TRANSACTIONS
OF THE
ROYAL SOCIETY OF NEW ZEALAND

ZOOLOGY

VOL. 5 NO. 11 FEBRUARY 10, 1965

# Leptocephali of the Nemichthyidae, Serrivomeridae, Synaphobranchidae and Nettastomidae in Australasian Waters

By P. H. J. CASTLE,

Department of Zoology, Victoria University of Wellington, N.Z.

[*Received by the Editor, April 4, 1964.*]

***Abstract***

COLLECTIONS of leptocephali assembled from the New Caledonian region and from the east and west coasts of Australia include 185 larvae of these families, referable to five genera and possibly ten species: *L. Nemichthys scolopaceus; L. Borodinula gilli* and/or *L. B. infans; L. Serrivomer bertini, L. S. samoensis* and possibly *L. S. neocaledoniensis*; *L. Stemonidium hypomelas*; *L. Synaphobranchus affinis* or *L. Histiobranchus bathybius*; *L. Nettastoma melanurum.* The presence of very small specimens of *L. Nemichthys scolopaceus* and of the serrivomerids in the collection suggests that adults of these species spawn in the waters around New Caledonia.

## INTRODUCTION

STUDIES on a large collection of over 1,100 eel-larvae from the Australasian region (including the waters around New Caledonia and off eastern Australia, south-west Australia and New Zealand) have so far been restricted mainly to leptocephali of the essentially shallow-water family, the Congridae (Castle, 1963b, 1964b) but also include those of the Anguillidae (Castle, 1963a) and other families (Castle, 1964c). These papers have thus covered about half (550) of the leptocephali in the collection. The present report extends this survey of the leptocephali found in Australasian waters to include the four deep-water families Nemichthyidae, Serrivomeridae, Synaphobranchidae and Nettastomidae.

In contrast to the eels of the family Congridae which are not systematically well-known in the southwest Pacific and which consequently have given rise to difficulties in the identification of their leptocephali, at least the first three families listed above have been worked over in sufficient detail by systematists to enable specific identifications to be made with relative ease. In the present study 185 leptocephali were examined and found to be referable to five genera and possibly ten species:—Nemichthyidae: *L. Nemichthys scolopaceus* (101 specimens), *L. Borodinula gilli* and/or *L. B. infans* (15 specimens); Serrivomeridae: *L. Serrivomer bertini* (6 specimens), *L. S. bertini* or *L. S. neocaledoniensis* (33 specimens), *L. S. samoensis* (21 specimens), *L. Stemonidium hypomelas* (6 specimens); Synaphobranchidae: *L. Synaphobranchus affinis* or *L. Histiobranchus bathybius* (1 specimen); Nettastomidae: *L. Nettastoma melanurum* (2 specimens).

*Published by the Royal Society of New Zealand, c/o Victoria University of Wellington, P.O. Box 196, Wellington.*

The larvae of *Nemichthys scolopaceus* are clearly the most abundant leptocephali amongst these deep-water families, but those of the various species of *Serrivomer* are also relatively numerous and indicate that the area would be a profitable one for the study of the growth stages of these species. Indeed, although the larval life of *N. scolopaceus* has been followed out closely from material collected in the Atlantic (Roule & Bertin, 1929, pp. 61–100 and Beebe & Crane, 1937, pp. 357–366) the present material is the first major contribution to knowledge of the larvae of this species in the south-west Pacific. The same is true to a lesser extent of the various south-west Pacific species of *Serrivomer*. The systematics, development and larval morphology of these species have been described in a fine account by Bauchot (1959). In view of the extensive descriptive work which has thus already preceded this account I have therefore considered it unnecessary to give more than brief comparative data on the leptocephali of the four families described here.

I would like to thank the following institutions again for the loan of material upon which this and preceding reports have been based: the Centre d'Océanographie de l'Institut Français d'Océanie, Nouméa, New Caledonia; the C.S.I.R.O. Division of Fisheries and Oceanography, Cronulla, N.S.W., Australia; the Western Australian Museum, Perth; the New Zealand Oceanographic Institute; the Fisheries Branch, New Zealand Marine Department.

## SYSTEMATIC ACCOUNT

### NEMICHTHYIDAE

Nemichthyid leptocephali are readily distinguished from those of other families in being relatively long and shallow in the body at full growth (up to 300mm total length in *L. Nemichthys scolopaceus*) in having an attenuated caudal region (sometimes filiform), a concave peglike snout, a subterminal vent and pigment spots distributed essentially along the kidney ducts as small, compact, splanchnic chromatophores as well as compact chromatophores along the dorsal aspect of the spinal cord. Larvae of *N. scolopaceus* have in addition four, conspicuous, somatic chromatophores equally placed along the lateral surface of the body with those on the left side alternating with those on the right side. A small number of nemichthyid leptocephali in the collection showed these lateral pigment spots to be groups of two or three chromatophores and these larvae have been referred to *Borodinula* (= *Avocettina*).

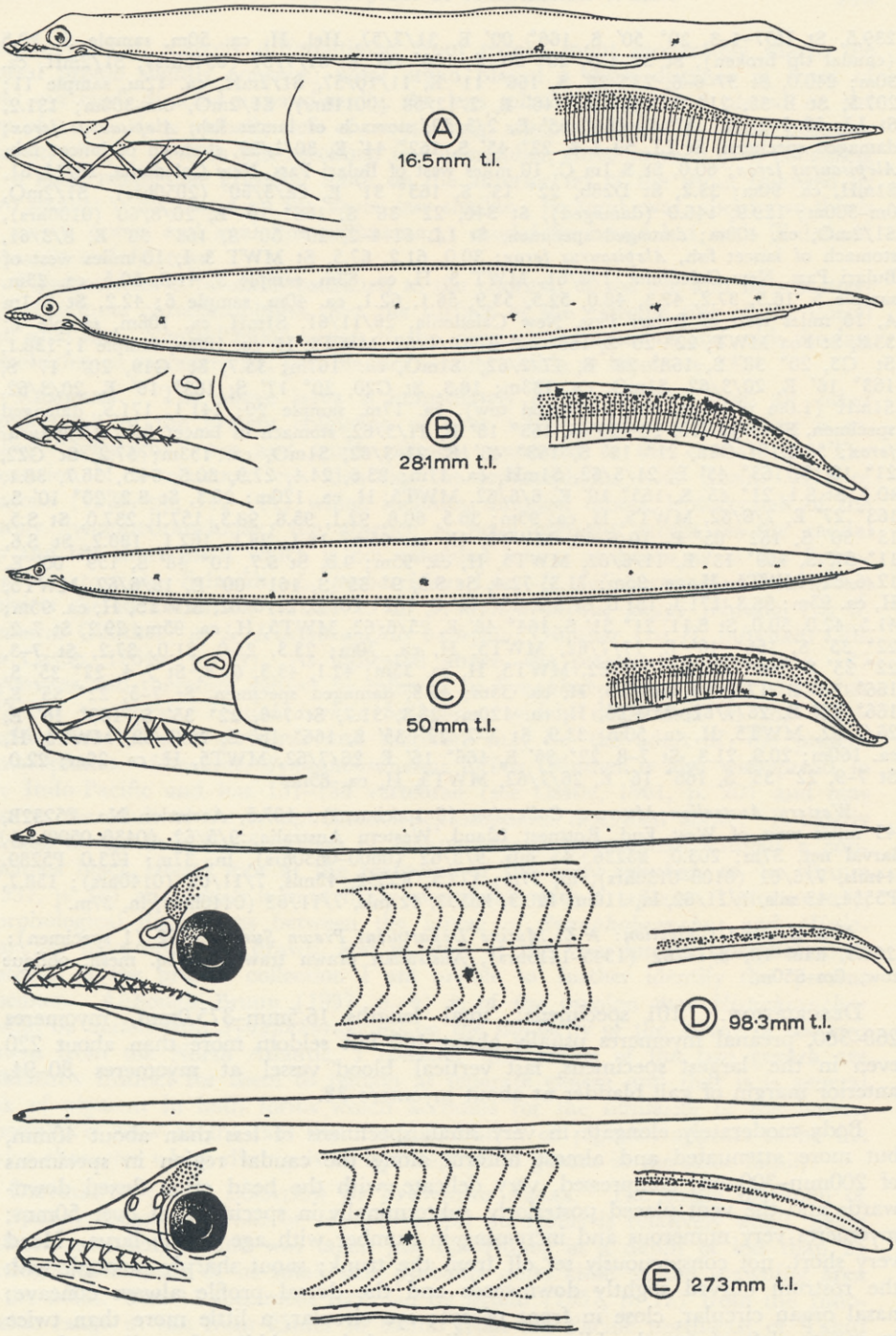
**L. Nemichthys scolopaceus** Richardson, 1848, Text-fig. 1.

