inland waters during March-April. The fishery of young *Hilsa* at all these stages leads to the depletion of the natural stock and with the increasing demand for fish, there is a corresponding activity in catching fish of all sizes. However, in legislating for regulating the unproductive fishery of the young, some alternate mode of subsistence will have to be found for the fishermen, otherwise it may mean great hardship to those poor people. In view of the existing extensive fisheries of the young *Hilsa* in Bengal waters, however, there is hardly any necessity for establishing *Hilsa* hatcheries. All the same the question of the *Hilsa* fishery in Bengal is of such vital importance that it requires very thorough investigation before any remedial measures can be suggested.

CAUSE OF THE ABSENCE OF *JATKA* FROM THE RIVER HOOGHLY.

Finlow (1923, p. 2) observed that " It is remarkable that the *Jatka* which is abundant in some of the Eastern Bengal rivers, is scarcely to be found in the Hughli, although large quantities of *Hilsa* are caught every year in this river during the rains" This is due to the fact that the Hooghly has silted up and deteriorated to such an extent, especially in its upper reaches, that, except during the monsoon, it receives little water from the main stream of the Ganges, and is, therefore, not comparable to the rivers of Eastern Bengal which flow throughout the year. In March, 1937, one of us (S. L. H.) made a survey of the fish-fauna of the river Hooghly above Calcutta as far as Nadia, a distance of about 100 miles. The river above the town of Hooghly was found to be only a foot or so deep at low tide. This silting up of the bed is probably the result of the lack of any freshwater current from above. The upper reaches of the river seemed almost like a stationary pool and the fish-fauna collected therefrom was composed of a large number of pool-dwell-

ing forms. The occurrence of bottom fishes of marine or estuarine genera, such as *Platycephalus, Cynoglossus, Pseudorhombus, Taenioides, Pseudapocryptes* and *Apocryptes* far inland above the tidal influence also showed that for lack of adequate flow from above the bottom wedge of brackish water had penetrated to a considerable extent inland. In several respects the Hooghly during the dry season may be compared to a lagoon. As the *Jatka* prefer a fast current of water, the Hooghly during March-May is not suitable for their inland migration. Only during and immediately after the monsoon the current is of sufficient intensity to induce the adult *Hilsa* and its young to migrate upstream in this river.

Summary.

A detailed summary of the earlier records of the occurrence of the *Jatka* fish in the rivers of East Bengal is given, and from a study of several lots of *Jatka*, comprising 138 specimens, received from Lakshmipur in February, Narayangunj and Dacca about the middle of March and Goalundo about the end of March it is concluded that (i) *Jatka* represent the young of *Hilsa* 2 to 5 months old, (ii) the migration of *Jatka* from the estuaries into fresh waters is for feeding purposes, and (iii) during the *Jatka* phase the *Hilsa* feed and grow and it is only in April-May that the feeding is stopped and, in consequence, the growth inhibited. Attention is directed to the significance of *Jatka* in the fishery of *Hilsa* and it is concluded that for the proper conservation and augmentation of the *Hilsa* fishery it is not necessary to have hatcheries, but to devise suitable means for protecting the young of *Hilsa* from destruction. The cause of absence of *Jatka* from the river Hooghly is attributed to the silting up of its upper reaches and, in consequence, to a general deterioration of the river.

List of References.

Day, Francis, 1878.—*Fishes of India*, pp. 638, 640.

De, K. C., 1910.—*Report on the Fisheries of Eastern Bengal and Assam*, p. 17.

Evans, G., 1921.—*Annual Report of the Department of Fisheries, Bengal and Bihar and Orissa, for the year ending 31st March 1921*, p. 3.

Evans, G., 1922.—*Annual Report of the Department of Fisheries, Bengal and Bihar and Orissa, for the year ending 31st March 1922*, p. 2.

Finlow, R. S., 1920.—*Annual Report of the Department of Fisheries, Bengal and Bihar and Orissa, for the year ending 31st March 1920*, p. 3.

Finlow, R. S., 1923.—*Annual Report of the Department of Fisheries, Bengal and Bihar and Orissa, for the year ending 31st March 1923*, p. 2.

Finlow, R. S., 1933.—*Director of Agriculture's Note on the Scheme for the reorganisation of a Fishery Department in Bengal*, p. 5.

Hamilton, F., 1822.—*Fishes of the Ganges*, pl. xix, fig. 73.

Hora, S. L., 1938.—A preliminary Note on the Spawning Grounds and Bionomics of the so-called Indian Shad, *Hilsa ilisha* (Ham.) in the River Ganges. *Rec. Ind. Mus.* XL, pp. 147-158.

Hora, S. L., and Nair, K. K., 1940.—Further observations on the Bionomics and Fishery of the Indian Shad, *Hilsa ilisha* (Ham.), in Bengal Waters. *Rec. Ind. Mus.* XLII, pp. 35-50.

Howard, Stanley, 1938.—*The Statesman*, Town Edition (September 7th).

Jenkins, J. T., 1938.—Spawning of *Hilsa*. *Current Science* VII, No. 5, p. 252.

Mojumdar, C. H., 1939.—Culture of Hilsa. *Modern Review*, p. 293.

Prashad, B., Hora, S. L. and Nair, K. K., 1940.—Observations on the Seaward Migration of the so-called Indian Shad, *Hilsa ilisha* (Ham.). *Rec. Ind. Mus.* XLII, pp. 529-552.

TABLE I.

Measurements, gut-contents and scale readings of "Jatka" caught at Lakshmipur during February, 1940.

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	85	24	Plenty of copepods, algal bits and digested green pulp.	*Nil.*	Growing phase.
2	93	24	Ditto.	Do.	Ditto.
3	94	25	Ditto.	Do	Ditto.
4	113	31	Ditto.	Do.	Ditto.
5	115	31	Ditto.	Do.	Ditto.
6	117	32	Ditto.	Do.	Growing phase in majority, 'A' phase in few.
7	124	33	Ditto.	Do.	Growing phase.
8	125	35	Ditto.	Do.	Ditto.
9	132	38	Ditto.	Do.	Ditto.
10	141	38	Ditto.	Do.	Ditto.

TABLE II.

Measurements, gut-contents and scale readings of "Jatka" caught at Narayangunj during March, 1940.

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	116	31	Plenty of green and brown algal bits, copepods and sand.	1	Growing phase.
2	118	32	Ditto.	1	Ditto.
3	128	34	Ditto.	1	Ditto.
4	129	35	Ditto.	1	Ditto.
5	129	34	Ditto.	1	Ditto.
6	131	36	Ditto.	1	Ditto.
7	133	35	Ditto.	1	Ditto.
8	133	35	Ditto.	1	Ditto.

Table II—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
9	133	35	Plenty of green and brown algal bits, copepods and sand.	1	Growing phase.
10	136	35		1	Ditto.
11	136	36	Ditto.	1	Ditto.
12	137	36	Ditto.	1	Ditto.
13	138	37	Ditto.	1	Ditto.
14	138	36	Ditto.	1	Ditto.
15	142	39	Ditto.	1	Ditto.
16	142	36	Ditto.	1	Ditto.
			Ditto.		
17	145	40	Ditto.	1	Ditto.
18	146	40	Ditto.	1	Ditto.
19	146	40	Ditto.	1	Ditto.
20	147	36	Ditto.	1	Growing phase in majority, 'A' phase in few.
21	148	39	Ditto.	1	Growing phase.
22	149	39	Ditto.	1	Ditto.
23	150	38	Ditto.	1	Ditto.
24	151	40	Ditto.	1	Ditto.
25	155	42	Ditto.	1	Growing phase in majority, 'A' phase in few.
26	156	41	Ditto.	1	Growing phase.
27	158	42	Ditto.	1	Ditto.
28	160	40	Ditto.	1	Ditto.
29	161	42	Ditto.	1	Ditto.
30	164	43	Ditto.	1	Ditto.

Table III.

Measurements, gut-contents and scale readings of "Jatka" caught at Goalundo during March, 1940.

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	86	22	Plenty of green algae and copepods.	*Nil.*	Growing phase.
2	90	23	Ditto.	Do.	Ditto.
3	90	23	Ditto.	Do.	Ditto.
4	91	22	Ditto.	Do.	Ditto.
5	91	23	Ditto.	Do.	Ditto.
6	95	24	Ditto.	Do.	Ditto.
7	95	24	Ditto.	Do.	Ditto.

TABLE III—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
8	95	24	Plenty of green algae and copepods.	*Nil.*	Growing phase.
9	96	24	Ditto.	Do.	Ditto.
10	96	24	Ditto.	Do.	Ditto.
11	98	24	Ditto.	Do.	Ditto.
12	99	25	Ditto.	Do.	Ditto.
13	99	25	Ditto.	Do.	Ditto.
14	100	25	Ditto.	Do.	Ditto.
15	102	26	Ditto.	Do.	Ditto.
16	103	26	Ditto.	Do.	Ditto.
17	103	27	Ditto.	Do.	Ditto.
18	105	27	Ditto.	Do.	Ditto.
19	106	26	Ditto.	1	Ditto.
20	109	27	Ditto.	1	Ditto.
21	109	27	Ditto.	1	Ditto.
22	111	29	Ditto.	1	Ditto.
23	115	30	Ditto.	1	Ditto.
24	118	30	Ditto.	1	Ditto.
25	131	35	Ditto.	1	Ditto.
26	133	36	Ditto.	1	Ditto.
27	134	36	Ditto.	1	Ditto.
28	158	41	Ditto.	1	Ditto.
29	163	44	Ditto.	1	Ditto.

TABLE IV

Measurements, gut-contents and scale readings of "Jatka" caught at Dacca during March, 1940.

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	95	26	Small quantity of diatoms, copepods, bits of green algae, sand and pulp.	*Nil.*	Growing phase in majority, 'A' phase in few scales.
2	103	27	Ditto.	Do.	Ditto.
3	111	30	Ditto.	Do.	Growing phase.
4	112	31	Ditto.	Do.	Ditto.
5	113	31	Ditto.	Do.	Ditto.
6	115	31	Ditto.	Do.	Growing phase in majority, 'A' phase in few.
7	115	32	Ditto.	Do.	Ditto.
8	118	30	Ditto.	Do.	Growing phase.

TABLE IV—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
9	118	29	Small quantity of diatoms, copepods, bits of green algae, sand and pulp.	*Nil.*	Growing phase in majority, 'A' phase in few.
10	121	32	Ditto.	Do.	Ditto.
11	122	33	Digested pulp.	Do.	Growing phase.
12	124	34	Small quantity of diatoms, copepods, bits of green algae, sand and pulp.	Do.	Growing phase in majority, 'A' phase in few.
13	126	33	Ditto.	Do.	Ditto.
14	130	35	Ditto.	Do.	Ditto.
15	131	32	Ditto.	Do.	Growing phase.
16	131	33	Digested pulp.	Do.	Ditto.
17	133	35	Small quantity of diatoms, copepods, bits of green algae, sand and pulp.	Do.	Ditto.
18	137	37	Ditto.	Do.	Ditto.
19	137	35	Ditto.	Do.	Ditto.
20	142	36	Digested pulp.	Do.	Growing phase in majority, 'A' phase in few.

TABLE V.

Measurements, gut-contents and scale readings of "Jatka" *caught at Dacca during April, 1940.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	91	25	Plenty of diatoms, few copepods and small quantity of digested pulp.	*Nil.*	Growing phase in majority, 'A' phase in few.
2	97	26	Ditto.	Do.	Ditto.
3	98	26	Small quantity of diatoms, copepods.	Do.	Ditto.
4	100	26	Plenty of diatoms and copepods.	Do.	'A' phase in majority, growing phase in few.
5	100	28	Ditto.	Do.	Growing phase in majority, 'A' phase in few.
6	100	29	Alimentary canal empty.	Do.	Growing phase.
7	101	28	Small quantity of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
8	101	27	Ditto.	Do.	Growing phase.
9	101	28	Plenty of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
10	101	27	Alimentary canal empty.	Do.	Ditto.
11	102	26	Small quantity of diatoms and copepods.	Do.	Ditto.
12	102	27	Alimentary canal empty.	Do.	Ditto.

