ON A FEW LEPTOCEPHALI FROM THE TRIVANDRUM COAST

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(Plate X)

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INTRODUCTION.

While engaged on a study of the larval and post-larval fishes of the Trivandrum Coast, a number of Leptocephali were obtained in tow-nets and close-meshed seines. On most occasions, these were brought to the laboratory either dead or about to die, and it had not been possible to rear them in aquaria and study their metamorphosis with a view to correlating them to their species. On one occasion, a few were obtained alive, but they succumbed soon after arrival in the laboratory, probably, owing to the imperfect handling at the time of capture.

The collection represents six different types of Leptocephali including those of *Congrellus anago* Schleg. previously described by the author (Gopinath, 1946) and *Muraenesox cinereus* described from Madras by Nair (1947). The other four types, even though they could be described under new specific names according to the definition of Lea (1913), are provisionally denoted by letters A, C, E and F, since studies are being continued and it is hoped to identify them on some future occasion.

EARLIER LITERATURE ON INDO-PACIFIC LEPTOCEPHALI.

The complete biology and life history of most of the European and American eels are known, while practically very little has been worked out regarding the development and life history of Indo-Pacific forms. Probably the earliest work on any such subject is the description by Cantor (1850) of *Leptocephalus dentex* taken from the stomach of a specimen of *Johnius diacanthus* at Penang. Kaup (1856), cataloguing the Apodal fishes in the British Museum, described *Leptocephalus acuticaudatus* and *L. dussumieri* collected from the Malabar coast, *L. taenia* Lesson from India and Maladives and lastly *L. marginatus* from Pondicherry. *L. lineo-punctatus* described by him was also considered to

have an Indian origin. Bleeker (1864) described from the Indo-Pacific region *L. ceramensis*, *L. taenoides* and *L. hypselosoma*; the last species he originally included under the generic name *Leptocephalichthys*. *L. taenia*, *L. marginatus* and *L. lineo-punctatus* of Kaup were grouped together by Günther (1870) under much elongated forms which appear to have been collected from the surface of open ocean. The adult eels to which they belong are not known, but Grassi and Calandruccio (1892) suggested that *L. taenia* is probably the larva of *Spagebranchus*. Giglioli and Issel in their report on the voyage of " Magenta ", cited by Cunningham 1895, record the capture of some beautiful Leptocephali from off the coast of Java, and Stromman (1896) described *L. scheelei* and *L. javanicus* collected by Capt. von Scheele from the Indo-Malayan region in 1885. From the collection of Siboga Expedition, Weber (1913) described nine forms of Leptocephali including four new forms, *L. indicus*, *L. peterseni*, *L. schmidti* and *L. hjorti*. Southwell and Prashad (1919) described two Leptocephali, *L. milnei* and *L. vermicularis* from the brackish waters of the Gangetic delta, and of these, the latter is obviously the elver stage of the former as seen from the similarity in the number of myotomes and other details. Schmidt (1924) described two Leptocephali of *Anguilla mauritania* taken from off Celebes by the Albatross during the Philippine Expedition 1907-1910, and subsequently recorded the larvae of *Anguilla bicolor* and *A. elphinstoni* from the west coast of Sumatra. Seven types of eel eggs, their embryonic forms and two or three advanced Leptocephali have been described by Delsman (1933), and although their exact identities are not given, he suggested that at least two larvae with serial pigment spots along the gut belonged to the Ophichthid group, *viz.*, one to *Ophichthys macrochir* and another to *Pisoodonophis boro*, while a third larva with two thickenings along its gut, he suggested, probably belonged to the Nettastomid *Venetica procera*. Deraniyagala (1934) also described nine interesting forms of Leptocephali from the Ceylon Pearl Banks and the Wadge Bank, off Cape Comorin. In revising the types of Leptocephali kept in the Upsala Museum and described by Stromman, Bertin (1936) suggested that *L. ekmani* of Stromman is synonymous with *L. taenia* Kaup and that *L. scheelei* is identical with *L. taenia* described by Weber, both differing only in their length and age and that this probably belonged to *Ophisoma anago* Schleg. The exact identity of *L. javanicus*, Bertin said, could not be established. Aiyar, Unny and Varkey (1944) described a collection of eel eggs and some Leptocephali from the Madras plankton, and in their rearing experiments one Leptocephalus was found to metamorphose into *Muraenesox cinereus*. Another one was suggested to belong to *Ophichthys boro* from a comparative study of the myotome count of the Leptocephalus, elver and adult. A number of Leptocephali along with a few elvers were collected from the Trivandrum coast, and from a comparative study of the myotomes and other details of the Leptocephalus and the elver, the author (1946) provisionally described it as that of *Congrellus anago*. Nair (1946) gave a short description of the Leptocephalus of *Uroconger lepturus* obtained from Madras, and the same author (1947) described the complete metamorphosis of the Leptocephali of *Muraenesox cinereus* and *Muraena macrura* obtained from the Madras plankton.