1929. *L. Nemichthys scolopaceus* Richardson. Roule & Bertin *Dana Rep.*, 1(4): 61–100 (description, development).

1937. *L. Nemichthys scolopaceus* Richardson. Beebe & Crane, *Zoologica, N.Y.*, 22: 357–366 (description, development).

1964c. *L. Nemichthys scolopaceus* Richardson. Castle, *Trans. roy. Soc. N.Z., Zool.*, 5(7): 79 (specimens from northern New Zealand).

MATERIAL EXAMINED. *Centre d'Océanographie de l'Institut Français d'Océanie Collection* (93 specimens): 105.5mm total length, IFO Station 56–5–4, 14° 50′ S, 166° 15′ E, 2/11/56 (0045hrs), S1/2mH (0.5m net, horizontal tow), ca. 30m; 40.1, St 57–5, 22° 40′ S, 166° 12′ E, 1/5/57, S1/2m, surface; 57.4, St A57–7–1, 22° 27′ S, 162° 40′ E, 6/7/57 (1315hrs), S1/2mO, ca. 100m; 185.9, 190.0, 191.7, 195.9, 200.0, 213.9, and 1 damaged, St LL 57–3–8, 22° 35′ S, 166° 08′ E, 9/7/57, stomach of lancet fish, *Alepisaurus ferox*; 83.3, St A57–7–3, 22° 33′ S, 166° 20′ E, 10/7/57, S1/2mO, ca. 100m; damaged specimen, St A57–7–4, 22° 33′ S, 166° 20′ E, 10/7/57 (0445hrs), S1/2mO, ca. 100m; 375.0, St 57–4–2, 18° 55′ S, 166° 55′ E, 29/7/57 (1215hrs), Hel (Heligoland larval fish net), H, ca. 30m; 189.0, St 58–4–3, 20° 50′ S, 166° 50′ E, 31/7/57 (0045hrs), S1/2mH, 50m;




TEXT-FIG. 1.—*L. Nemichthys scolopaceus* Richardson, showing five stages in the growth of the larva. Fig. A—16.5mm total length, IFO Station MWT 3 I (sample 6), lateral view, teeth and caudal tip. Fig. B—28.1mm total length, IFO Station S.6. Fig. C—50mm total length, IFO Station S.11. Fig. D—98.3mm total length, IFO Station S.11. Fig. E—273mm total length, IFO Station S.11.

239.5, St H57–4–3, 20° 50′ S, 166° 00′ E, 31/7/57, Hel, H, ca. 50m, sample 5; 70.5 (caudal tip broken), St 57–4–5, 20° 50′ S, 166° 00′ E, 31/7/57 (0945hrs), S1/2mH, ca. 30m; 240.0, St 57–6–6, 23° 29′ S, 166° 11′ E, 11/10/57, S1/2mH, ca. 12m, sample 11; 207.5, St B 35, 21° 52′ S, 168° 46′ E, 2/12/58 (0011hrs), S1/2mO, 0m–300m; 131.2, St LL 59–5–2, 22° 57′ S, 164° 55′ E, 2/5/59, stomach of lancet fish, *Alepisaurus ferox*; damaged specimen, St LL 59–1–3, 22° 45′ S, 162° 44′ E, 30/1/59, stomach of lancet fish, *Alepisaurus ferox*; 60.0, St S 1m C, 10 miles west of Bulari Pass, New Caledonia, 29/11/61, S1mH, ca. 90m; 33.2, St D28b, 22° 13′ S, 165° 31′ E, 28/5/60 (2050hrs), S1/2mO, 0m–300m; 129.9, 146.0 (damaged), St S40, 22° 36′ S, 166° 10′ E, 20/8/60 (0100hrs), S1/2mO, ca. 400m; damaged specimen, St LL 61–1–2, 20° 50′ S, 163° 38′ E, 8/3/61, stomach of lancet fish, *Alepisaurus ferox*; 30.0, 61.2, 67.5, St MWT 3 I, 10 miles west of Bulari Pass, New Caledonia, 1/8/61, MWT 3, H, ca. 83m, sample 3, 41.8, 50.5, ca. 23m, sample 5, 16.5, 37.2, 42.3, 48.0, 52.5, 53.9, 56.1, 62.1, ca. 40m, sample 6; 42.2, St S 1m A, 10 miles west of Bulari Pass, New Caledonia, 28/11/61, S1mH, ca. 106m, sample 1; 33.8, St Foa MWT, 22° 20′ S, 165° 42′ E, 10/1/62, MWT3, H, ca. 100m, sample 1; 138.1, St G3, 20° 38′ S, 168° 28′ E, 17/2/62, S1mO, ca. 167m; 35.7, St G19, 20° 17′ S, 163° 16′ E, 20/3/62, S1mO, ca. 133m; 18.3, St G20, 20° 17′ S, 163° 16′ E, 20/3/62, S1mH (1.0m plankton net, horizontal tow), ca. 17m, sample 20; 141.1, 171.5, damaged specimen, St G LL 10, 20° 55′ S, 163° 18′ E, 21/3/62, stomach of lancet fish, *Alepisaurus ferox*; 58.8, St G21, 21° 13′ S, 163° 43′ E, 21/3/62, S1mO, ca. 133m; 57.2, St G22, 21° 13′ S, 163° 43′ E, 21/3/62, S1mH, ca. 17m; 23.6, 24.4, 27.9, 30.6, 34.5, 36.7, 38.1, 40.4, St S.1, 21° 45′ S, 165° 10′ E, 6/6/62, MWT5, H, ca. 120m; 26.3, St S.2, 20° 10′ S, 163° 27′ E, 7/6/62, MWT5, H, ca. 95m; 36.5, 60.8, 92.1, 95.8, 98.3, 157.1, 237.0, St S.5, 13° 30′ S, 162° 05′ E, 10/6/62, MWT5, H, ca. 95m; 18.1, 28.1, 162.1, 180.2, St S.6, 11° 51′ S, 159° 13′ E, 11/6/62, MWT5, H, ca. 95m; 9.8, St S.7, 10° 48′ S, 159° 00′ E, 12/6/62, MWT5, H, ca. 95m; 71.3, 72.4, St S.8, 9° 35′ S, 161° 00′ E, 18/6/62, MWT5, H, ca. 95m; 96.3, 171.1, 181.0, St S.9, 15° 42′ S, 162° 20′ E, 21/6/62, MWT5, H, ca. 95m; 41.5, 42.0, 50.0, St S.11, 21° 31′ S, 164° 48′ E, 25/6/62, MWT5, H, ca. 95m; 29.2, St 7–2, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, ca. 70m; 23.3, 25.0, 31.0, 37.2, St 7–3, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, ca. 35m; 42.1, 43.3, 67.3, St 7–4, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, ca. 35m; 46.3, damaged specimen, St 7–5, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, ca. 120m; 28.3, 31.7, St 7–6, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, ca. 50m; 33.9, St 7–7, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, ca. 160m; 20.9, 21.3, St 7–8, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, ca. 20m; 22.0, St 7–9, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, ca. 85m.