TABLE V—*contd.*

Serial No.	Length.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
13	102	28	Small quantity of diatoms and copepods.	*Nil.*	Growing phase in majority, 'A' phase in few.
14	102	27	Ditto.	Do.	Ditto.
15	103	28	Plenty of diatoms and copepods.	Do.	Ditto.
16	103	28	Ditto.	Do.	Ditto.
17	104	29	Ditto.	Do.	Ditto.
18	105	29	Small quantity of diatoms and copepods.	Do.	Ditto.
19	105	28	Ditto.	Do.	Growing phase.
20	105	28	Plenty of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
21	106	29	Small quantity of diatoms and copepods.	Do.	Growing phase.
22	106	29	Ditto.	Do.	Ditto.
23	107	28	Ditto.	Do.	Ditto.
24	107	28	Plenty of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
25	107	29	Small quantity of diatoms and copepods.	Do.	Growing phase.
26	107	29	Ditto.	Do.	'A' phase.
27	108	29	Plenty of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
28	108	29	Ditto.	Do.	Ditto.
29	109	29	Small quantity of diatoms and copepods.	Do.	Ditto.
30	109	29	Plenty of diatoms and copepods.	Do.	Growing phase.
31	109	30	Small quantity of diatoms and copepods.	Do.	Ditto.
32	110	29	Ditto.	Do.	Ditto.
33	110	29	Plenty of diatoms and copepods.	Do.	Growing phase in majority, 'A' phase in few.
34	112	32	Ditto.	Do.	Ditto.
35	112	29	Ditto.	Do.	Growing phase.
36	112	30	Ditto.	Do.	Growing phase in majority, 'A' phase in few.
37	112	33	Ditto.	Do.	Ditto.
38	113	29	Ditto.	Do.	Ditto.
39	117	31	Ditto.	Do.	Growing phase.
40	118	32	Ditto.	Do.	Growing phase in majority, 'A' phase in few.
41	122	32	Ditto.	Do.	Growing phase.

Table VI.

Measurements, gut-contents and scale readings of "Jatka" caught at Dacca during May, 1940.

Serial No.	Lengtn.	Height.	Gut-contents.	No. of rings on scale.	Condition of edge of scale.
	mm.	mm.			
1	118	31	Digested pulp	*Nil.*	Majority in growing phase, few in 'A' phase.
2	119	34	Ditto.	Do.	Ditto.
3	120	33	Ditto.	Do.	Ditto.
4	132	38	Plenty of algae, copepods and greenish digested pulp.	Do.	Growing phase.
5	134	39	Ditto.	Do.	Ditto.
6	134	36	Ditto.	Do.	Ditto.
7	137	38	Ditto.	Do.	Ditto.
8	143	40	Ditto.	Do.	Ditto.

CYCLOPIDES (CRUSTACÉS COPÉPODES) DE L'INDE.

IV Une revision des représentants indiens et iraniens du sous-genre *Metacyclops* Kiefer, du genre *Cyclops* Müller.

Par Knut Lindberg.

Cyclops (Metacyclops) gracilis var. **margaretae** (Lindberg).

Syn. *Cyclops* (*Metacyclops*) *margaretae* Lindberg.

Décrite en 1938 sous le nom de *C.* (*M.*) *margaretae* j'avais déjà alors été frappé par la ressemblance que présente cette forme avec le *C.* (*M.*) *gracilis* Lilljeborg, mais ne disposant à ce moment-là que de la description de Kiefer, j'avais accepté son assertion quant au nombre d'articles

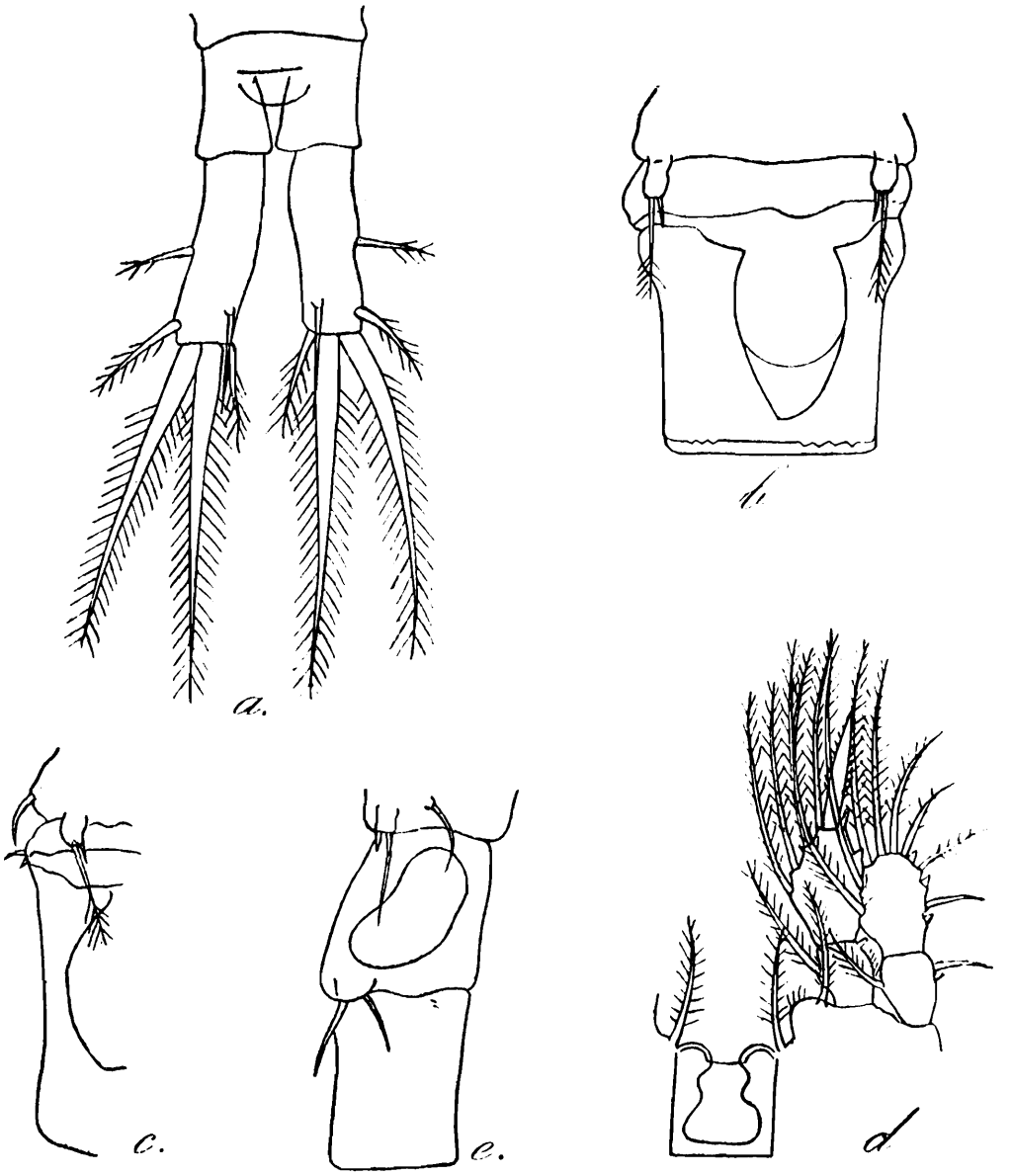

Fig. 1. *Cyclops* (*Metacyclops*) *gracilis* var. *margaretae* (Lindberg).

a. ♀ Furca (Bassein) ; *b.* ♀ P 5 et segment génital, face ventrale (Bassein) ; *c.* ♀ Do., face latérale (Bassein) ; *d.* ♀ Première paire de pattes, montrant une ébauche de transformation en soies de deux épines de l'exopodite (Bassein) ; *e.* ♂ P 5 et P 6 (Bassein).

de la première antenne, de 12 selon Kiefer, mais qui en réalité n'est que de 11, nombre déjà donné par Lilljeborg et corroboré par Sars. De plus, les branches de la furca sont bien divergentes d'après les deux auteurs scandinaves et non pas " presque parallèles " Les faits étant ainsi, la similitude entre *C.* (*M.*) *margaretae* et *C.* (*M.*) *gracilis* devient encore plus grande, et je crois maintenant plus approprié de voir en le premier une variété du second, plutôt qu'une espèce distincte, mais il ne me semble pourtant pas possible de l'identifier avec ce dernier. A part des différences dans la configuration du segment génital et dans la longueur de la première antenne, le *C.* (*M.*) *gracilis* var. *margaretae* se distingue du *C.* (*M.*) *gracilis* par le fait que la soie apicale interne de la furca est de longueur à peu près égale à celle de la soie apicale externe, tandis qu'elle est considérablement plus longue que celle-ci chez *C.* (*M.*) *gracilis*. D'après Sars elle atteindrait même près de la moitié de la longueur de la soie apicale médiane externe, qui, chez *C.* (*M.*) *gracilis* var. *margaretae*, est environ 3 fois plus longue que la soie apicale interne. L'épine apicale du deuxième article de l'endopodite de la première paire de pattes est chez *C.* (*M.*) *gracilis* var. *margaretae* forte et élargie, tandis que Sars, qui avait lui-même examiné des spécimens suédois, a représenté cette épine comme étant longue et mince et Gurney en a fait de même sur sa figure, différence de structure assez remarquable.

Habitat.—Bassein (sur la côte au nord de Bombay), une citerne délabrée à eau de pluie, en juin ; Pandharpour (Deccan), mare temporaire, en juillet.

Cyclops (Metacyclops) grandispinifer, sp. nov.

Description.—Espèce grande et robuste. Longueur de la femelle adulte (sans soies apicales) de 902 à 1244 μ ; largeur de 294 à 356 μ. Cinquième segment thoracique portant sur son rebord latéral une très forte et longue soie recourbée. Segment génital de forme trapue, de contours un peu irréguliers, se rétrécissant légèrement du côté distal ; il est le plus souvent un peu moins long que large et sa longueur égale à peu près celle des trois autres segments abdominaux combinés. Le bord postérieur du premier, deuxième et troisième segments abdominaux porte sur les faces ventrale et latérales une fine indentation, assez indistincte ; sur celui du quatrième segment il y a une rangée de petites épines. Furca à branches bien divergentes, de 3·77 à 5·65 fois aussi longues que larges (moyenne 4·44). Soie latérale externe insérée un peu en arrière du milieu de la branche de la furca. Soie dorsale assez courte, le plus souvent inférieure en longueur à celle de la soie apicale interne. Soie apicale externe plus longue que la soie apicale interne (rapport moyen de 1·40 : 1). Les deux soies apicales médianes bien développées ; rapport moyen entre la longueur de la soie apicale médiane interne et celle de la soie apicale médiane externe de 1·43 : 1. Première antenne à 11 articles, rabattue, elle atteint le tiers postérieur du premier segment céphalothoracique. Pattes natatoires à branches bi-articulées. Formule des épines 3. 4. 4. 3. Article terminal de l'enp. 4 un peu plus de 1·5 fois aussi long que large (rapport moyen 1·66 : 1). Cet article porte une épine apicale unique, toujours plus courte que l'article (rapport moyen 1·13 : 1). Lamelle réunissant la base de la quatrième paire de pattes

à éminences latérales arrondies faisant une légère saillie au-dessus du rebord libre. Cinquième patte à article trapu, un peu plus long que