These probably constitute all that has so far been done regardig Leptocephali of the Indo-Pacific region, and with the exception of Kaup's description of a few Leptocephali from Malabar and Maladives, there is no further record of any Leptocephali from the west coast.

LEPTOCEPHALI FROM TRIVANDRUM COAST.

Leptocephalus A.

Year.	Month.	Number collected.	Length.
1944	January	4	72--99 mm.
1945	January and February	13	68--93 mm.
1946	January	4	68—97 mm.

The transparent larva is moderately long and slightly thick, and the body has a rather uniform height (6-8 mm.) throughout, which is contained about 10-11 times in the total length. The head is small and is contained about 19-21 times in the length. The snout is pointed and both jaws are equal in length, and gape of mouth extends to below the first quarter of the eye. There are about 22 teeth in the upper jaw and about 20 in the lower, all pointing, as in other Leptocephalids, towards the front. The marginal diaphanous zone is found both along the dorsal and ventral borders, and the latter is much broader than the former. There are 156 myotomes in the body of which 63 are pre-anal. The alimentary canal is looped, and between the heart region and the anal opening there are eight distinct loops. At the angle between two successive loops is a small ganglion-like swelling with a characteristic pigment concentration over it (Text-fig. 1*a*).

There are three to four small chromatophores on the middle of the sides of the upper jaw. Most of the myocomma bear one or two elongated and much-branching chromatophores along its middle region, below the level of the vertebral column, and these are observed to exist from the anterior end of the body to the tip of the tail, although there is no regularity in their arrangement, *i.e.*, these chromatophores are not present in every myocomma, but found only at irregular intervals of two to three or sometimes even four myotomes. Ventral to the heart there is a large chromatophore, while along the alimentary canal, dorsal to the ganglion-like swellings, there are thick groups of chromatophores which are clearly visible in fresh specimens through the transparent body wall and partially visible in preserved ones. At the region of the ganglia, externally, on the body wall are found groups of large closely arranged chromatophores. Along the post-anal part of the body, between the anal opening and the tip of the tail, are found 9-10 black patches along the side, at intervals of 9-10 myotomes. These are really composed of pigment cells placed internally below the level of the vertebral column and clearly visible in fresh specimens. The anal fin has a row of branched chromatophores along its base, the pigment cells being placed

in groups at irregular intervals along the base of the finrays. The dorsal fin is devoid of any pigment cell.