*Western Australian Museum Collection* (6 specimens): 107.5, Accession No. P5232B, 45 miles west of West End, Rottnest Island, Western Australia, 9/5/62 (0430–0500hrs), larval net, 37m; 203.0, P5236, 43 mls, 9/5/62 (0600–0630hrs), ln, 37m; 123.0 P5289, 44mls, 7/6/62 (0100–0130hrs), ln, 37m; 172.3, P5552, 45mls, 7/11/62 (0140hrs); 158.7, P5554, 43 mls, 7/11/62, ln, 110m; 120.3, P5555, 42 mls, 7/11/62 (0440hrs), ln, 37m.

*New Zealand Collection*: *N.Z. Marine Department Prawn Survey 1962* (1 specimen): 266.9, haul 18, 8/11/62 (1345–1415hrs), Australian prawn trawl, 1in sq. mesh, oblique tow, 0m–650m.

DESCRIPTION. 101 specimens: total lengths 16.5mm–375.0mm, myomeres 268–380, preanal myomeres usually about 160 but seldom more than about 220 even in the largest specimens, last vertical blood vessel at myomeres 80–94, anterior margin of gall bladder at about myomere 38.

Body moderately elongate in very small specimens of less than about 40mm, but more attenuated and almost filiform along the caudal region in specimens of 200mm–300mm; compressed, very delicate, with the head often flexed downwards and the vent placed posteriorly, subterminally in specimens of over 50mm; myomeres very numerous and increasing in number with age of the larva. Head very short, not conspicuously set off from the trunk; snout sharply pointed, with the rostrum curved slightly downwards and the dorsal profile always concave; nasal organ circular, close in front of eye; eye circular, a little more than twice in snout; cleft of mouth oblique, extending to below middle of pupil; teeth extremely long and acute in larvae of less than about 30mm, relatively shorter and less acute in larger larvae where they are distributed typically as follows: an anterior grasping tooth sometimes preceded by a minute dorsal tooth followed

by a series of up to five large, acute teeth and then by as many as 10 smaller teeth. Pectoral fin minute, inconspicuous; dorsal fin-rays obvious posteriorly only in larvae of greater than 200mm, in these the fin originating over the vent; anal short, similarly developed; caudal poorly differentiated.

Pigmentation of a 30mm specimen as follows: a diffuse, somatic chromatophore, as large as the pupil, placed just below the midlateral line at myomere 19, a similar chromatophore just above level of intestine at myomere 41, another just below midlateral line at myomere 78 and yet another in the same relative position at myomere 117; rather less conspicuous chromatophores deep on the spinal cord each at myomeres 56, 94, and 140; a conspicuous scattering of deep pigment on the dorsal tip of the vertebral column with a few spots below it; an irregular scattering of chromatophores on the body wall below the liver; a row of regularly spaced splanchnic chromatophores above the intestine (along the kidney ducts) from just behind the pectoral to the vent; chorioid pigment present.

Vertical blood vessels to the viscera numerous but the last is more conspicuous and lies at about myomere 88. Gall bladder clearly distinguishable, its anterior margin at about myomere 38.

REMARKS. The larvae described here conform well with those described by Roule & Bertin (1929, pp. 68–81) and Beebe & Crane (1937, pp. 357–366) and which were referred by these authors to *Nemichthys scolopaceus* Richardson, 1848. The present specimens have the same attenuated body, round eye, posteriorly placed vent, minute pectoral, sharp snout and pigmentation in the form of four conspicuous, lateral, somatic chromatophores, all of which are established characters of the leptocephali of this species. The collection contains no metamorphosing specimens, but there are a number of relatively small larvae as well as many examples covering a wide range of growth stages. There are no essential differences between the present material and that already described by the above authors, and reference may be made to these accounts for detailed comparative data. Of the 101 larvae described here, about 16 lack the characteristic lateral somatic chromatophores which are so typical of *L. Nemichthys scolopaceus*. In this way these specimens resemble similar specimens described by Roule & Bertin (as Leptocephalus B) and Beebe & Crane. I have compared these 16 specimens in detail with the remainder in the collection, but apart from the lack of lateral pigment can find no other significant difference—e.g., in myomere number, position of vertical blood vessels, gall bladder, etc., which would suggest that these specimens may belong to another nemichthyid species. I therefore feel little justification in setting these specimens aside from the remainder in terms of a separate species.

CHANGES IN PIGMENTATION DURING GROWTH. Small larvae of *Nemichthys scolopaceus* of about 15mm–20mm examined showed pigment entirely restricted to the chorioid of the eye and to three or four of the lateral spots; there is no pigment above the intestine, on the spinal cord or on the caudal tip. At about 25mm a few widely-spaced, compact spots appear on the spinal cord and the characteristic caudal pigment develops. Larvae of 50mm show widely-spaced, compact, splanchnic pigment spots above the intestine (along the kidney ducts); this pigment extends from about myomere 25 to the vent. At lengths greater than about 50mm pigment spots increase slightly in number to about 1–2 per segment along the spinal cord and to about 1–2 per segment along the intestine, but the number in both cases shows considerable variation. Spots are retained on the dorsal tip of the spinal cord and pigment appears on the bases of the incipient anal and dorsal fin-rays.

DISTRIBUTION AND LOCATION OF SPAWNING AREAS. The larvae of *N. scolopaceus* in the above collection were trawled or taken from the stomachs of lancet fish (*Alepisaurus ferox*) from two main areas, (a) the New Caledonia region from 10° S to 23° S between the Solomon Islands and New Caledonia, with a single large specimen from close to the northern coast of New Zealand, and (b) an area 35–45 miles west of Rottnest Island, Western Australia. The larvae from New Caledonia range in size from 16.5mm to 375mm and suggest that spawning of *N. scolopaceus* takes place in this region, but that spawning probably takes place over a very wide area. The larvae from Western Australia are all relatively large (107.5mm–203mm) and there is no indication (by the presence of very small larvae) that spawning in the eastern Indian Ocean occurs in this area. It probably takes place further northwards.

**L. Borodinula infans** (Günther, 1878) or **L. Borodinula gilli** (Bean, 1890), Text-fig. 2, A-C.

1914. *Leptocephalus oxycephalus* Pappenheim, *Dtsch. Südpol Exped.*, 15, Zoologie, 7(2): 190, pl. 9, figs. 3, 5.

1916. *Leptocephalus acuticeps* Regan, *Brit. Antarct. Terra Nova Exped. 1910*, 1: 140–141, pl. 7, fig. 5.