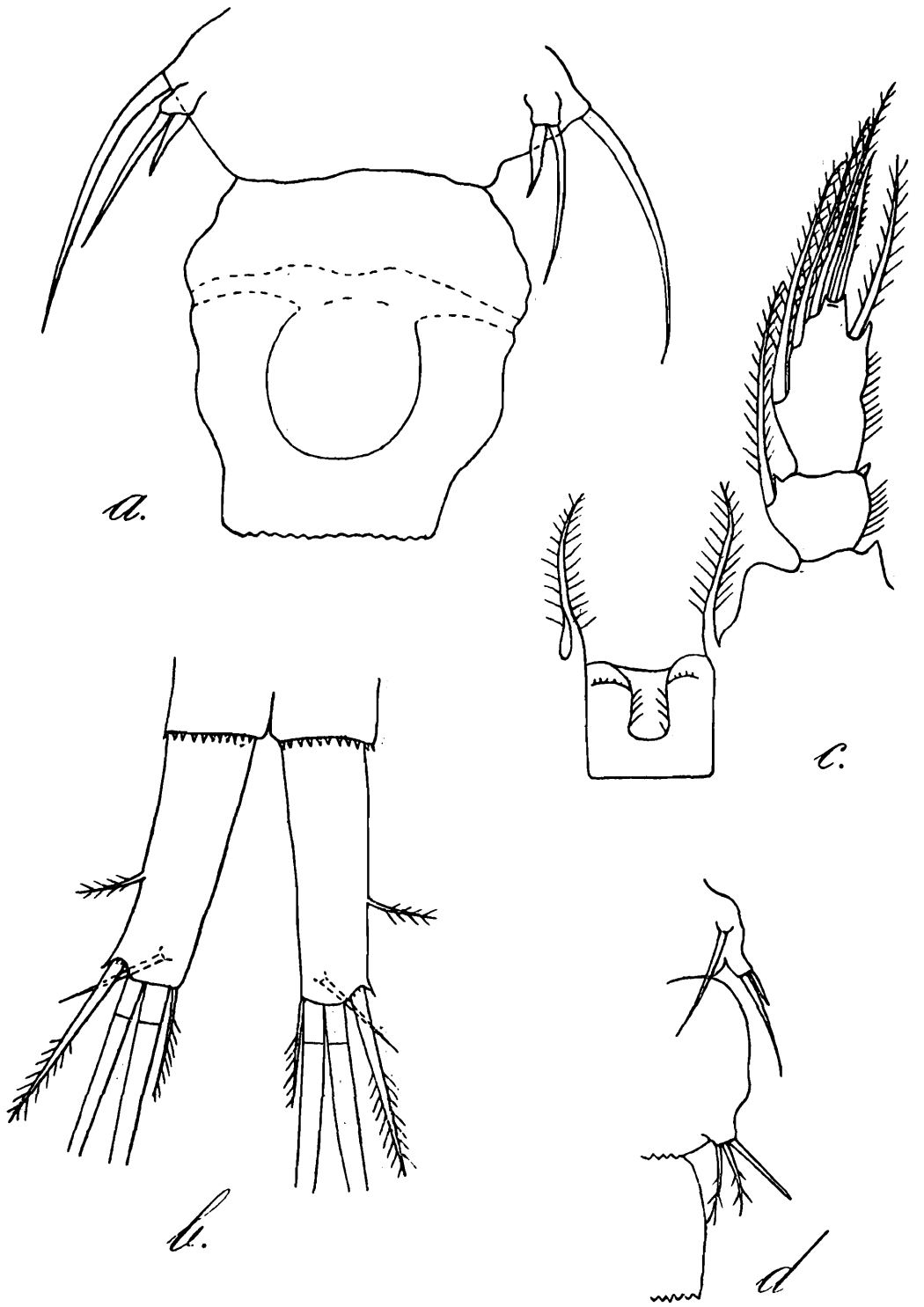

FIG. 2. *Cyclops* (*Metacyclops*) *grandispinifer*, sp. nov.

a. ♀ P 5 et segment génital (Ahvaz) ; *b.* ♀ Furca (Ahvaz) ; *c.* ♀ P 4 Endopodite (Ahvaz); *d.* ♂ P 5 et P 6 (Ahvaz).

large, portant une soie assez forte, mais de longueur bien inférieure à celle de la soie thoracique, et une grosse épine insérée sur le rebord interne à une faible distance de l'extrémité de l'article. Cette épine est de développement considérable, plus de deux fois aussi longue, que

C. (M.) grandispinifer ♀.

Localité.	Longueur. μ	Furca.	Soies apicales.	Art. 2. enp. 4 Long. : larg.	Art. 2. enp. 4 : épine apic.	P 5 Soie thor. : soie apic. : épine.	P 5 Long. art.
Ahvaz	1244	(67+50) : 27=4·33 : 1	93 : 295 : 422 : X	73 : 40=1·82 : 1	73 : 65=1·12 : 1	112 : 53 : 22	..
		(73+50) : 25=4·92 : 1	83 : 253 : 370 : 60			..	..
Chouch (Suse)	1083	(61+47) : 25=4·32 : 1	83 : 234 : 355 : 43	58 : 40=1·45 : 1	58 : 47=1·23 : 1	92 : 50 : 21	
Béhbéhan	998	(52+48) : 25=4·0 : 1	77 : 250 : X : 53	70 : 37=1·89 : 1	70 : 63=1·11 : 1	87 : 52 : 22	11
Gatch Saran	902	(41+42) : 22=3·77 : 1	65 : 200 : 300 : 52	58 : 33=1·76 : 1	58 : 55=1·05 : 1	67 : 33 : 22	..
	1064	(65+48) : 25=4·52 : 1	83 : 257 : 330 : 58	67 : 37=1·81 : 1	67 : 58=1·16 : 1	97 : 50 : 25	10
Bouchir	1112	(58+47) : 23=4·56 : 1	75 : 267 : 392 : 42	58 : 42=1·38 : 1	58 : 50=1·16 : 1	90 : 58 : 18	
Tchaghadak ..	1045	(59+48) : 27=3·96 : 1	85 : 260 : 369 : 68	65 : 40=1·62 : 1	65 : 58=1·12 : 1	108 : 67 : 22	11
Réchir (Païtell) ..	1112	(68+50) : 25=4·72 : 1	88 : 250 : 362 : X	67 : 45=1·49 : 1	67 : 73=1·06 : 1	108 : 67 : 27	11
Borazdjan	940	(56+42) : 23=4·26 : 1	75 : 197 : 314 : 67	63 : 25=1·80 : 1	63 : 50=1·26 : 1	83 : 50 : 18	8

C. (M.) grandispinifer ♂.

Ahvaz ..	864	(57+40) : 18=5·39 : 1	68 : 233 : 362 : 60	58 : 27=2·15 : 1	58 : 58=1 : 1	50 : 43 : 20	10
Bouchir ..	769	(38+35) : 21=3·48 : 1	62 : 202 : 310 : 50	50 : 30=1·67 : 1	50 : 60=0·83 : 1	33 : 38 : 13	..
Borazdjan	731	(38+37) : 22=3·41 : 1	57 : 219 : 315 : 52	53 : 29=1·79 : 1	52 : 50=1·04 : 1	45 : 32 : 15	8

l'article qui la porte. Réceptacle séminal de forme arrondie dans sa partie distale ; la partie proximale a été difficile à distinguer et n'est représentée sur la figure que d'une façon approximative. Ovisacs très grands, accolés, dépassant l'extrémité de la furca ; j'ai compté jusqu' à 37 oeufs dans un sac.

Mâle, plus petit. Longueur de 731 à 864 μ ; largeur de 204 à 230 μ. Branches de la furca divergentes, de 3·41 à 5·39 fois plus longues que larges. Chez deux individus la longueur de l'épine apicale de l'article 2 de l'enp. 4 surpassait celle de l'article. Sixième patte formée d'une épine interne, d'une soie médiane et d'une soie externe ; la soie médiane est l'appendice le plus court et l'épine interne le plus long ; chez quelques spécimens il y a eu peu de différence de longueur entre les trois appendices.

Habitat.—J'ai rencontré cette espèce aussi bien dans de l'eau douce que dans de l'eau saumâtre, mais seulement dans le Sud de l'Iran (Khouzistan, Bouchir et sa région) et toujours, avec une seule exception, dans des collections d'eau plus ou moins étendues, de caractère temporaire. Partout, elle a été présente en très petit nombre, et parfois ce n'est qu'un seul exemplaire qui a été récolté.

Ahvaz, petite mare dans un jardin potager, avec *E. serrulatus* ; Chouch, petit marécage près de l'Imam Zadéh Abbas, avec *C. minutus* ; Béhbéhan, mare de rivière dans les montagnes, à 20 kilomètres au sud-est de la ville ; Gatch Saran, mare d'un torrent d'eau douce, avec *C. minutus* ; Bouchir, étang temporaire d'eau saumâtre, seul ; fosse à eau saumâtre près de la route entre Bouchir et Tchaghadak, avec *C. planus*, *C. minutus* et *C. bicuspidatus odessanus* ; Tchaghadak, fosse à eau douce à 1 kilomètre du village, avec *C. bicuspidatus odessanus*. Réchir (près Bouchir), mare de rivière à Paï Tell ; Borazdjan, puits à eau saumâtre, avec *M. leuckarti*.

Remarques.—Ce *Metacyclops* diffère si notablement de tous les autres représentants du groupe, dont la description m'est connue, qu'on ne puisse le rapprocher d'aucune autre espèce, et il est par conséquent présenté ici comme nouvelle pour la science. Les traits caractéristiques principaux sont ses grandes dimensions, son segment génital trapu, la furca divergente, l'épine apicale unique de l'enp. 4 plus courte que l'article chez la femelle, la très forte soie latérale du cinquième segment thoracique, la grande épine interne de la cinquième patte et la présence de 3 appendices de la sixième patte du mâle, particularité qui n'a été observée, pour autant que je le sache, chez aucun autre *Metacyclops* du groupe *minutus*.

Cyclops (Metacyclops) dengizicus Lepechkine.

Déjà connue de l'Asie centrale soviétique, de la Mésopotamie et des environs du canal de Suez, cette espèce avait été rapportée de l'Inde (lac Tchilka sur la côte Nord-Est) pour la première fois en 1924. En octobre 1940 je l'ai rencontrée près de Bombay, et quelques notes sont données ici sur ces animaux qui ne se conforment pas entièrement aux descriptions antérieures, celles-ci semblant du reste assez incomplètes.