The pectoral fin fold is feeble and vestigeal. Dorsal fin is imperfectly developed and is found only over a short distance in front of the tip of the tail. Only 33-35 rays could be counted in this fin, while there are 209-211 rays in the anal fin. The last few rays in both these fins are the longest, and both the fins stop some distance behind the tail the pointed tip of which projects freely ou t

This species very closely resembles the Leptocephalus with seven sections and constrictions along the gut described by Delsman (*op. cit.*) from Labuan in Sunda Strait. But the intestine is not 'constricted' as he has put it, but is looped festoon-fashion, and at the angle formed by two loops there is a slight thickening with pigment concentrations. In Delsman's specimens there were seven such constrictions, whereas in the present specimens there are eight sectors. The position of the anus also is different in the two specimens. In the specimens described here, the anal opening is situated on the 63rd myotome, while in the Java specimen it opens below the 51st. The dark patches found along the sides of the larva between the anal opening and the tip of the tail has also not been observed by Delsman. Loops in the intestine are also observed in the figures of larvae V and VI recorded by Deranyiagala (*op. cit.*).

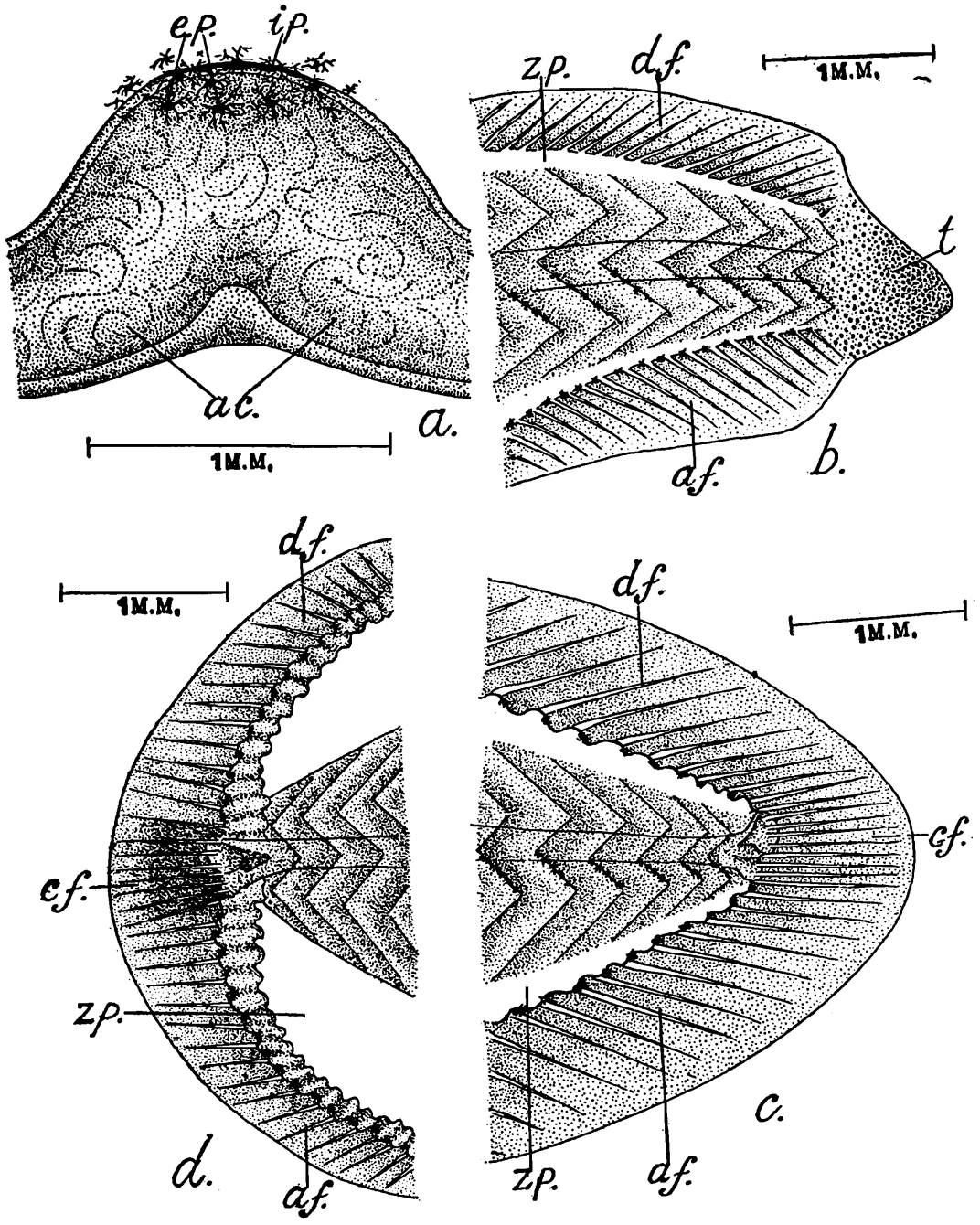
The festooned intestine and the free tail indicate that the present specimens belong to some species of the Ophichthid group, in which the free tail is a characteristic feature.