MATERIAL EXAMINED. *Centre d'Océanographie de l'Institut Français d'Océanie Collection* (12 specimens): 67.3mm total length, IFO Station 56–4–18, 13° 20′ S, 174° 03′ E, 19/10/56, S1/2mH (0.5m net, no. 2 mesh, horizontal tow), ca. 10m; 77.1, St 56–5–6, 12° 57′ S, 166° 05′ E, 3/11/56 (0006hrs), S1/2mH, ca. 70m; 171.3, St 56–5–8, 11° 30′ S, 163° 23′ E, 4/11/56 (2228hrs), S1/2mH, ca. 150m; 41.8, St 56–5–9, 12° 35′ S, 162° 42′ E, 5/11/56 (2230hrs), S1/2mH, ca. 5m; 121.1, St 56–5–11, 16° 45′ S, 163° 15′ E, 7/11/56 (2225 hrs), S1/2mH, ca. 180m; 34.5, St A57–6–2, 22° 32′ S, 166° 11′ E, 10/10/57 (0030hrs), S1/2mH, ca. 10m; 105.3, St P58–3–3–5, 22° 41′ S, 166° 15′ E, 1/4/58 (0200hrs), S1/2mO, ca. 80m; 101.2, St LL 59–1–2, 22° 46′ S, 162° 00′ E, 29/1/59, stomach of lancet fish, *Alepisaurus ferox*; 102.5, St Ep 15b(1), 11° 06′ S, 158° 19′ E, 20/9/60 (0158hrs), S½m O, 0m–300m; 74.0, St G22, 21° 13′ S, 163° 43′ E, 21/3/62, S1mH (1.0m plankton net, horizontal tow), ca. 17m; 124.8, St S.7, 10° 48′ S, 159° 00′ E, 12/6/62, MWT5, H, ca. 95m; 98.3, St S.8, 9° 35′ S, 161° 00′ E, 18/6/62, MWT5, H, ca. 95m.

*C.S.I.R.O. Division of Fisheries and Oceanography* (*Cronulla*) *Collection* (1 specimen): 32.1, *Warreen* St 30/40, 30° 18′ S, 153° 32′ E, 22/4/40, N70 H, surface, 15mins.

*Western Australian Museum Collection* (2 specimens): 85.8, Acc. No. P5158, 47 miles west of West End, Rottnest Island, Western Australia, 12/9/61 (0200–0230hrs), larval net, 55m; 123.8, P5552, 45 mls, 7/11/62 (0140hrs), ln, 37m.

DESCRIPTION. 15 specimens: total lengths 41.8mm–171.3mm, myomeres 188–224, dorsal fin-rays 273–287, anal fin-rays 233–245, last vertical blood vessel at myomere 69–72, anterior margin of gall bladder at myomere 26–28. Description made from a specimen from IFO Station S.7 (measurements in mm): total length 124.8, head 5.1, snout 1.8, eye 1.1, cleft of mouth 2.3, postorbital 2.2, pectoral 1.2, snout-vent 116.1, predorsal 112.4, depth just before eye 2.5, at pectoral origin 3.9, at midpoint between pectoral and vent 10.2, at vent 5.0. Branchiostegal and pectoral rays not yet developed, dorsal rays ca. 230, anal rays 273, caudal rays ca. 6. Teeth $\frac{1 + \text{VI} + 5}{1 + \text{VII} + 2}$. Myomeres 170 + 27 = 197. a–d = 8. Last vertical blood vessel at myomere 71. Anterior margin of gall bladder at myomere 27.

Body elongate, but not excessively so, compressed, except along head, relatively shallow, its greatest depth slightly behind midpoint where it is contained about 12 times in total length, tapering a little more rapidly posteriorly than anteriorly. Head appreciably differentiated from trunk, short, about 25 in total length; snout short, nearly three times in head, acute, the rostrum narrow and clearly defined, the dorsal profile concave; nasal organ circular, close in front of eye; eye circular, 4.5 in head; cleft of mouth slightly oblique, reaching to below middle of pupil;

teeth moderately acute, in three series on each jaw as follows: a large grasping tooth on the tip of snout, followed by a series of six large teeth and then by five smaller teeth, the last below middle of pupil, those on the lower jaw similar but fewer. Pectoral fin oval, relatively large, about equal to eye diameter; dorsal fin low, originating a few segments in advance of level of vent; anal fin similar but less well-developed; caudal fin not distinct from tips of dorsal and anal fins and with the hypurals hard to distinguish.

Pigmentation in formalin as follows: three small somatic spots occur in an almost vertical line below the midlateral line on myomere 27, another two are similarly placed on myomere 58 and another on myomere 104; a single series of minute, compact chromatophores on the dorsal aspect of the spinal cord (actually on the most dorsal aspect of the vertebral column) from the extreme anterior tip of the vertebral column to the tip of the caudal region, these chromatophores at a frequency of about 5–6 per segment but fewer posteriorly; a single series of small, somatic chromatophores in the ventral midline from the throat to the level of the pyloric caecum—that is, to about myomere 23, 4–5 per segment; a paired series of minute, splanchnic chromatophores, about 5–6 per segment, from segment 10 to the vent, above the intestine (along the kidney ducts); a small chromatophore on the base of many of the posterior dorsal and anal fin-rays; a few small chromatophores on the dorsal and ventral edges of the most posterior segments; scattered chromatophores over the caudal tip; pigment in the chorioid.

Vertical blood vessels to the viscera numerous and the last at myomere 71, is the most conspicuous. Gall bladder not readily seen but placed at myomere 27.

REMARKS. In general body form and configuration of the head and snout the leptocephali described above show many resemblances to the larvae of *Nemichthys scolopaceus*. In the present species, however, there is a large pectoral; the caudal region is relatively broad and not filamentous with the postanal myomeres easily countable; there are much more numerous spots on the dorsal aspect of the spinal cord; a ventral series of spots is present from the throat to the pyloric caecum; there are more numerous spots on the bases of the dorsal and anal rays; lateral pigment spots occur in groups and at different levels along the body than in *Nemichthys*. The general similarity to *Nemichthys* nevertheless suggests that the present species belongs in the Nemichthyidae but the non-filiform caudal region restricts the identification to the two genera *Borodinula* (= *Avocettina*) Whitley, 1931 and *Labichthys* Gill & Ryder, 1883. *Nemichthys, Nematoprora* Gilbert, 1905 and *Cercomitus* Weber, 1913, all have an attenuated caudal region. *Labichthys* is at present known from the Atlantic only while *Borodinula* is world-wide in its distribution. In view of the fact that eels of this genus are not uncommon in the south-west Pacific (Castle, 1964c, in press) I have confidence in referring the above leptocephali to *Borodinula,* the first time that larvae of this genus have been recognised. Two species of *Borodinula* are known from the south-west Pacific (actually New Zealand waters, see Castle, 1961, pp. 5–11); these are *B. infans* (Günther, 1878) and *B. gilli* (Bean, 1890). Briefly the two species are separated in the adult as follows: *B. infans* is a cosmopolitan species having a high number of dorsal fin-rays (300–350) and anal rays (about 30 less than the dorsal) and with about 200 vertebrae: *B. gilli* has about 260 dorsal rays and about 215 anal rays and with about 180 vertebrae. There is sufficient variation in the number of vertebrae in both species to cause confusion of the two on this character alone, but the adults are readily separated by the number of fin-rays. In the nine specimens described above the myomeres number 188–224,