Description.—Longueur de la femelle adulte de 1225 à 1349 μ ; largeur de 370 à 408 μ. Aile latérale du cinquième segment thoracique

munie de quelques gros poils, placés au-dessus de l'insertion de la soie thoracique de P 5. Segment génital à peu près aussi long que large, ou de longueur légèrement inférieure à la largeur. Rebord distal du quatrième segment abdominal, portant sur la face ventrale une rangée d'épines minuscules. Opercule anal pourvu de denticules très distinctes, disposées régulièrement un peu au-dessus du bord libre. Branches de la furca parallèles, de 6·5 à 7·4 fois aussi longues que larges. Soie latérale

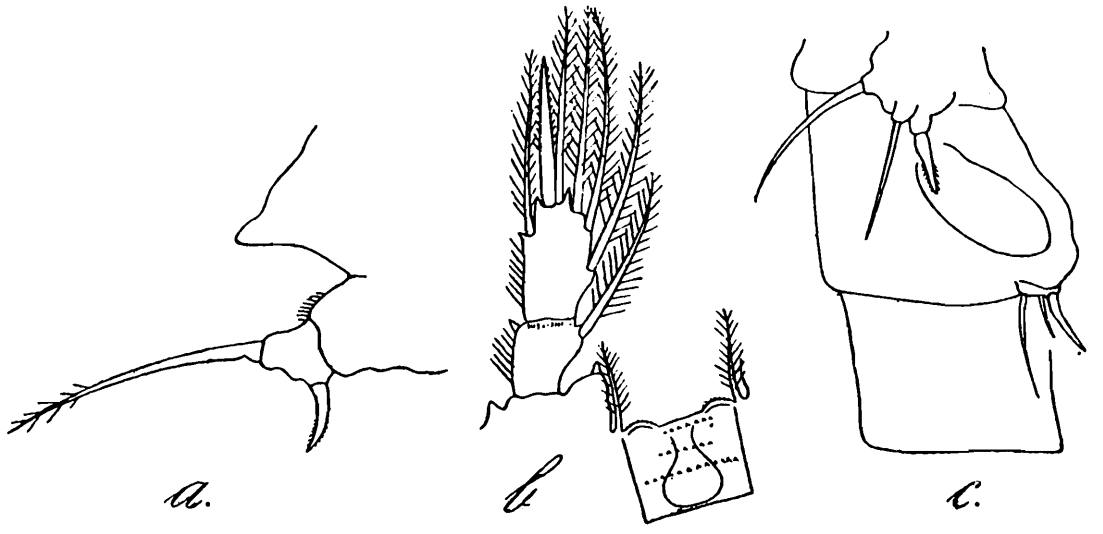

FIG. 3. *Cyclops* (*Metacyclops*) *dengizicus* Lepech.

a. ♀ Ailes latérales du quatrième et du cinquième segments thoraciques, face ventrale (Bandra) ; *b*. ♀ P 4. Endopodite (Bandra) ; *c*. ♂ P 5 et P 6 (Bandra).

externe insérée un peu en arrière du milieu. Soie dorsale assez courte, le plus souvent un peu inférieure en longueur à celle de la soie apicale externe. Celle-ci légèrement plus longue que la soie apicale interne. Peu de différence de longueur entre les deux soies apicales médianes. Première antenne à 11 articles, rabattue, elle atteint le tiers postérieur du premier segment céphalothoracique. Branches des pattes natatoires bi-articulées. Formule des épines 3. 4. 4. 3. Deuxième article de l'enp. 4 moins de deux fois aussi long que large. Il porte une épine apicale externe de longueur variable : parfois plus longue que l'article, d'autres fois elle l'égale en longueur ou elle est un peu plus courte que l'article. L'appendice apicale interne est une soie, considérablement plus longue que l'article. Lamelle basale de P 4 à éminences latérales faisant une légère saillie au-dessus du rebord libre. P 5 formée d'un article très élargi, à forte épine interne et à soie externe plus longue que la soie du cinquième segment thoracique. Réceptacle séminal présentant un gros sac arrondi distal ; la partie horizontale proximale montre une concavité du bord antérieur. Ovisacs grands, écartés du corps ; ramenés vers l'abdomen, ils ne dépassent pas l'extrémité de la furca ; ils contiennent chacun de 15 à 32 gros oeufs rougeâtres.

Mâle, longueur de 950 à 997 μ ; largeur de 228 à 266 μ. Branches de la furca parallèles, de 5 à 7·47 fois aussi longues que larges. Article 2 de l'enp. 4 semblable à celui de la femelle, mais l'épine apicale externe a été trouvée plus longue que l'article chez tous les spécimens examinés. P 5 à épine plus longue et à soies externe et thoracique plus courtes que chez la femelle. P 6 formée de trois appendices : une épine interne bien développée, une soie médiane un peu plus courte, et une soie externe plus longue que l'épine.

C. (M.) dengizicus ♀.

Longueur. μ	Furca.	Soie dorsale.	Soies apicales.	Art. 2. enp. 4 Long. : larg.	Art. 2. enp. 4 : ép. apic. ext.	Art. 2. enp. 4 : soie apic. int.	P 5 Soie thor. : soie apic. : épine.	P 6 Soie ext. : soie méd. : ép. int.
1349	(98+70) : 24=7 : 1	58	62 : 280 : 314 : 58	58 : 33=1·76 : 1	58 : 65=0·89 : 1	58 : 83=0·69 : 1	83 : 100 : 22	..
1244	(100+63) : 22=7·4 : 1	43	62 : 279 : 312 : 57	62 : 33=1·89 : 1	62 : 62=1 : 1	62 : 83=0·75 : 1	62 : 117 : 23	..
1254	(95+62) : 23=6·83 : 1	63	60 : 265 : 284 : 53	53 : 33=1·60 : 1	53 : 50=1·06 : 1	..	75 : 117 : 22	..

C. (M.) dengizicus ♂.

960	(62+38) : 20=5 : 1	64	45 : 237 : 303 : 46	50 : 25=2 : 1	50 : 63=0·79 : 1	50 : 80=0·62 : 1	50 : 58 : 32	37 : 27 : 30
..	(80+50) : 22=5·91 : 1	70	50 : 239 : 297 : 48	50 : 28=1·78 : 1	50 : 63=0·79 : 1	50 : 78=0·64 : 1	67 : 67 : 25	38 : 20 : 33
950	(82+50) : 18=7·33 : 1	58	43 : 217 : 262 : 40	48 : 25=1·92 : 1	48 : 62=0·77 : 1	48 : 80=0·60 : 1	55 : 67 : 26	42 : 18 : 30

Habitat.—Des marais salins, à eau bourbeuse, fort malpropre, à Bandra, faubourg de Bombay, en petit nombre.

Remarques.—La description originale de Lepechkine ne m'est pas accessible à présent, mais, à juger de la figure de la cinquiéme patte, reproduite par Kiefer, à épine mince et très pointue, bien différente de la courte et grosse épine présente chez les spécimens indiens et figurée aussi par Gurney d'après un exemplaire récolté dans le Tigre, il est possible qu'il s'agit en réalité de deux formes distinctes, et ce n'est que provisoirement que j'ai attribué mes échantillons à l'espèce *C.* (*M.*) *dengizicus* Lepechkine, réservant la question du démembrement de cette forme au temps quand un matériel plus abondant et de provenances diverses sera disponible. Malgré quelques divergences il semble cependant que les animaux de Bandra doivent se rapporter à l'espèce mésopotamienne, décrite par Gurney sous le nom de *C. buxtoni* et considérée comme identique au *C. dengizicus*. Quant aux spécimens du lac Tchilka, Seymour Sewell n'en a malheureusement donné aucune description.

Cyclops (Metacyclops) dengizicus var. **elamicus,** nov.

Dans une localité unique du Sud de l'Iran j'ai récolté une femelle et un mâle offrant les caractéristiques essentielles de *C.* (*M.*) *dengizicus* tel que je l'ai observé dans l'Inde, et tel qu'il a été décrit par Gurney. Cependant ces animaux ont présenté quelques particularités distinctives, par suite desquelles je crois utile de les séparer comme une variété différente.

Description.—Forme très grande et robuste. Longueur de la femelle (sans soies apicales) 1340 μ (céphalothorax 798 μ, queue 542 μ) ; largeur 437 μ. Opercule anal garni d'une rangée régulière de petites denticules. Branches de la furca parallèles, près de 7 fois et demi aussi longues que larges (187 : 25 μ=7·48 : 1). Soie latérale insérée en arrière du milieu de la branche de la furca. Soie apicale externe plus courte que la soie apicale interne. Très peu de différence de longueur entre les deux soies apicales médianes. (Soies apicales de la furca du dehors en dedans : 57 : 275 : 290 : 67μ.) Première antenne à 11 articles ; rabattue, elle atteint le tiers postérieur du premier segment céphalothoracique. Branches des pattes natatoires à deux articles. Formule des épines 3. 4. 4. 3. Deuxième article de l'enp. 4 un peu moins de deux fois aussi long que large (67 : 37 μ=1·81 : 1). Il porte deux appendices apicaux, dont l'externe est une épine qui est plus courte que l'article (67 : 57 μ =1·18 : 1). L'appendice interne a les caractères d'une soie, et cette soie est bien plus longue que l'article (67 : 97 μ=0·69 : 1). Lamelle basale de P 4 à éminences latérales arrondies faisant saillie au-dessus du bord libre ; elles sont munies de très petites épines. Soie latérale du cinquième segment thoracique insérée sur le côté dorsal ; elle est recourbée et moins longue que la soie apicale de la cinquième patte. L'article de celle-ci est très élargie et porte la soie déjà mentionnée et une épine interne courte et obtuse. Le réceptacle séminal a l'aspect d'un gros sac arrondi dans sa partie distale ; la partie proximale n'a pas été vue distinctement et n'est représentée sur la figure que d'une façon approximative. Les ovisacs n'ont pas été observés.

Mâle, plus petit et plus svelte. Longueur 1045 μ ; largeur 256 μ. Branches de la furca parallèles, plus de 5·5 fois aussi longues que larges

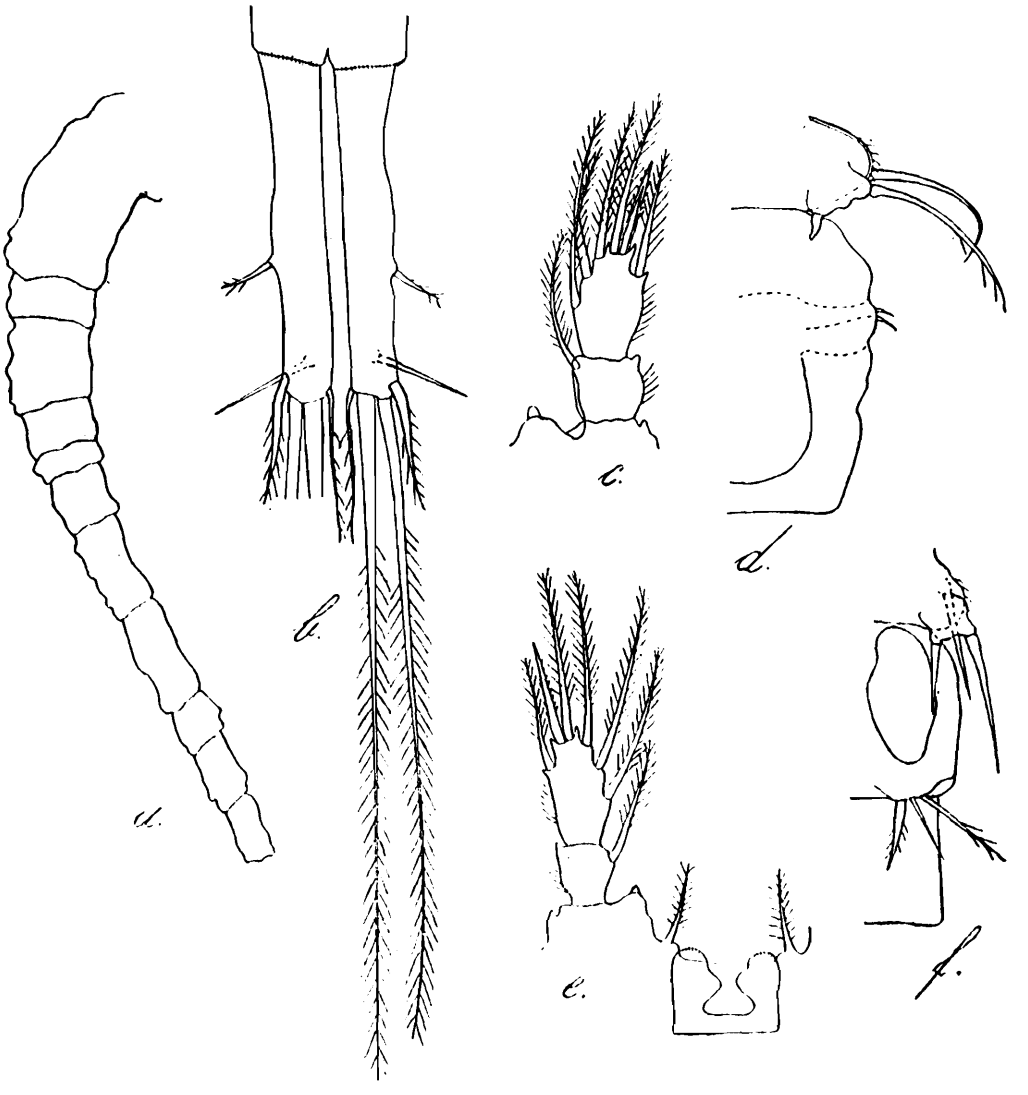

FIG. 4. *Cyclops* (*Metacyclops*) *dengizicus* var. *elamicus*, nov.

a. ♀ Première antenne (Ahvaz); *b*. ♀ Furca (Ahvaz) ; *c*. ♀ P 4 Endopodite (Ahvaz) ; *d*. ♀ P 5 (Ahvaz) ; *e*. ♂ P 4 Endopodite (Ahvaz) ; *f*. ♂ P 5 et P 6 (Ahvaz).