Muraenenox cinereus (Forks.).

Year.	Month.	Number collected.	Length.
1944	January	2	68—81 mm.
1945	February	8	70—81 mm.
1946	January	1	80 mm.

This larva represents stage 1 described by Nair (*op. cit.*) and completely agrees with his description. However, the following additional characters are also worth mentioning.

The body tapers towards the head and tail, and the maximum height, which is at the region immediately in front of the anal opening, is contained about 7-8 times in the total length. The head is long and is contained about 15-17 times in the total length. Both the jaws possess teeth, there being 32 in the upper and 30 in the lower. The dorsal fin starts far in advance of the anal and possesses about 256-262 rays of which the posterior ones are much longer than the anterior ones. The anal possesses 209-212 rays, and here also the posterior rays are longer. Both these fins are continuous with the caudal fin, the rays of which are about twice the length of the posterior rays of the dorsal and anal fins, thus giving a tapering appearance to the caudal portion as a whole.



TEXT-FIG. 1.—Leptocephali from the Trivandrum Coast. *a.* The thickening and pigmentation between two successive loops in *Leptocephalus* A ; *b.* Tail of *Leptocephalus* C ; *c.* Caudal portion of the *Leptocephalus* of *Congrellus anago; d.* Caudal portion of *Leptocephalus* E.

ac., alimentary canal ; af., anal fin ; *cf.*, caudal fin ; *df.*, dorsal fin ; *ep.*, external pigment ; *ip.*, internal pigment patch ; *t.*, tail ; *zp.*, zona pelucida.

Leptocephalus C.

Year.	Month.	Number collected.	Length.
1944	February	23	73—82 mm.

This Leptocephalus is transparent, slightly thick and has a body which gradually tapers to the head and tail. The post-anal part is longer than the trunk, and this larva is comparatively smaller in height (5-5·3 mm.), which is contained about 24-26 times in the total length. The snout is bluntly rounded and the upper jaw is longer than the lower. The gape extends to a level beyond the posterior border of the eye, and the full set of teeth is wanting. Only about 10 teeth in the upper and 14 in the lower jaw are found, and protuberances in place of other teeth indicate that they have dropped out. The alimentary canal is rather straight, but has 8-9 distinct humps on its dorsal side. Myotomes vary from 205-206, of which 79 are pre-anal.

There are two to three chromatophores on the middle of the sides of the upper jaw. Two to three chromatophores are also found on the ventral side of the heart, and there are a few patches along the ventral border of the alimentary canal. These patches are placed close together along the anterior part, immediately behind the heart, and more distantly placed towards the posterior region. On the dorsal side of the humps along the alimentary canal and also between them, internally, are to be found patches of chromatophores of varying size, and these are very clear in fresh specimens. Viewed from the ventral side, the alimentary canal appears to possess a series of black patches along its entire length. The patch found immediately above the anal opening is rather very large and composed of complexly branching chromatophores. Along the middle of the myocomma, below the mid-lateral line, at intervals of two to three myotomes are found rows of three to four large branching chromatophores. This chromatophore arrangement is observed right up to the tip of the tail. The anal fin has a complete row of prominent chromatophores at its base, while the dorsal fin is devoid of any pigment cells.