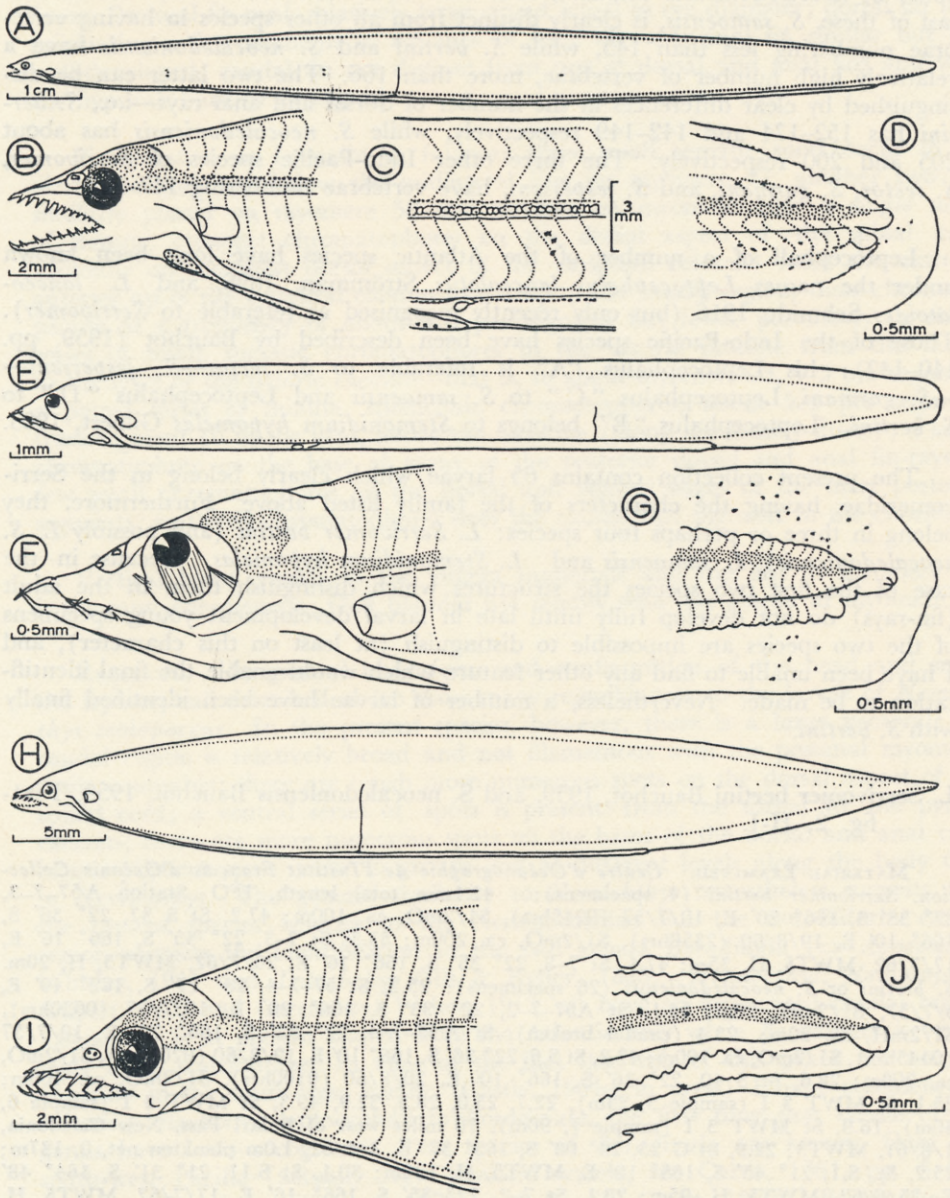
with the average about 198; in specimens of over 100mm the fin-rays are numerous and number about 275 in the dorsal and about 230 in the anal; smaller specimens have only a few rays, numbering about 25 in each fin. These counts suggest that the specimens may possibly be referred to *B. infans* on the number of vertebrae or to *B. gilli* on the number of fin-rays. Unfortunately, there is no way of determining whether the full complement of fin-rays has formed in the large leptocephali; at full growth the number may be somewhat greater. In view of this the above leptocephali cannot therefore be referred to either one or both of *B. infans* or *B. gilli* although I suggest that because there are no full-grown larvae in the collection the dorsal and anal fin-ray number may be less than the adult total, in which case the specimens would properly be referred to *B. infans*.

There are also no very small larvae of *B. infans–B. gilli* in this collection, most specimens being over 70mm, and therefore no positive suggestions can be made as to the location of the spawning areas for the species. In view of the location of capture of most specimens in the area around New Caledonia, however, it is likely that the spawning area in the south-west Pacific is a wide, tropical one. The two specimens from Western Australia may have originated from a spawning area in the Indian Ocean.

Two species of *Leptocephalus*, whose adults have previously remained undetermined, may now also be referred to *Borodinula*. These are *L. oxycephalus* Pappenheim, 1914, from the Atlantic and with 220–230 myomeres (180–190 + 40) and *L. acuticeps* Regan, 1916, from the Central Atlantic with 174 + 33 = 207 myomeres, teeth $\frac{1+6}{1+5}$, and pigment as "a series of dots along the axis and along the dorsal border of the gut; a group of similar dots at the end of the tail"—Regan (1916, p. 141). In his re-examination of the type of *L. acuticeps*, Bertin (1936, p. 7, fig. 4) found that the last blood vessel to the viscera was placed at myomere 74 and that the three groups of lateral somatic chromatophores were placed at myomeres 25–28, 59–60, 102–105. These are essentially identical with the condition in the present specimens. I therefore have confidence in referring both *L. oxycephalus* and *L. acuticeps* to *Borodinula*. Both Ancona (1928, p. 109) and Bertin (1936, pp. 8 and 12) refer these species to the Congridae, but they were clearly in error. Furthermore, in number of myomeres both species fall readily within the range shown in the leptocephali described above (188–224) and may therefore be referred to *Borodinula gilli* and/or *B. infans*. Studies on the adults of these latter species have shown that *B. gilli* has a range of 156–181 lateral line pores (Castle, 1961), while *B. infans* has 166–195 (Roule & Bertin, 1929, p. 25). There is thus an appreciable discrepancy between the number of myomeres in the supposed adults and that in the larvae.

### SERRIVOMERIDAE

The detailed studies of Bauchot (1959) have now clearly established the distinguishing characters of serrivomerid larvae. Leptocephali of this family are elongate-oval in general body shape (rather similar in shape to anguillid larvae) and reach about 60mm at full growth; they have a sharp, peg-like snout, a vent placed about two-thirds of the way along the body just before the onset of metamorphosis, a well-developed pectoral fin and pigment restricted to minute chromatophores spaced fairly regularly every four or five segments along the midlateral line on the myosepta. Three genera are currently recognised for the family: *Serrivomer* Gill & Ryder, 1883, *Platuronides* Roule & Bertin, 1924 and *Stemonidium* Gilbert, 1903. *Serrivomer* has 10 species, separated mainly on the nature of the attachment of the branchiostegal rays to the hyoid arch, dentition and number of fin-rays and vertebrae. *Platuronides* has three species and *Stemonidium* one.




TEXT-FIG. 2.—Figs. A-D: *L. Borodinula gilli* or *L. B. infans*, 124.8mm total length, IFO Station S.7; lateral view, lateral view of head; lateral view at level of pyloric caecum to show lateral grouped chromatophores; splanchnic pigment above gut and deep pigment on spinal cord; caudal tip. Figs. E-G: *L. Synaphobranchus affinis* or *L. Histiobranchus bathybius*, 17.8mm total length, DFO (Cronulla) *Warreen* Station 205/39. Figs. H-I: *L. Serrivomer bertini*, 47.4mm total length, IFO Station 7–8.

Six species of *Serrivomer* occur in the Indo-Pacific: *S. jesperseni* Bauchot-Boutin, 1954, *S. garmani* Bertin, 1944, *S. sector* Garman, 1899, *S. bertini* Bauchot, 1959, *S. neocaledoniensis* Bauchot, 1959 and *S. samoensis* Bauchot, 1959. The last of these, *S. samoensis,* is clearly distinct from all other species in having vertebrae numbering less than 145, while *S. bertini* and *S. neocaledoniensis* have a relatively high number of vertebrae, more than 166. The two latter can be distinguished by clear differences in the number of dorsal and anal rays—i.e., *S. bertini* has 152–174 and 142–149 respectively, while *S. neocaledoniensis* has about 205 and 200 respectively. The three other Indo-Pacific species of *Serrivomer, S. sector, S. garmani,* and *S. jesperseni,* have vertebrae numbering 147–153.