(125 : 22μ=5·68 : 1). Article de P 5 portant une épine interne de structure plus ordinaire et beaucoup plus longue que celle de la femelle. Soie thoracique droite et assez courte. P 6 formée de trois appendices : une épine interne, une soie médiane plus courte et une mince soie externe, qui est l'appendice le plus long.

Habitat.—Un étang d'eau saumâtre près de la cimetière musulmane à Ahvaz (Khouzistan). Deux spécimens adultes furent récoltés au mois de janvier, en compagnie de *C.* (*M.*) *grandispinifer* Lindberg, *C.* (*D.*) *bicuspidatus* Claus et *E. serrulatus* (Fischer).

Cyclops (Metacyclops) royi, sp. nov.

En mai 1939 j'ai récolté dans des marais à Bandra, à environ 1 kilomètre de distance de l'endroit où fut trouvé en octobre 1940 le *C.* (*M.*) *dengizicus*, un autre représentant du même groupe. Comme celui-ci diffère très notablement de *C.* (*M.*) *dengizicus*—il s'en distingue aisément

même à l'oeil nu—il est présenté ici comme une espèce nouvelle pour la science, et je l'ai nommé en honneur du professeur J. Roy, auteur de travaux bien connus sur les copépodes de la France et de l'Afrique.

Description.—Longueur de la femelle adulte de 912 à 988 μ ; largeur de 266 à 304, μ. Segment génital plus long que large. Bord postérieur des trois premiers segments abdominaux découpé sur la face ventrale en très petites dents, assez indistinctes. Rebord distal du quatrième segment abdominal portant sur la face ventrale une rangée d'épines minuscules. Je n'ai pas vu de denticules sur l'opercule anal, ni l'ornementation

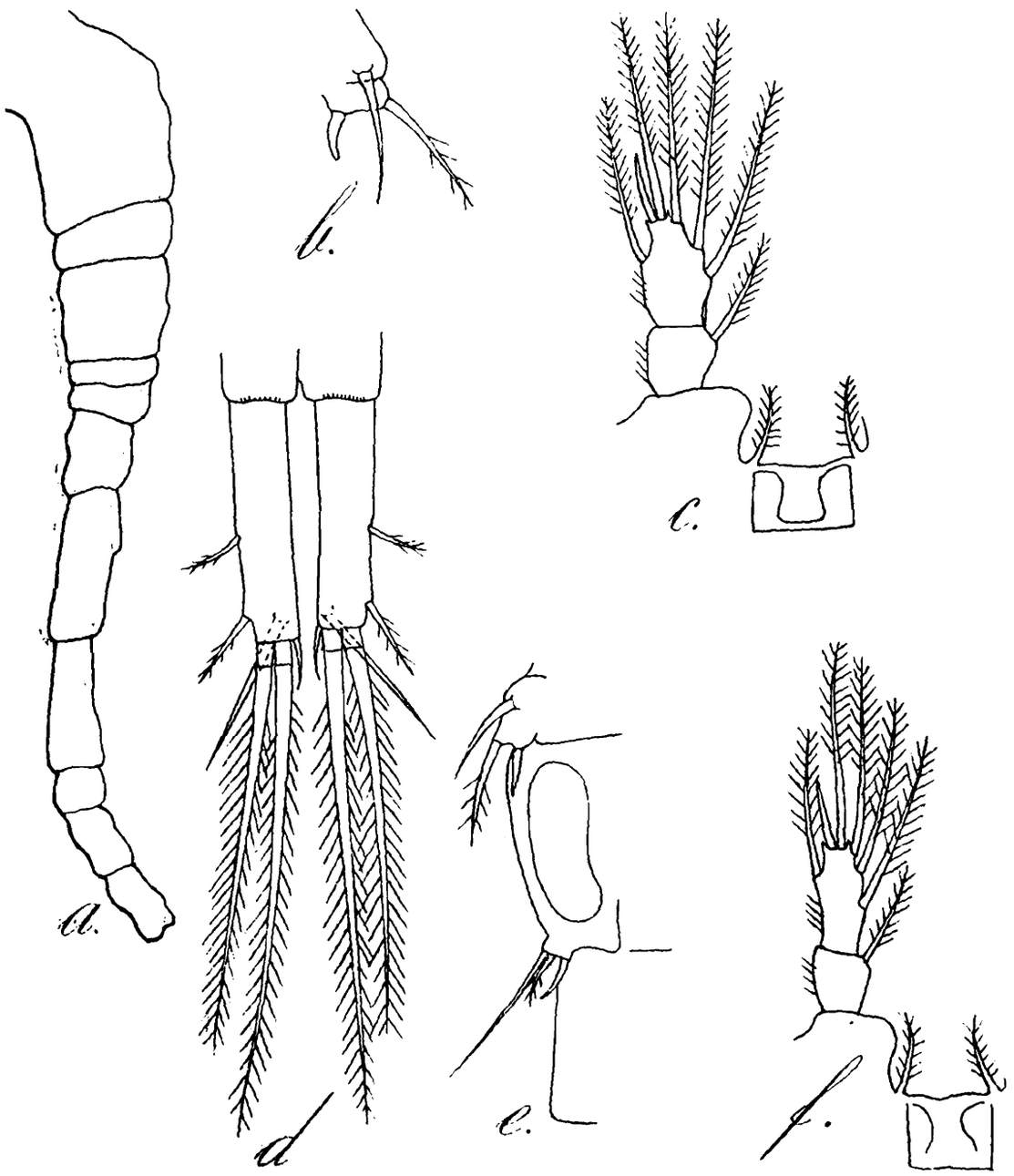

Fig. 5. *Cyclops* (*Metacyclops*) *royi*, sp. nov.

a. ♀ Première antenne (Bandra) ; *b*. ♀ P 5 (Bandra) ; *c*. ♀ P 4 Endopodite (Bandra) ; *d*. ♀ Furca (Bandra) ; *e*. ♂ P 5 et P 6 (Bandra) ; *f*. ♂ P 4. Endopodite (Bandra).

du segment génital décrite par Gurney chez *C.* (*M.*) *dengizicus*. Branches de la furca parallèles, de 3·95 à 5·94 fois aussi longues que larges. Soie latérale externe insérée un peu en arrière du milieu de la branche de la furca. Soie apicale interne plus courte que la soie apicale externe ; peu

C. (M.) royi ♀.

Longueur. μ	Furca.	Soie dorsale.	Soie apicales.	Art. 2. enp. 4 Long.: larg.	Art. 2. enp. 4: ép. apic. ext.	Art. 2. enp. 4: soie apic. int.	P 5 Soie thor.: soie apic.: épine.	P 6 Soie ext.: soie méd.: ép. int.
959	(59+48) : 19=5·63 : 1	92	35 : 181 : 207 : X	42 : 23=1·83 : 1	42 : 25=1·68 : 1	42 : 83 =0·50 : 1	63 : 67 : 21	..
974	(60+40) : 19=5·26 : 1	83	33 : 195 : 229 : 25	37 : 23=1·60 : 1	37 : 27=1·37 : 1	37 : 80=0·46 : 1	50 : 60 : 20	..
950	(60+47) : 18=5·94 : 1	75	32 : 164 : 190 : 18	42 : 23=1·83 : 1	42 : 25=1·68 : 1	42 : 80=0·52 : 1	X : X : 22	..
912	(45+38) : 21=3·95 : 1	75	30 : 172 : 202 : 25	38 : 25=1·52 : 1	38 : 27=1·41 : 1	38 : 72=0·53 : 1	53 : 50 : 22	..
988	(59+38) : 22=4·41 : 1	67	28 : 170 : 200 : 22	42 : 22=1·90 : 1	42 : 83=1·83 : 1	42 : 83=0·50 : 1	X : 55 : 20	..

C. (M.) royi ♂.

765	(44+33) : 17=4·53 : 1	83	25 : 153 : 215 : 16	35 : 20=1·75 : 1	35 : 17=2·06 : 1	35 : 92=0·38 : 1	25 : 33 : 22	58 : 22 : 15
803	(45+35) : 17=4·70 : 1	83	27 : 150 : 220 : 21	37 : 20=1·85 : 1	37 : 22=1·68 : 1	37 : 88=0·42 : 1	50 : 50 : 23	67 : 22 : 18

de différence de longueur entre les deux soies apicales médianes. Soie dorsale très développée, plus de deux fois aussi longue que la soie apicale externe. Premiere antenne à 11 articles ; rabattue, elle atteint le milieu ou le tiers postérieur du deuxième segment thoracique. Branches des pattes natatoires bi-articulées. Formule des épines 3. 4. 4. 3. Deuxième article de l'enp. 4 moins de deux fois aussi long que large. Il porte une épine apicale externe qui est beaucoup plus courte que l'article et une soie apicale interne, celle-ci environ deux fois plus longue que l'article. Lamelle basale de P 4 à expansions latérales arrondies, faiblement prominentes au-dessus du bord libre ou ne l'atteignant pas du tout. P 5 formée d'un article très élargi, à forte épine interne et à soie apicale plus longue que la soie thoracique. Réceptacle séminal présentant un sac arrondi distal ; la partie horizontale proximale est peu élargie et montre une légère concavité du rebord antérieur. Ovisacs écartés du corps ; ramenés vers l'abdomen, ils n'atteignent pas l'extrémité de la furca. J'ai compté de 9 à 15 oeufs dans chacun des ovisacs.

Mâle, longueur de 765 à 803 μ ; largeur de 190 à 195 μ. Branches de la furca parallèles, environ 4 fois et demi aussi longues que larges. Article terminal de l'enp. 4 semblable à celui de la femelle. P 6 formée de trois appendices : une épine interne assez courte, une soie médiane un peu plus longue et une mince soie externe, qui peut presque égaler en longueur celle du deuxième segment abdominal.

Habitat.—Des marais à Bandra (Bombay) de caractère permanent, situés plus près du bord de la mer et de salinité vraisemblablement plus élevée que ceux dans lesquels fut trouvé le *C.* (*M.*) *dengizicus*. Autrement l'eau avait le même aspect bourbeux, manquait de végétation et était fortement polluée. Je n'ai pas trouvé les deux espèces ensemble.

Remarques.—Les différences principales notées entre *C.* (*M.*) *dengizicus* (de l'Inde et de la Mésopotamie) et l'espèce qui vient d'être décrite sont brièvement les suivantes : (1) Taille bien plus petite. (2) Furca plus courte. (3) Soie dorsale relativement très longue. (4) Soie apicale interne de la furca très courte et grêle. (5) Première antenne dépassant considérablement le premier segment céphalothoracique. (6) Epine apicale externe de l'article 2 de l'enp. 4 beaucoup plus courte que l'article. (7) Absence de denticules de l'opercule anal et d'ornementation de la face ventrale des segments abdominaux (pour autant que j'ai pu voir). (8) Structure différente de P 6 du mâle.

Cyclops (Metacyclops) minutus Claus.

Syn. *Cyclops* (*Metacyclops*) *unacanthus* Lindberg.