The pectoral fin fold is developed and a few rays could be distinguished. In the dorsal fin only 98-101 rays could be clearly counted in front of the tip of the tail, while in the anal fin there are 315-317 rays. The posterior rays of both these fins are longer than the rest and these stop some distance short of the tail, which clearly protrudes out as a free pointed tip (Text-fig. 1*b*).

The partial loss of larval teeth, the comparatively thick body and the well developed free tail indicate that this specimen represents an advanced stage in which metamorphosis has already begun. This larva resembles to a large extent *L. kefersteini* with " seven spots composed of points along the intestine, and anus a little behind the middle of the body ", described by Kaup (1860) from Messina. Leptocephali with serial intestinal spots have been described by Delsman also from the Java Sea. *L. kefersteini* Kaup was found to metamorphose into *Ophichthys serpens=Ophisurus serpens* Linn.) by Grassi and Calandruccio (*op. cit.*), while Delsman suggested that his specimens belonged to the Ophichthid group, probably to *O. macrochir* and *Pisoodonophis boro.* Thus the pigment spots along the intestine and the free pointed tail in the present specimen also suggest that this might belong to some species of the Ophichthid group.

Congrellus anago Schleg.

Year.	Month.	Number collected.	Length.
1941 1942 1943	November to February	118	116—132 mm.
1944	January	19	123—132 mm.
	February	31	
1945	January	22	145—150 mm.
	February	17	145—158 mm.
1946	February	9	138—148 mm.

This is probably the longest Leptocephalus represented in the present collection. It has a rather uniform height of 10-10·5 mm. throughout, and only slightly tapers to the head and tail. The head is small and is contained about 28-30 times in the total length. The snout is short and bluntly pointed, and the upper jaw is slightly longer than the lower. The gape of the mouth is oblique and extends to below the middle of the bulging and prominent eye. There are minute teeth on both jaws, those of the upper jaw being more prominent. There are 115 myotomes on the body of which 78 are pre-anal. Each intersegmental septum, along its lower half, has a row of small chromatophores arranged on it, and this arrangement is observed right up to the tip of the tail. The anal fin is placed slightly in advance of the dorsal and both are continuous with the caudal, giving the caudal region a broadly pointed appearance (Text-fig. 1*c*). The dorsal has 115-120 distinct rays and a number of closely placed rays at the anterior end which could not be counted, and the anal has 100-104 distinct rays and a number of indistinct rays at the anterior end. Each ray of the dorsal and anal fins carries a chromatophore at its base. The pectorals are feebly developed with a number of indistinct rays.

A number of Elvers showing some of the distinct characters of *Congrellus anago* were obtained along with the Leptocephali from this coast during 1941, and from a comparative study of the number of myotomes, branchiostegals and hypurals, the latter was provisionally identified as that of *Congrellus anago* Schleg. by the present writer (*op. cit.*). Bertin (1936) suggested that *L. taenia* described by Weber (*op. cit.*) from Ceram Sea and *L. scheelei* described by Strömman (*op. cit.*) from Banda Sea are in all respects the same, representing only different ages, and that this is the larva of *Ophisoma anago* (*Congrellus anago* Schleg.). *L. taenia* and *L. scheelei* resemble the present specimens in the number of myotomes, pigmentation of the fins and details of the head. But in the former two the anus opens by far behind, *viz.*, below the 103rd myotome, and the dorsal and anal fins composed of fewer rays are confined to the caudal extremity, whereas in the present specimens the anus opens below the 78th myotome and the fins are comparatively long, composed of a larger number of rays and cover about one-third the total length of the body.

Leptocephalus E.

Year.	Month.	Number collected.	Length.
1945	January	8	48—68 mm.