Leptocephali of a number of the Atlantic species have long been known under the names *Leptocephalus lanceolatus* Strömman, 1896, and *L. lanceolatoides* Schmidt, 1916 (but only recently recognised as referable to *Serrivomer*). Those of the Indo-Pacific species have been described by Bauchot (1959, pp. 140–142): his Leptocephalus "A" is referable to *S. sector*—*S. jesperseni*——*S. garmani,* Leptocephalus "C" to *S. samoensis* and Leptocephalus "D" to *S. bertini.* Leptocephalus "B" belongs to *Stemonidium hypomelas* Gilbert, 1903.

The present collection contains 65 larvae which clearly belong in the Serrivomeridae, having the characters of the family listed above. Furthermore, they belong in three or perhaps four species: *L. Serrivomer bertini* (and possibly *L. S. neocaledoniensis*), *L. samoensis* and *L. Stemonidium hypomelas.* Because in the case of the first two species the structures which distinguish them in the adult (fin-rays) do not develop fully until late in larval development young specimens of the two species are impossible to distinguish (at least on this character), and I have been unable to find any other feature which would enable the final identification to be made. Nevertheless, a number of larvae have been identified finally with *S. bertini.*

**L. Serrivomer bertini** Bauchot, 1959, and **S. neocaledoniensis** Bauchot, 1959, Text-fig. 2, H-J.

MATERIAL EXAMINED. *Centre d'Océanographie de l'Institut Français d'Océanie Collection. Serrivomer bertini* (4 specimens): 42.1mm total length, IFO Station A57–7–3, 22° 33′ S, 166° 20′ E, 10/7/57 (0245hrs), S1/2mO, ca. 100m; 47.2, St S 37, 22° 36′ S, 166° 10′ E, 19/8/60 (2358hrs), S1/2mO, ca. 200m; 53.3, St 7–3, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, 35m; 47.4, St 7–8, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, 20m. *S. bertini* or *S. neocaledoniensis* (26 specimens): 25.2, St 57–7–4, 23° 27′ S, 162° 40′ E, 6/7/57, S1/2mH, 20m; 54.1, St A57–7–2, 22° 33′ S, 166° 20′ E, 10/7/57 (0030hrs), S1/2mH, ca. 20m; 23.4 (caudal broken), St A 57–7–4, 22° 33′ S, 166° 20′ E, 10/7/57 (0445hrs), S1/2mO, ca. 100m; 47.2, St S.6, 22° 36′ S, 166° 10′ E, 19/8/60 (0205hrs), S1/2mO, ca. 200m; 28.6, St S 40, 22° 36′ S, 166° 10′ E, 20/8/60 (0100hrs), S1/2mO, ca. 400m; 25.1, St MWT 3 I (sample 5, 23m), 22.7, 25.0, 28.5, 32.9, 49.3, St MWT 3 I (sample 6, 40m), 16.9, St MWT 3 I (sample 7, 90m), 10 miles west of Bulari Pass, New Caledonia, 1/8/61, MWT3; 22.9, St G 25, 23° 08′ S, 165° 37′ E, 3/4/62, 1.0m plankton net, 0, 137m; 25.2, St. S.1, 21° 45′ S, 165° 10′ E, MWT5, H, 120m; 30.1, St S.11, 21° 31′ S, 164° 48′ E, 25/6/62, MWT5, H, 95m; 28.1, St 7–2, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, 70m; 13.7, 16.8, 19.5, 20.2, 22.1, 23.2 (caudal broken), 25.0, St 7–3, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, 35m; 26.0, 44.9, St 7–4, 22° 35′ S, 166° 16′ E, 17/7/62, MWT5, H, 35m; 15.2, St 7–5, 22° 35′ S, 166° 16′ E, 26/7/62, MWT5, H, 120m.

*C.S.I.R.O. Division of Fisheries and Oceanography* (*Cronulla*) *Collection. Serrivomer bertini* or *S. neocaledoniensis* (3 specimens): 16.5, *Warreen* Station 144/39, 36° 15′ S, 150° 25′ E. 31/5/39, N200, H, 100m, 30mins; 26.0, St 199/39, 28° 47′ S, 153° 56′ E, **16/7/39, N70, O, 0m–200m;** 41.7, *Discovery* St 2719, 33° 52′ S, 152° 38′ E, 9/10/50, N100B, V, 90m–0m.

*Western Australian Museum Collection. Serrivomer bertini* (1 specimen): 57.5, Accession No. P5557, 21 miles west of West End, Rottnest Island, Western Australia, 13/11/62 (0400hrs), larval net, 37m. *S. bertini* or *S. neocaledoniensis* (4 specimens): 32.5, P5545, no position given, but probably west of Rottnest Island, 18/10/62 (0100hrs), ln, 37m; ca. 47.5 (damaged), P5549, 28 mls, 24/10/62 (0500hrs), N70, surface; 52.8, P5556, 25 mls, 13/11/62 (0100hrs), ln, 37m; 60.0, P5559, 40 mls, 15/11/62 (0320hrs), ln, 110m.

*New Zealand Oceanographic Institute Collection. Serrivomer bertini* (1 specimen): 44.5, Station C555, 17° 10′ S, 158° 00′ W, 28/9/60 (2140–2215hrs), N70, surface.

DESCRIPTION. 39 specimens: total lengths 13.7mm–60.0mm, myomeres 165–177, last vertical blood vessel at myomere 31–37, anterior margin of gall bladder at myomere 34–43, dorsal rays 139–164, dorsal rays before level of vent 46–47, anal rays 126–140, a–d = 10–14. Description made from a specimen of *S. bertini* 47.4mm total length, IFO Station 7–8 (measurements in mm): head 3.9, snout 1.5, eye 0.9, cleft of mouth 1.9, postorbital 1.5, pectoral 0.8, snout-vent 36.2, predorsal 33.0, depth just before eye 2.0, at pectoral origin 3.0, at midpoint between pectoral and vent 7.1, at vent 6.0. Branchiostegal and pectoral rays not yet developed, dorsal rays ca. 164, dorsal rays before level of vent ca. 46, anal rays ca. 132. Teeth $\frac{1 + VI + 3}{1 + V + 4}$. Myomeres 101 + 74 = 175. a–d = 12. Last vertical blood vessel at myomere 37. Anterior margin of gall bladder at myomere 27. Pyloric caecum at myomere 43.

REMARKS. Six of the above 39 specimens (total lengths 42.1mm—57.5mm) are clearly referable to *Serrivomer bertini* in having dorsal rays numbering about 165 and anal rays about 135, compared with respective values in *S. neocaledoniensis* of about 205 and 200. The remainder (total lengths 13.7mm to 60.0mm) have the fin-rays poorly developed and the fin-ray number being the only character at present known by which these two species may be distinguished further identification of the 33 specimens cannot be made.

*S. bertini* is known from the eastern Indian Ocean (one adult) and the southwest Pacific (four adults, five larvae) from Bauchot (1959, pp. 132 and 142) and from 15 adults taken north of New Zealand (Castle, 1964c, p. 73). As in the larvae of this species recorded by Bauchot the present specimens have the midlateral somatic chromatophores restricted to the posterior part of the body, and decreasing in number with age. In a full grown specimen of about 50mm the first pigment spot lies at about the level of the 84th myomere and the last at about 20 segments in advance of the caudal tip. The presence of many specimens in the collection suggests that the adults of *S. bertini* and/or *S. neocaledoniensis* spawn in the waters around New Caledonia.