Dans la majorité des habitats dans lesquels j'ai récolté des cyclopes pendant mes voyages dans le Khouzistan et dans la région du golfe Iranien (janvier, février et début de mars, époque de l'année correspondante à la saison des pluies dans ces contrées), j'ai trouvé, en nombre plus ou moins grand, un *Metacyclops* ayant le deuxième article de l'endopodite de la quatrième paire de pattes muni d'une épine apicale unique, forme appartenante par conséquent au groupe "*minutus*" Les variations de ce cyclope se sont montrées très grandes, et, au cours de l'étude, il m'a parfois même semblé nécessaire d'en distinguer des variétés, mais

certaines caractéristiques importantes, telles que la structure de la cinquième patte, celle des soies apicales de la furca et le rapport de longueur entre l'épine apicale et le deuxième article de l'endopodite de P 4 ont été assez constantes, de sorte que je crois que les variations doivent être considérées plutôt comme dépendant de conditions écologiques différentes que comme ayant la valeur de traits distinctifs. Aussi j'ai référé toutes ces formes sans exception à l'espèce *C.* (*M.*) *minutus* Claus.

Après avoir ainsi observé la grande variabilité de ce cyclope dans le Sud de l'Iran, il ne me semble plus justifié de maintenir comme une espèce distincte la forme décrite en 1936 sous le nom de *C.* (*M.*) *unacanthus* d'après des spécimens récoltés en novembre 1935 dans un bassin à Sebzévar (Khorassan), le *C.* (*M.*) *unacanthus* devenant par conséquent synonyme de *C.* (*M.*) *minutus*.

Description.—La longueur totale des femelles ovigères (sans soies apicales de la furca) a varié de 712 à 1159 μ. Huit des 78 spécimens mesurés étaient inférieurs à 800 μ (10 pour cent) ; 23 mesuraient de 800 à 900 μ (30 pour cent) ; 39 de 900 à 1,000 μ (50 pour cent) ; 8 dépassaient 1,000 μ (10 pour cent). Les branches de la furca étaient parallèlles ou très légèrement divergentes chez 71 (91 pour cent.), nettement divergentes chez 7 (9 pour cent). Les femelles à branches de la furca divergentes appartenaient toutes à la forme grande (dépassant 900 μ) sauf une seule, dont la longueur était de 874 μ. Le rapport entre la longueur et la largeur des branches de la furca a varié de 2·91 : 1 à 4·45 : 1, avec une moyenne de 3·51 : 1. L'insertion de la soie latérale externe s'est trouvée le plus souvent légèrement en arrière du milieu de la branche de la furca. La longueur de la soie apicale externe a toujours été considérablement supérieure à celle de la soie apicale interne, les variations dans ce rapport étant allées de 1·34 : 1 à 2·33 : 1, avec une moyenne de 1·85 : 1. Le rapport moyen entre la soie apicale médiane interne et la soie apicale médiane externe a été de 1·48 : 1. La soie dorsale, d'une longueur moyenne de 42 μ a toujours été moins longue que la soie apicale externe (longueur moyenne 66 μ), mais a dépassé la longueur de la soie apicale interne (longueur moyenne 36 μ). Le segment génital, dont le rapport moyen entre la longueur et la largeur a été de 1·20 : 1, a surpassé en longueur celle des deuxième, troisième et quatrième segments abdominaux combinés. La première antenne rabattue, a presque toujours dépassé le milieu du premier segment céphalothoracique mais sans jamais atteindre son bord postérieur ; je l'ai trouvée composée invariablement de 11 articles ; chez quelques individus il y a toutefois eu une division incomplète du troisième article et, plus rarement, aussi du quatrième. Les articles les plus longs ont été les premier, huitième et septième et les plus courts, les cinquième, quatrième et deuxième. La formule des épines a été de 3. 4. 4. 3. Le rapport entre la longueur et la largeur du deuxième article de l'enp. 4 (variant de 1·47 : 1 à 2·11 : 1) a donné une moyenne de 1·77 : 1, et le rapport moyen entre l'épine apicale et la longueur de cet article a été de 1·44 : 1 (allant de 1·18 : 1 à 1·70 : 1). La structure de la lamelle basale réunissant la quatrième paire de pattes a peu varié, la saillie des éminences latérales au-dessus du bord libre a toujours été faible ou inexistante. La soie latérale du cinquième segment thoracique a été considérablement plus longue que la soie apicale

de l'article de la cinquième patte (longueurs moyennes de 53 μ et 36 μ respectivement). L'épine de P 5 a chez tous les animaux été bien déve-

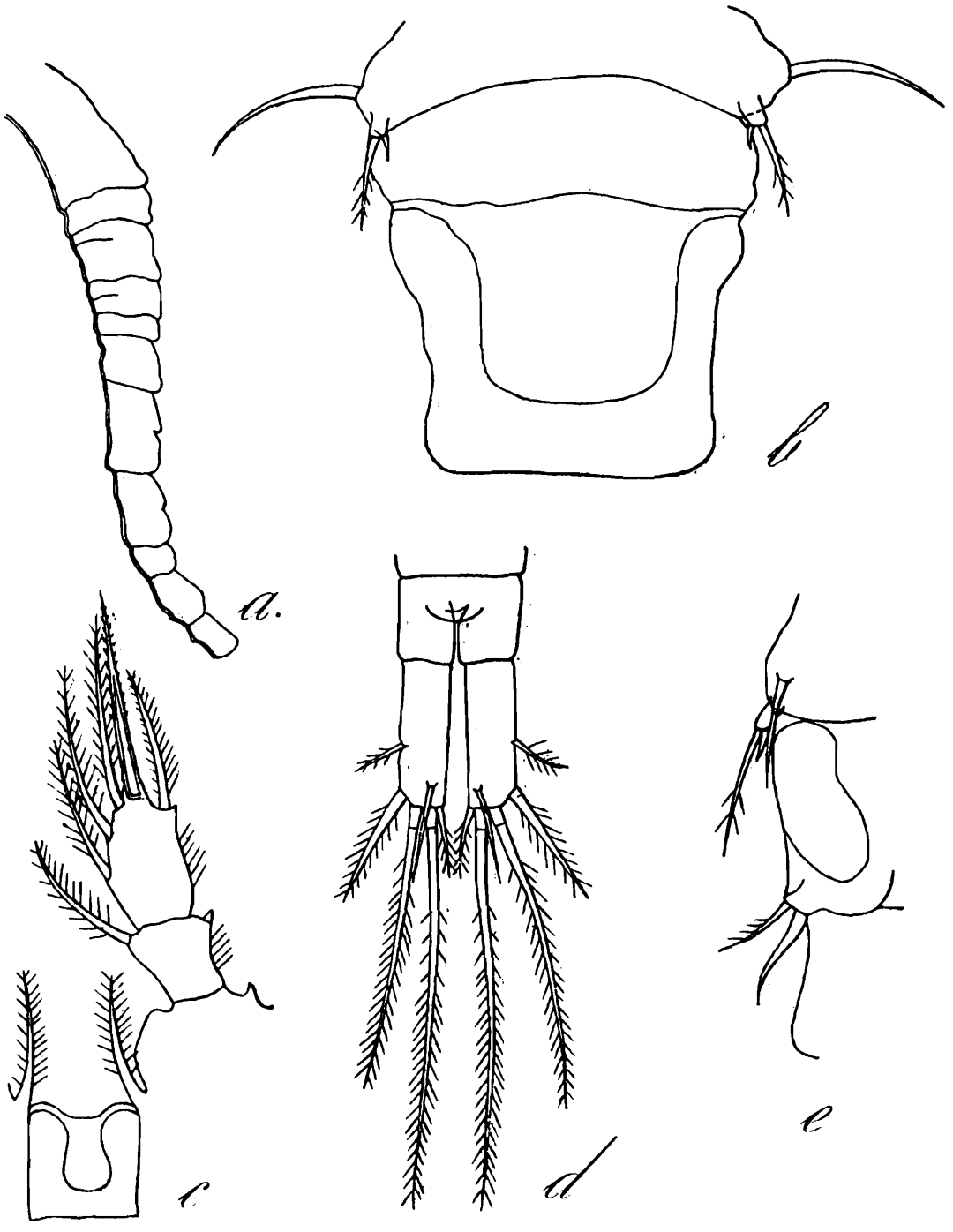

FIG. 6. *Cyclops* (*Metacyclops*) *minutus* Claus.

a. ♀ Première antenne, montrant une division incomplète du troisième et du quatrième article (Mansouriyéh) ; *b.* ♀ P 5 et segment génital (Tahiri) ; *c.* ♀ P 4 Endopodite (Tahiri) ; *d.* ♀ Furca (Assalou) ; *e.* ♂ P 5 et P 6 (Béhbéhan).

loppée, sa longueur moyenne a été de 9 μ et elle a le plus souvent légèrement surpassé la longueur de l'article ; elle s'est trouvée insérée sur le rebord interne, près de l'extrémité de celui-ci. Le rapport moyen entre la longueur et la largeur de l'article a été de 1·34 : 1. Le réceptacle séminal a semblé très variable dans sa partie proximale, mais n'a pas toujours pu être distingué d'une façon irréprochable ; sa partie distale s'est presque toujours montrée sous l'aspect d'un gros sac arrondi et quelquefois elle a eu une forme presque quadrangulaire. Les sacs ovi-

gères ne m'ont semblé offrir aucune caractéristique constante ; ils ont parfois été appliqués contre l'abdomen mais plus souvent écartés du corps; en général ils ont été gros et ramassés, ne dépassant pas le quatrième segment abdominal, d'autres fois allongés et surpassant l'extrémité de la furca ; j'ai compté un maximum de 37 oeufs dans un ovisac.

Le mâle, beaucoup plus svelte et élancé, a bien de fois surpassé la femelle en longueur, même parmi des individus d'une même population. Cependant, en calculant la moyenne, sa longueur de 867 μ a été trouvée légèrement inférieure à celle de la femelle, dont la longueur moyenne (de 78 spécimens) a été de 914 μ. Des 46 mâles mesurés 7 étaient inférieurs à 800 μ (15 pour cent) ; 24 mesuraient de 800 à 900 μ (52 pour cent) ; 13 de 900 à 1,000 μ (environ 29 pour cent), et 2 dépassaient 1,000 μ (4 pour cent). Le plus petit était long de 722 μ, le plus grand de 1045 μ. Le rapport entre la longueur et la largeur des branches de la furca a varié de 2·38 : 1 à 5·68 : 1, avec une moyenne de 4·29 : 1. Chez 36 de 45 spécimens, elles étaient divergentes (80 pour cent), et parallèles chez 9 (20 pour cent), des proportions à peu près inverses de celles obtenues chez la femelle à cet égard. Les dimensions des soies apicales de la furca ont été plus grandes chez le mâle, mais les variations dans leurs rapports se sont montrées comparables à celles observées chez la femelle. Le deuxième article de P 4 a été trouvé beaucoup plus allongé chez le mâle, le rapport moyen entre sa longueur et sa largeur ayant été de 2·24 : 1 chez 45 exemplaires ; le rapport moyen entre la longueur de l'épine apicale et celle de l'article a été de 1·67 : 1. La structure de la cinquième patte s'est distinguée de celle de la femelle en ce qui la soie apicale de l'article a été plus longue que la soie thoracique, la longueur absolue de celle-ci ayant aussi été inférieure à celle de la femelle. La configuration de la sixième patte se voit sur la figure ; chez les animaux que j'ai examinés, la soie externe a été considérablement plus courte que l'épine interne (longueurs moyennes 39 μ épine, 27 μ soie).

Habitats.—J'ai déjà mentionné l'époque de l'année pendant laquelle j'ai récolté ce cyclope dans le Sud de l'Iran, et, je dois ajouter, qu'au cours de mes collections dans les provinces Caspiennes, fin octobre et novembre (saison également pluvieuse), je ne l'ai pas trouvé une seule fois. Il est cependant certain que cette espèce n'est pas confinée au Sud de l'Iran, puisqu'en novembre 1935 je l'avais trouvée dans le Nord-Est de l 'Iran [décrite sous le nom de *C.* (*M.*) *unacanthus*], mais ce qui est connu de sa répartition ailleurs dans le monde, montre, qu'elle a une prédilection pour les régions arides, où les collections d'eau de surface ont un caractère temporaire, dépendant d'une saison des pluies de durée limitée.