This transparent and strongly compressed Leptocephalus is spindle-shaped, with broadly rounded ends. It is comparatively high, and the maximum height, which is immediately behind the anal opening, is contained about $5\frac{1}{2}$ times in the total length. The head is short and rounded, and is contained about 21-$22\frac{1}{2}$ times in the length. The snout is rounded and the upper jaw is slightly longer. The gape of the mouth extends to below the middle of the bulging eye, and both jaws possess minute larval teeth, 26 in the upper and 22 in the lower. The alimentary canal is straight and opens below the 79th myotome. The dorsal and ventral diaphanous zones are equal in breadth, and these become very broad towards the posterior region, behind the anal opening. There are 132 myotomes in the body.

Compared with the other specimens in the present collection, this one has fewer chromatophores on the body. The large elongate chromatophores found along the myocomma in most of the other species are wanting in this. In smaller specimens, a row of chromatophores is found ventral to the intestine up to the 21st myotome, and beyond that dorsal to the intestine up to the nal opening. These are, however, missing in larger specimens. A few small chromatophores are found on the nape, some at the base of the rudimentary pectoral fold and four or five in the neighbourhood of the heart. Both the dorsal and anal fins possess a row of deeply coloured chromatophores along their base,

The dorsal fin starts far in front of the anal and possesses 323 rays, whereas the latter possesses about 203 rays. Both these fins are continuous with a broadly rounded caudal (Text-fig. 1*a*). The pectoral fin is rudimentary and it is difficult to count the rays.

Leptocephalus F.

Year.	Month.	Number collected.	Length.
1946	January	1	104 mm.

This long transparent Leptocephalus has almost a uniform height of 7 mm. throughout. Compared with the other species, this is much smaller in height which is contained about 15 times in the total length. The head is short and bluntly pointed. Both jaws possess teeth, 24 in the upper and 22 in the lower, and are of equal length. The gape of the mouth extends to below the middle of the orbit. The intestine possesses six humps along its entire length. The marginal diaphanous zones are very narrow. The specimen had 183 myotomes of which 66 were pre-anal.

The middle of the sides of the upper and lower jaws have three to four chromatophores, and there is one very large one below the angle of the jaws. Three chromatophores, two large and one small, are found in a slanting line behind the eye. There is a group of pigment cells ventral to the heart and a few irregularly scattered groups along the ventral border of the intestine, confined especially to its anterior region. The six humps along the intestine and also the interspace between them possess a series of black patches on the dorsal surface. These patches are placed on the dorsal surface of the intestine, internally, and are visible through the transparent body wall. The last patch over the anal opening is large and composed of complexly branching chromatophores. Each myocomma along its middle portion, below the mid-lateral line, carries a row of elongated and branching chromatophores. Both the dorsal and anal fins have along their base pigment cells in groups of four or five.

The dorsal fin is short and placed very near the caudal region ; 45 rays could be counted in this, while the anal fin has 212 rays which are clearly visible. The posterior rays in both the fins are longer, and instead of being continued round the tail, stop some distance short of the tip, beyond which the free tail projects out. The pectoral fold is small with indications of a few faint rays.

Measurements in millimetres of the Leptocephali of the Trivandrum Coast.

Species.	A.	*Muraenesox cinereus*	C.	*Congrellus anago*	E.	F.
Number Collected	21	11	23	216	6	1
Total length	68-99	68-81	73-82	110-158	48-68	104
Length of head	3-4·5	4·5-5	3-3·4	3·5-4·5	2·3-3	3·5
L. from Snout to anus	33-47	44-54	33-34	74-102	29-46	43·5
L. from anus to tip of tail	35-62	24-27	40-48	35-56	19-22	60·5
Height without fins	6-8	9·5-10	5-5·3	10-10·5	9-12·5	7·0
Height with fins	7-8·5	10.5-11	6·5-7	10·5-11	9·5-13	7·5
Number of myotomes	156	138	206	115	132	183
Number of pre-anal myotomes	63	78	79	78	79	66

GENERAL OBSERVATIONS.