### L. Serrivomer samoensis Bauchot, 1959

*L. Serrivomer samoensis* Bauchot, 1959, *Dana Rep.*, 48: 141–142.

MATERIAL EXAMINED. *Centre d'Océanographie de l'Institut Français d'Océanie Collection* (21 specimens): 39.4mm total length, IFO Station 56–4–5, 29/9/56 (2324hrs), 8° 54′ S, 170° 00′ E, S1/2mH, ca. 35m; 25.4, St 56–4–6, 6° 50′ S, 169° 55′ E, 30/9/56 (2324 hrs), S1/2mH, ca. 100m; 57.2, St 56–4–7, 1/10/56 (2324hrs), 4° 45′ S, 169° 58′ E, S1/2mH, ca. 30m; 32.7, 35.1, St 56–4–15, 8° 05′ S, 177° 06′ E, 17/10/56 (0001hrs), S1/2mH, ca. 30m; 37.6, St 56–4–16, 10° 04′ S, 177° 16′ E, 17/10/56 (2330hrs), S1/2mO, ca. 180m; 62.1, St 56–5–11, 7/11/56 (2225hrs), 16° 45′ S, 160° 15′ E, S1/2mH, ca. 5m; 50.1, St 57–4–2, 18° 55′ S, 166° 55′ E, 29/7/57 (1215hrs), Heligoland larval fish net, H, ca. 30m; 50.2, St P As 35, 18° 50′ S, 167° 54′ E, 14/6/58 (2000hrs), S1/2mO, 0m–300m; 31.0, St D10, 14° 50′ S, 157° 52′ E, 16/5/60 (2003hrs), S1/2mO, 0m–300m; 31.3, St D10b, 14° 13′ S, 157° 55′ E, 17/5/60 (0214hrs), S1/2mO, 0m–300m; 44.3, 54.9, 57.5, St S.4, 15° 48′ S, 161° 00′ E, 9/6/62, MWT5, H, 95m; 20.9, 30.9, 54.3, St S.6, 11° 51′ S, 159° 13′ E, 11/6/62, MWT5, H, 95m; 16.9, 36.5, 37.1, 38.8, St S.8, 9° 35′ S, 161° 00′ E, 18/6/62, MWT5, H, 95m.

Description. Total lengths 16.9mm–62.1mm, myomeres 139–146, last vertical blood vessel at myomere 33–36, anterior margin of gall bladder at myomere 34–39, dorsal rays 139–156, dorsal rays before level of vent 49–65, anal rays 135–147, a–d = 9–15.

Remarks. The distinguishing feature of this species is the relatively low number of myomeres, 139–146. All other species of *Serrivomer* have myomeres numbering more than 147. However, *Stemonidium hypomelas* has about 139 vertebrae and fin-rays which are about equal in number to those of *S. samoensis* so that these numerical characters cannot be used to separate larvae of the two species. Nevertheless, leptocephali of *S. samoensis* always have the first midlateral pigment spot posterior to about the 43rd myomere, while those of *Stemonidium hypomelas* have the midlateral pigment more anteriorly placed so that the first chromatophore occurs in front of the 45th segment. Bauchot (1959, p. 134) records the type specimen of *S. samoensis* and 90 larvae from waters around Samoa, while a second adult specimen has been recorded from Cook Strait, New Zealand (Castle, 1960, p. 12).

**L. Stemonidium hypomelas** Gilbert, 1903

*L. Stemonidium hypomelas* Gilbert. Bauchot, 1959, *Dana Rep.*, 48: 140–141.

Material Examined. *Centre d'Océanographie de l'Institut Français d'Océanie Collection* (6 specimens): 56.9mm total length, IFO Station 56–4–3, 12° 55′ S, 170° 03′ E, 27/9/56 (2223hrs), S1/2mH, ca. 15m; 19.8, 21.2, St S.4, 15° 48′ S, 161° 00′ E, 9/6/62, MWT5, H, 95m; 15.9, 31.1, 35.5, St S.9, 15° 42′ S, 162° 20′ E, 21/6/62, H, MWT5, 95m.

Description and Remarks. Total lengths 15.9mm–56.9mm, myomeres 135–142, last vertical blood vessel at myomere 30–34, anterior margin of gall bladder at myomere 33 (one specimen), dorsal rays 179, dorsal rays before level of vent 65, anal rays 169, a–d = 7.

This group of six leptocephali is immediately distinguished from the others here described in having the first midlateral pigment spot placed anteriorly along the body, usually at about myomere 15. Bauchot (1959, p. 141) has shown by reference to postlarval specimens that such leptocephali, having otherwise the characters of larval *Serrivomer samoensis* are referable to *Stemonidium hypomelas* (Leptocephalus "B").

Synaphobranchidae

**L. Synaphobranchus affinis** Günther, 1877 or **L. Histiobranchus bathybius** (Günther, 1877), Text-fig. 2, E, F, G.

Material Examined. *C.S.I.R.O. Division of Fisheries and Oceanography* (*Cronulla*) *Collection* (1 specimen): 17.8mm total length, *Warreen* Station 205/39, 34° 03′ S, 151° 11.5′ E, 4/8/39, N70, oblique tow, 0m–25m.

Description. 1 specimen (measurements in mm): head 2.0, snout 6.6, eye 0.5, cleft of mouth 1.1, postorbital 0.9, pectoral 0.4, snout-vent 13.5, depth just before eye 0.8, at pectoral origin 1.3, at midpoint between pectoral and vent 1.6, at vent 1.7. Branchiostegal rays and pectoral rays not yet obvious. Teeth—$\frac{\text{I + II}}{\text{I + II}}$ Myomeres 90 + 47 = 137. Last vertical blood vessel at myomere 65. Anterior margin of gall bladder at myomere 23.

Body elongate, much compressed except along head, moderately deep, the maximum depth contained about ten times in total length and vent placed about three-quarters of the way along body length. Head long, about one-ninth of total

length, conical, scarcely differentiated from trunk; snout moderately sharp, the dorsal profile slightly concave; nasal organ placed a short distance in front of eye; eye oval, directed anterodorsally, the lens relatively large and placed on the top of a very deep eyeball; cleft of mouth long, reaching almost to below posterior margin of eye; teeth in this specimen few in number, three in each jaw, consisting of a long, needle-like grasping tooth on the anterior tip of the snout followed by two smaller teeth; those on the lower jaw similar. Pectoral oval, about two-thirds of snout; dorsal and anal fins rudimentary; caudal fin broad but with ill-defined hypurals and fin-rays.

Pigmentation in formalin restricted to the chorioid of the eye and to a scattering of minute chromatophores over the surface of the extreme tips of the dorsal and anal fins. Ventral blood vessels to the viscera not numerous and with the last vessel lying at myomere 65; gall bladder readily visible at myomere 23.