Des 143 échantillons d'eau contenant des cyclopides collectionnés dans le Sud, le *C.* (*M.*) *minutus* se trouvait dans 76. Il était très abondant surtout dans de petits étangs à eau douce fortement souillée et dans certaines citernes d'eau croupissante à ciel ouvert. Je l'ai trouvé aussi bien dans des collections d'eau à végétation aquatique envahissante que dans de l'eau dépourvue de flore macroscopique, et une fois je l'ai récolté dans l'eau limpide d'un torrent de montagne à un endroit où le courant était faible. Le plus souvent tant des mâles que des femelles étaient présents. Dans 47 habitats il était le seul cyclopide ; dans les autres

29 habitats je l'ai trouvé en compagnie d'autres membres de la famille. Selon les habitats il se répartissait ainsi.

I. Biotopes temporaires :

Mares d'eau de pluie	15
Mares d'eau saumâtre	2
Etangs d'eau douce	12
Etangs d'eau saumâtre	3
Marais	4
Fosses d'eau douce	2
Fosse d'eau saumâtre	1
Mares de rivières d'eau douce	4
Rivières d'eau douce	2
Rivière d'eau saumâtre	1

II. Biotopes permanents et semipermanents :

Citernes à ciel ouvert	11
Citernes couvertes	8
Puits d'eau douce	3
Puits d'eau saumâtre	6
Lagunes	2

La liste des localités dans lesquelles j'ai récolté le *C.* (*M.*) *minutus* est la suivante :

Ahmedabad, petits étangs temporaires ; Ahvaz, mares, citerne à ciel ouvert ; Akhtar, citernes couvertes ; Andimèchk, mares ; Assalou, étang salin, puits d'eau douce, citerne couverte ; Béhbéhan, petits étangs, citernes à ciel ouvert, puits d'eau saumâtre, mare de rivière à eau douce, petite rivière à eau saumâtre, fosse à eau douce ; Bender Chahpour, citerne à ciel ouvert ; Bender Rig, puits d'eau saumâtre ; Bétaneh, puits d'eau saumâtre ; Birikou, citerne couverte ; Route entre Birkéh Tchipou et Mianlou, citerne à ciel ouvert ; Borazdjan, petit étang ; Borde Khoun, petit étang ; Bouchir, étangs d'eau saumâtre, fosse à eau saumâtre, lagune ; Chouch, marécage ; Chouchter, mares de rivière ; Dar-oul-Mizan, citerne à ciel ouvert ; Dilou, citerne à ciel ouvert ; Dilvar, citerne couverte ; Dizfoul, mares de pluie ; Do Magz, puits d'eau saumâtre ; Galéhdar, citernes délabrées ; Ganavéh, mare à eau saumâtre ; Gatch Saran, mare de rivière à eau douce ; Gorgor, marais ; Hadakou, puits d'eau douce ; Kangan, puits d'eau saumâtre ; Voie ferrée entre Karoun et Mian Dacht, mares ; Khalfabad, mare, petit étang ; Khorab, rivière à eau saumâtre ; Kourdou, puits d'eau douce ; Makkou, citerne couverte ; Mansouri, étang ; Mansouriyéh, mares, petits étangs, fosse, citerne couverte ; Marghezar, mare ; Mian Dacht marais ; Nérékou, puits d'eau saumâtre ; Parak, mare, étang salin ; Pazanoun, torrent ; Tahiri, mare d'eau douce ; Tang-i-Qil, citerne à ciel ouvert, mares de rivière ; Tchabadi, marais. Tchaghadak, petit étang ; Sebzévar, dans le Khorassan, bassin, novembre 1935.

Cyclops (Metacyclops) minutus var. **communis** (Lindberg).

Syn. *Cyclops* (*Metacyclops*) *communis* Lindberg.

En 1938 j'ai décrit sous le nom de *C.* (*M.*) *communis*, un *Metacyclops* ressemblant beaucoup à *C.* (*M.*) *minutus* Claus, mais s'en distinguant par une furca plus courte, à branches divergentes, une épine apicale de

l'enp. 4 relativement plus courte par rapport à la longueur de l'article, une ornementation particulière du segment génital, celui-ci portant des rangées d'épines minuscules n'ayant pas le caractère de fossettes ou de

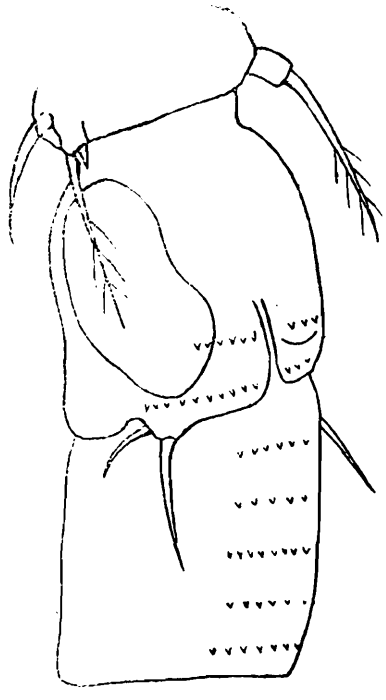

FIG. 7. *Cyclops* (*Metacyclops*) *minutus* var. *communis* (Lindberg).
♂ P 5 et deux premiers segments abdominaux (Pandharpour).

crêtes observées par Gurney, et représentées sur une de ses figures, et une sixième patte du mâle à appendice externe considérablement plus court que l'épine interne. De plus, j'avais accepté, faute de matériel pouvant servir de comparaison, l'assertion erronée de Kiefer (Das Tierreich, Cyclopoida Gnathostoma, p. 74) que la formule des épines chez *C.* (*M.*) *minutus* est de 3. 3. 3. 3. au lieu de 3. 4. 4. 3. qui est celle de *C.* (*M.*) *communis*.

Comme il a déjà été mentionné, l'étude de *C.* (*M.*) *minutus*, provenant d'un grand nombre de localités du Sud de l'Iran, m'a montré la variabilité de cette espèce, et je crois maintenant qu'il serait plus juste de considérer le *C.* (*M.*) *communis* comme en étant une variété plutôt que de voir en lui une espèce distincte. Par contre, je dois dire, que je n'ai jusqu'à présent rencontré dans l'Inde aucun *Metacyclops* qu'il m'ait été possible d'identifier complètement, soit avec le *C.* (*M.*) *minutus* tel qu'il a été décrit en Europe, soit avec les représentants de cette espèce que j'ai récoltés dans l'Iran, ceux-ci offrant à plusieurs égards des caractéristiques intermédiaires entre le *C.* (*M.*) *minutus* d'Europe et d'Afrique du Nord et les variétés indiennes.

Habitats.—Pandharpour (Deccan), mares d'eau de pluie et puits, juillet ; Ramling, près Barsi (Deccan), mares d'eau de pluie, fin juin ; Aurangabad (Haidérabad), mare de rivière, décembre.

Cyclops (Metacyclops) minutus var. **bernieri,** nov.

Description.—Petite forme. Longueur de la femelle adulte (sans soies apicales) de 713 à 827 μ ; largeur de 209 à 256 μ. Segment génital

plus long que largre, se étrécissant graduellement du côté distal. Il est dépourvu de denticules telles que présentes chez *C.* (*M.*) *minutus* var. *communis*. Le bord postérieur du quatrième segment abdominal porte sur sa face ventrale la rangée usuelle de petites épines. Furca à

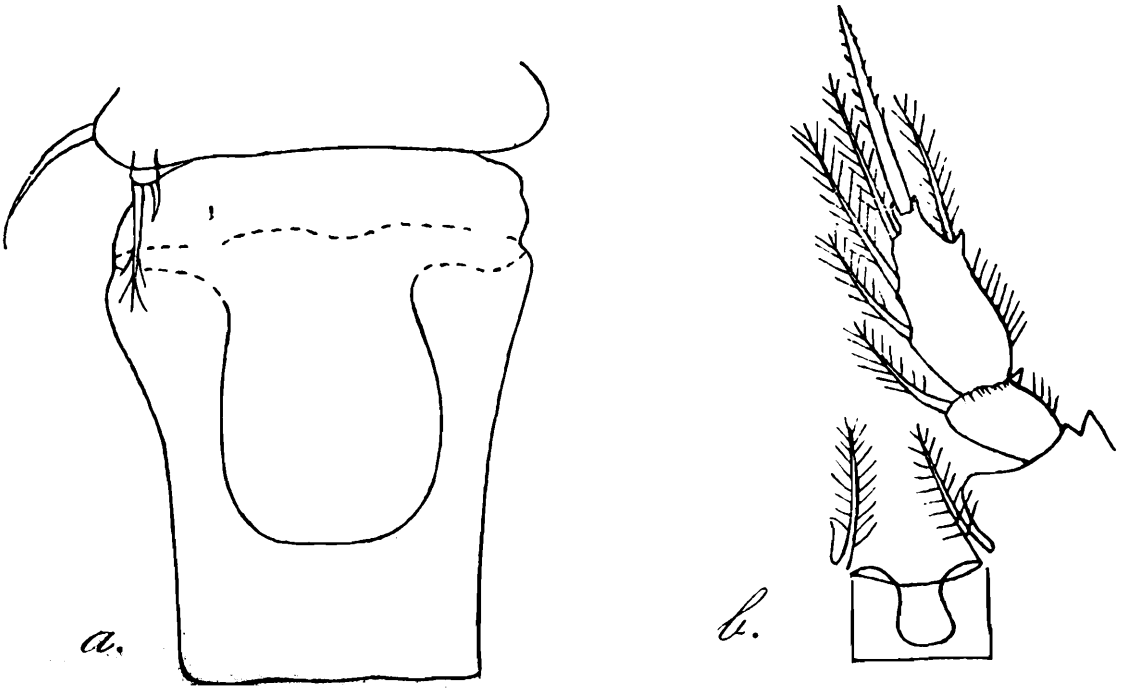

FIG. 8. *Cyclops* (*Metacyclops*) *minutus* var. *bernieri*, nov.
a. ♀ P 5 et segment génital (Sandjan) ; *b*. ♀ P 4 Endopodite (Sandjan).

branches divergentes, de 3·04 à 3·25 fois aussi longues que larges. Soie latérale externe insérée un peu au-dessous du milieu de la branche. Soie dorsale moins longue que la soie apicale externe. Celle-ci deux fois ou plus de deux fois aussi longue que la soie apicale interne. Première antenne à 11 articles ; rabattue, elle atteint le tiers postérieur du premier segment céphalothoracique. Branches des pattes natatoires bi-articulées. Formule des épines 3. 4. 4. 3. Lamelle basale de P 4 ressemblant à celle des spécimens iraniens de *C.* (*M.*) *minutus*. Rapport entre la longueur et la largeur du deuxième article de l'enp. 4 comparable à celui chez *C.* (*M.*) *minutus* var. *communis*, mais épine apicale encore plus courte par rapport à la longueur de l'article que chez cette variété.

Rapport épine : article—

C. (*M.*) *minutus*, d'après Kiefer, 1·50 : 1 (moyenne).
,, ,, spécimens de l'Iran, 1·44 : 1 (moyenne).
,, ,, var. *communis*, 1·16 : 1 à 1·26 : 1.
,, ,, var. *bernieri*, 1·06 : 1 à 1·12 : 1.

Cinquième patte semblable à celle de la variété précédante. Le réceptacle séminal n'a pas été bien vu. Ovisacs accolés, grands, dépassant l'extrémité de la furca. Mâle inconnu.

Habitat.—Une mare d'eau de pluie à Sandjan (Gujerate), le " Saint-Jean " de Bernier, début du mois de juillet.