Investigations of Grassi and Calandruccio (*op. cit.*), Cunningham (1895) and Schmidt (1906, 1911) have shown that the Leptocephali of the European eels are demersal in their distribution. This has been supported by subsequent collections of Leptocephali not only from around the British Isles but also from the Atlantic. The tropical Leptocephali, on the other hand, show much variation in their distribution. *L. taenia*, *marginatus* and *lineo-punctatus* of Kaup (*op. cit.*) are suggested by Günther to belong to elongated forms collected from the surface of open ocean. Weber (*op. cit.*) collected three of his specimens from surface in tow-nets, one in esturine waters and five from varying depths between 600—1,200 fathoms. *L. miluei* and *L. vermicularis* described by Southwell and Prashad were obtained by operating a small beam trawal in

the Doorakara area of the Gangetic delta, and therefore, may be considered to have been taken from a depth. Albatross collection of Leptocephali of *Anguilla mauritania* was made from survey over considerable depths, off Celebes. The advanced Leptocephali described by Deisman were collected along with young *Stolephorus* in a type of purse-seine net at Labuan in Sunda Strait from surface waters. The collections of Aiyar, Unny and Varkey (*op. cit.*) and Nair (*op. cit.*) were made from Madras plankton, and evidently had a surface distribution.

Along the Trivandrum coast, the Leptocephali were collected mostly in seine nets and rarely in tow-nets. Only on two occasions did tow-net collections contain any Leptocephali the species obtained being A and F. All the other specimens described in this paper were taken in seine sets. These shore seines, after being shot at a distance of about half a mile in 6-8 fathoms of water are dragged towards the shore, and are operated in any desired depth by the adjustment of floats along the head-rope and weights along the foot-rope. During January and February, when Leptocephali are caught in plenty, larvae and post-larvae of other teleosteans, especially Clupeids and Scopelids, are also plentiful in the coastal waters (Gopinath, 1942), and the seines are operated in slightly mid-water position at about 5-6 fathoms in order to gather the largest number of post-larvae.

Some of the common characters observed in most of the Leptocephali are the transparent and thin body, presence of larval teeth including the front grasping teeth, presence of chromatophores along the myocomma, base of the dorsal and anal fins and lastly the pointed or rounded caudal fin with which the median fins are continuous. The number of larval teeth in the various types differs, but in all they show a regular increase in length from the posterior ones to the anterior ones. Except in species E, chromatophores are present along the myocomma in all, regularly arranged in some and at intervals in others. *Congrellus anago*, E and F have chromatophores along the base of the dorsal as well as anal fins, whereas in A, *Muraenesox cinereus* and C, these are present only along the anal fin. The intestine is straight in *M. cinereus*, *C. anago* and E, while it has humps along its dorsal side in C and F. In A, it is looped with eight distinct loops and ganglion-like swellings on the dorsal side.

Schmidt (1912) suggested the division of eels into two groups, *viz.*, those which spawn over great depths and those which spawn in comparatively shallow waters inside the 100-fathom line. Those which spawn far from the coast are supposed to have a specialised larva, while those which spawn in shallow waters have not. A Leptocephalus with anus situated far back is considered as a specialised larva since it leads a longer larval life and takes a longer time for its anus to assume the normal position. Bertin (1926) suggested a formula for this anal movement as $\frac{a^2 - a^1 \times 100}{t.}$ in which a^2 is the number of pre-anal myotomes in the Leptocephalus, a^1 the number of pre-anal myotomes in the adult and t, the total number of myotomes, and called this "the percentage amplitude of anal displacement". Those species which show a high percentage amplitude value indicate that the anus moves over a larger number of myomeres and *vice versâ*, and the value of the amplitude always depends on the position of the anus in the Leptocephalus.

On this basis, a rough calculation of the percentage amplitude for the six species in the present collection shows that there are two distinct groups, one with a high percentage amplitude value consisting of *M. cinereus, C. anago* and E, and another group with a low percentage value consisting of A, C and F. Probably the first group of *M. cinereus, C. anago* and E may belong to eels which spawn far from the coast, while A, C and F might belong to species which spawn in shallow waters.

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SUMMARY.

1. Six different types of Leptocephali obtained from the Trivandrum coast are described in detail. Their seasons of occurrence are also given.

2. The probable identities of the various specimens are discussed in the light of work done on other Indo-Pacific Leptocephali.

REFERENCES.

AIYAR, R. G., UNNY, M. M. & VARKEY, P. M., 1944.—Studies on leptocephali of the Madras coast. (Abstract) *Proc. Indian Sci. Congr.* pt. iii, p. 85.

BERTIN, L., 1926.—Les migration de l'anus au cours de l'ontogenise chez les poissons Apodes. *Bull. Soc. Zool. Fr.*, p. 327.

——— 1936.—Contribution a' lietude des larves de poisson Apodes (les types de Stromman a' l'Institute Zoologique de l' universite d' Upsal). *Bull. Inst. Ocean.* No. 694, pp. 1-15.

BLEEKER, P., 1864.—*Atl. Ichth.* IV, p. 123.

CANTOR, T., 1850.—*Journ. As. Soc. Bengal*, XVIII, p. 1315.

CUNNINGHAM, J. T., 1895.—Larvae of the eel. *Journ. Mar. Biol. Assoc. U. K.* III, pp. 278-287.

DELSMAN, H. C., 1933.—Fish eggs and larvae from Java Sea., No. 21, Eel eggs. *Tereubia* XIV, pp. 237-247.

GOPINATH, K., 1942.—Distribution and feeding of the post larval fishes of the Trivandrum coast. *Curr. Sci.* XI, pp. 337-338.

——— 1946.—Notes on the larval and post-larval fishes found along the Trivandrum coast. *Proc. Nat. Inst. Sci. India*, XII, pp. 7-21.

GRASSI, B., & CALANDRUCCIO, S., 1892.—Le leptocephalide e la loro transformazione in Murenide. Nota preliminare. *Atti de Accad d Lincei*, (v) I.

GUNTHER, A., 1870.—*British Museum Catalogue of Fishes* VIII.

KAUP, J. J., 1856.—*British Museum Catalogue of Apodal Fishes*, pp. 146-153.

——— 1860.—On some new genera and species of fishes. *Ann. Mag-Nat. Hist.* VI.

LEA, E., 1913.—" Muraenoid Larvae, *Rep. Sci. Res. Michael Sars' North Atlantic Deep-Sea Exped.* III, Part I.

NAIR, R. V., 1946.—On the leptocephalus of *Urocouger lepturus* (Richardson) from the Madras plankton. *Curr. Sci.* XV, pp. 318-319.

———1947.—On the metamorphosis of two Leptocephali from the Madras plankton. *Proc. Ind. Acad. Sci.* XXV, pp. 1-14.

SCHMIDT., J., 1906.—Contribution to the life history of the eel *A. vulgaris Cons. perm. intern. pour l'exploration de la Mer, Rapports et process-verbaux* V, No. 4.

——— 1911.—Biology of the eel, especially Conger. *Nature* LXXXVI, pp. 61-63.

——— 1912.—Danish researches in the Atlantic and Mediterranean on the life history of the eel, *Anguilla vulgaris* Turt. *International Revue der gesamten Hydrobiol. and Hydrograph.* v Band.

——— 1924.—The breeding place of the eel. *Ann. Rep. of Smith. Inst.*, pp. 314-316.

SOUTHWELL, T., & PRASHAD, B., 1919.—Notes from the Bengal Fisheries Laboratory, No. 6, Embryological and developmental studies of Indian fishes. *Rec. Ind. Mus.* XVI, pp. 215-240.

STROMMAN, 1896.—Leptocephali in the University Zoology Museum of Upsala. *Dissert. Upsal.*, p. 30.

WEBER, M., 1913.—*Siboga Exped.*, Fische., pp. 65-74.