Remarques.—Comme on le voit, la forme qui vient d'être décrite doit manifestement être considéré comme un *C.* (*M.*) *minutus*, mais pourtant il me semble utile de la séparer comme une variété distincte, à titre peut-être provisoire, les formes indiennes de *C.* (*M.*) *minutus* étant encore

très imparfaitement connues. Les particularités distinctives sont la configuration allongée du segment génital, la structure de la furca, à branches courtes et à soie apicale externe longue, par rapport à la soie apicale interne, et celle du deuxième article de l'enp. 4 à épine apicale relativement beaucoup plus courte que chez l'espèce typique. Je l'ai nommée en souvenir du célèbre voyageur et médecin du XVII^{e} siècle, François Bernier.

Cyclops (Metacyclops) planus Gurney.

Cette espèce, connue des Balkans, de la Tunisie, de l'Egypte et de la Syrie, n'avait pas encore été signalée plus à l'Est. Je l'ai récoltée aussi bien dans le Sud que dans le Nord de l'Iran, mais dans peu d'endroits,

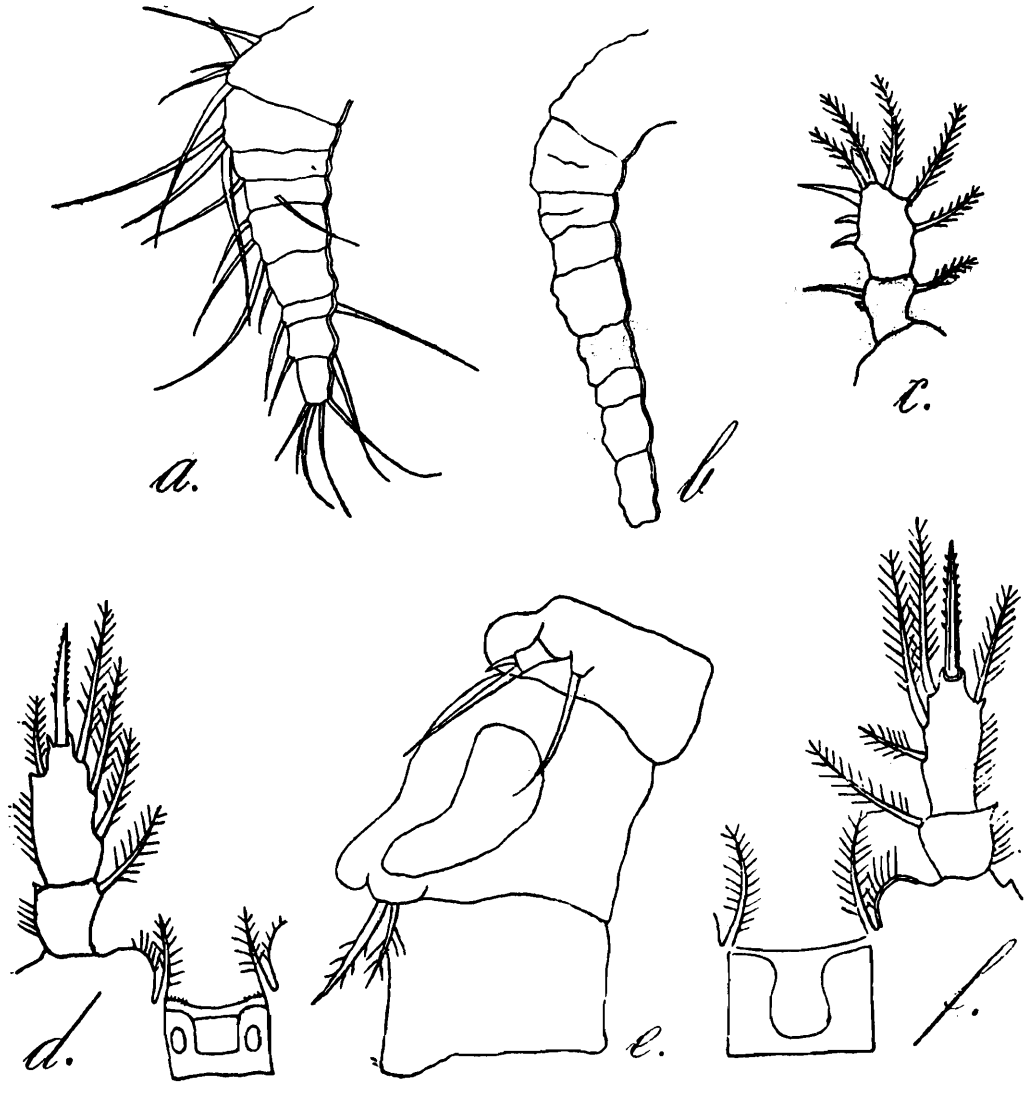

FIG. 9. *Cyclops* (*Metacyclops*) *planus* Gurney.

a. ♀ Première antenne (Bender Gaz) ; *b.* ♀ Do., montrant une division incomplète du troisième article (voie ferrée entre Karoun et Mian Dacht) ; *c.* ♀ P 1 Exopodite (Bender Gaz) ; *d.* ♀ P 4. Endopodite (Bender Gaz) ; *e.* ♂ P 5 et P 6 (Abd Imam) ; *f.* ♂ P 4. Endopodite (Abd Imam).

et toujours en très petit nombre. Comme mes échantillons diffèrent à certains égards des animaux décrits de l'Afrique du Nord et du Proche

Orient, quelques notes et des figures semblent nécessaires. De plus, j'ai rencontré le mâle, qui était inconnu jusqu'à présent.

Description.—Longueur de la femelle adulte (sans soies apicales) de 817 à 950 μ (longueur moyenne de 7 spécimens 871 μ) ; largeur de 252 à 285 μ. Les branches de la furca étaient divergentes chez 5 des femelles examinées, parallèles chez 2. Le rapport entre leur longueur et leur largeur a varié de 3·40 : 1 à 4·35 : 1 (moyenne 3·72 : 1). Soie latérale externe insérée un peu en arrière du milieu de la branche de la furca. Soie apicale externe nettement plus longue que la soie apicale interne (rapport moyen 1·57 : 1). Soie apicale médiane interne environ deux fois aussi longue que la soie apicale médiane externe. Soie dorsale assez courte, inférieure en longueur à la soie apicale externe (longueur moyenne 46 μ). Première antenne rabattue, atteint à peu près le milieu du premier segment céphalothoracique ; elle compte 9 articles ; chez un individu il y avait une division incomplète du troisième article. Branches des pattes natatoires bi-articulées. Formule des épines 3. 4. 4. 3. Rapport entre la longueur et la largeur du deuxième article de l'enp. 4 allant de 1·70 : 1 à 2·32 : 1 (moyenne 1·96 : 1). Epine apicale unique, le plus souvent un peu plus courte que l'article, mais l'égalant parfois en longueur (rapport, article : épine, variant de 1 : 1 à 1·21 : 1, avec une moyenne de 1·07 : 1). Soie du rebord externe du deuxième article de l'enp. 4 courte. Lamelle réunissant la base de la quatrème paire de pattes semblable à celle de *C.* (*M.*) *minutus*. Soie latérale du cinquième segment thoracique bien développée, surpassant en longueur celle de la soie apicale de l'article de P 5. Celui-ci et ses appendices ressemblant aux parties correspondantes de *C.* (*M.*) *minutus*. Le réceptacle séminal n'a pas pu être distingué d'une façon satisfaisante. Ovisacs appliqués contre l'abdomen ; le plus souvent ils sont grands et allongés, dépassant l'extrémité de la furca ; d'autres fois plus petits, n'atteignant pas le commencement de la furca et ne contenant que de 7 à 10 oeufs. Le nombre maximum d'oeufs comptés dans un ovisac a été de 19.

Mâle, un spécimen examiné ; longueur 807 μ, largeur 199 μ. Branches de la furca légèrement divergentes, de 3·77 fois aussi longues que larges. Deuxième article de l'enp. 4 près de trois fois plus long que large ; épine apicale un peu plus courte que l'article. Soie apicale de la cinquième patte plus longue que la soie thoracique. P 6 formée d'une forte épine interne et d'une soie externe plus grêle et plus courte que l'épine ; les deux appendices portent des poils fins.

Habitats.—Des mares, des fosses et des étangs d'eau douce et d'eau saumâtre dans le Sud, le plus souvent en compagnie de *C.* (*M.*) *minutus*. Des mares, un bassin et une petite rivière dans le Nord de l'Iran. Abd Imam (près Ganavéh), étang d'eau douce ; Bender Gaz, rivière ; Bouchir, fosses à eau saumâtre, entre Bouchir et Tchaghadak ; Chahi, petite mare ; Dizfoul, mare d'eau douce fortement souillée ; Gorgan, mare d'eau douce sans végétation, bassin cimenté ; mares entre Karoun et Mian Dacht ; Mansouriyéh, mare à surface couverte d'algues vertes.

Autant que je sache le *C.* (*M.*) *planus* n'a pas encore été observé dans l'Inde, mais, vu son aire de répartition très étendue et sa présence dans le Sud de l'Iran, il semble probable qu'il pourra se rencontrer également dans la péninsula Indienne.

C. (M.) planus.

Localité.	Longueur. μ	Furca.	Soies apicales.	Art. 2. enp. 4. Long. : larg.	Art. 2. enp. 4 : épine apic.
Abd Imam	♀ 817	(51+36) : 22=3·95 : 1	53 : 135 : 262 : 33	50 : 23=2·17 : 1	50 : 50=1 : 1
Karoun-Mian Dacht ..	♀ 950	(58+42): 23=4·35 : 1	57 : 153 : 300 : 33	58 : 25=2·32 : 1	58 : 48=1·20 : 1
Mansouriyéh	♀ 883	(43+40) : 23=3·60 : 1	57 : 138 : 317 : 35	50 : 29=1·72 : 1	50 : 48=1·04 : 1
Chahi	♀ 845	(45+40) : 25=3·40 : 1	60 : 150 : X : 35	55 : 28=1·96 : 1	55 : 55=1 : 1
Bender Gaz	♀ 845	....	....	52 : 25=2·08 : 1	52 : 43=1·21 : 1
Gorgan (Bassin) ..	♀ 921	(46+40) : 23=3·74 : 1	55 : 155 : 305 : 40	50 : 27=1·85 : 1	50 : 48=1·04 : 1
Gorgan (Mare) ..	♀ 836	(46+37) : 23=3·60 : 1	50 : 133 : 300 : 35	51 : 30=1·70 : 1	51 : 50=1·02 : 1
Karoun-Mian Dacht ..	♂ 807	(41+42) : 22=3·77 : 1	65 : 170 : X : 42	50 : 17=2·94 : 1	50 : 47=1·06 : 1

Résumé.

De courtes descriptions ont été données de 5 espèces et de 4 variétés appartenant au sous-genre *Metacyclops* et actuellement connues de l'Inde et de l'Iran.

BIBLIOGRAPHIE.

Gurney, R., 1921.—Fresh water Crustacea collected by Dr. P. A. Buxton in Mesopotamia and Persia. *Journ. Bombay Nat. Hist. Soc.* XXVII, pp. 835-843.

Kiefer, F., 1929.—Cyclopoida Gnathostoma. *Das Tierreich,* 53 Lief. Berlin u. Leipzig, pp. 72-74.

Lindberg, K., 1936.—Notes sur des Cyclopides (Crustacés Copépodes) de l'Iran. *Bull. Musée royal d'Hist. nat. de Belgique* XII, No. 17.

Lindberg, K., 1938.—Cyclopides (Crustacés Copépodes) nouveaux de l'Inde. *Bull. Soc. Zool. de France* LXIII, pp. 291-302.

Sewell, R. B. S., 1924.—Fauna of the Chilka Lake : Crustacea Copepoda. *Mem. Ind. Mus.* V, pp. 771-851.

MGIPC—M—III-8-16—19-12-40—370.