REMARKS. The above larva is immediately distinguishable from all other leptocephali in the present collection of over 1,100 specimens in having a so-called "telescopic" eye and trunk pigment restricted to the caudal tip. The possession of a telescopic eye identifies the leptocephalus with Group VIII of Ancona (1928, pp. 112–114) which includes, amongst others, leptocephali of the family Synaphobranchidae; the absence of body pigment except on the caudal tip and the short snout which is not extended into a proboscis as in the *Leptocephalus rostratus* Schmidt—*L. proboscideus* Lea—*L. dolichorhynchus* Lea group restricts the identification further to *L. Synaphobranchus kaupi* Johnson (= *S. pinnatus* Günther) or *L. Histiobranchus bathybius* Günther (= *H. infernalis* Gill, see Castle, 1964a, p. 34). As indicated above, the present specimen has 137 myomeres and therefore cannot be referred to *Synaphobranchus kaupi* which has 142–151 vertebrae. *Histiobranchus bathybius*, widely distributed in the Indo-Pacific, has 126–140 vertebrae and therefore may be the adult of the present leptocephalus. However, *Synaphobranchus affinis* Günther is also widespread in the Indo-Pacific and has 131–138 vertebrae (see Castle, 1961, p. 20) and may also be the adult of the synaphobranch leptocephalus described above. It clearly belongs to the Indo-Pacific group of synaphobranch leptocephali without a conspicuous black lateral spot at the midpoint of the body referred to by Bruun (1937, p. 12) and which is most likely identifiable with *S. affinis*. Unfortunately, morphological distinctions between the larvae of *Synaphobranchus* and *Histiobranchus* have not been drawn, and in view of the very limited synaphobranch material in the present collection I am unable to further identify the present specimen. Although Bruun (1937, p. 4) is of the opinion that *Histiobranchus* should be united with *Synaphobranchus* on the similarity of the larvae of the two genera from the North Atlantic, I consider that adults of the two genera are sufficiently distinct for them to remain as separate genera and that it is general lack of pigment in both forms which accounts for the similarity of the larvae, especially in view of the fact that the distribution of pigment appears to be the major character which distinguishes leptocephali of genera in the same family.

DISTRIBUTION AND LOCATION OF SPAWNING AREAS. The single specimen of *L. Synaphobranchus affinis* or *Histiobranchus bathybius* is relatively small, being 17.8mm total length, and was taken just off Sydney in a depth of less than 25 metres, and because of its small size, probably quite close to the spawning area of the adult. The 11 specimens recorded by Bruun (1937, p. 12) from the Indo-Pacific range in size from 25mm to 89mm from the Pacific north-east of Tahiti westwards to New Guinea and to the South China Sea. The smallest specimen was captured off northern New Guinea. In view of the rather wide distribution of the larvae, therefore, it would be unwise to suggest a single spawning area off Sydney.

### Nettastomidae

Members of this family are rare eels, more typical of deep water, the morphology and relationships of which are so poorly known that the limits of the family are not clearly established. There are about seven genera and 15 species (Grey, 1956, p. 140) of which only two genera and species have been recorded from the south-west Pacific. Whitley (1935, p. 220) describes *Chlopsis finitimus* from North Queensland and the present author (1964c, in press) describes the larva of *Nettastoma melanurum* Rafinesque, 1810, from north of New Zealand. Larvae of this family in general have a sharp snout, the vent placed midway along the body, pectorals present or absent but often reduced and pigment in two conspicuous groups along the intestine. As larval *Nettastoma melanurum* have already been described (Castle, 1964c) I shall here give only brief comparative data on the two specimens in the present collection.

**L. Nettastoma melanurum** Rafinesque, 1810

1910. *L. Nettastoma melanurum* Rafinesque. Grassi, *Soc. Ital. Prog. Sci.*, Mem. I.
1964c. *L. Nettastoma melanurum* Rafinesque. Castle, *Trans. roy. Soc. N.Z., Zool.*, 5(7): 80.

Material Examined. *Centre d'Océanographie de l'Institut Français d'Océanie Collection* (1 specimen): 82.6m total length, IFO Station S 1m 1, 10 miles west of Bulari Pass, New Caledonia, 30/11/61, S1mH (1.0m plankton net, horizontal tow), ca. 70m. *C.S.I.R.O. Division of Fisheries and Oceanography* (*Cronulla*) *Collection* (1 specimen): 78.3mm total length, *Warreen* Station unknown, probably ca. 34° 04′ S, 151° 15′ E, ?/39, no other data.

Description and Remarks. Total lengths 78.3mm and 82.6mm, myomeres 76 + 159 = 235, 56 + 172 = 238, intestinal pigment spot at myomere 100 and 82. These two specimens agree well with the specimen I have already recorded (1964c) in number of myomeres (ca. 246) and in position of the deep, midlateral chromatophore posterior to the vent (myomere 104). Ancona (1928, pp. 60–61) records two specimens 14.5mm and 24mm total lengths from the Red Sea, both of which have between 155 and 200 myomeres, while Lea (1913, p. 32) records two specimens both of 27mm total length, which have about 190 myomeres. The present specimens are much larger than any of these, and it is possible that the much greater number of myomeres can be explained by this species adding myomeres as larval growth proceeds.

## Discussion

As this study shows, leptocephali belonging to the two deep-water families Nemichthyidae and Serrivomeridae make up a substantial portion of the present collection of eel-larvae from the Australasian region, or about one-sixth of the total number of 1,100 specimens. In contrast, the number of larvae of the Synaphobranchidae and Nettastomidae is insignificant. Bruun (1937, p. 22) records that larvae of the Synaphobranchidae are much more abundant in depths of 225m–300m. The majority of the present hauls were made in depths of less than 100m, so that at least in the case of this family the almost complete absence of their larvae in the collection may be explained by the relative shallowness of most hauls.

The abundance of larvae of *Nemichthys scolopaceus* in the collection compares well with the records of Roule & Bertin (1929) of about 650 larvae of this species from the Atlantic. Bauchot-Boutin (1959) record about 1,800 serrivomerid larvae from both the tropical Atlantic and Indo-Pacific, and with the numerous larvae of this family in the present collection shows that these leptocephali are also common constituents of the plankton of these areas. In view of the relative abundance of adult nemichthyid and serrivomerid eels in bathypelagic hauls taken in the south-west Pacific (Castle, 1964c, p. 83) the number of leptocephali of these groups in the

hauls which make up the present collection is not surprising. These eels, like anguillids and congrids, clearly have an extended larval life, and the chances of their leptocephali appearing in plankton hauls are thus much greater than for those eels with more transient larvae. The familial composition of hauls of eel-larvae may also be determined by marked differences in fecundity in the various eel families. Those eel groups in which the larval life is short and in which the larvae are thus subjected to fewer environmental hazards may possibly have a lower fecundity than those which typically have an extended larval period. This is a subject which must await further examination. Nevertheless, in the present collection only 10% of the 1,100 larvae are muraenid larvae compared with about 50% congrids and about 17% nemichthyids and serrivomerids. A further 10% belong to the Ophichthidae and 13% to eels of other families. In view of the well-known abundance of both species and individuals of muraenids and ophichthids in Indo-Pacific waters it is therefore a strong possibility that these groups typically have a short larval life.

The widely distributed collections of eel-larvae studied in the preparation of this paper indicate that the majority of the species of nemichthyids and serrivomerids discussed have a relatively wide spawning area in the tropical waters of the central and south-west Pacific. There appears to be no major barrier to dispersal of leptocephali taking place by way of the predominantly south-westward trend of subsurface currents from this spawning area through to New Caledonia, Queensland and New Zealand. Those larvae collected off Western Australia are probably derived from a spawning area in the north-east Indian Ocean.

## LITERATURE CITED


ANCONA, U. D', 1928. Muraenoidi (Apodes) del Mar Rosso e del Golfo di Aden. Materiali raccolti dal Prof. L. Sanzo nella campagna della R.N. "Ammiraglio Magnaghii" 1923–24. *Mem. R. Com. talassogr. ital.*, 146: 1–146, 5 pls.

BAUCHOT, M–L., 1959. Etude des larves leptocephales du groupe *Leptocephalus lanceolatus* Strömman et identification à la famille des Serrivomeridae. *Dana Rep.*, 48: 1–148, 105 figs, 2 pls.

BEEBE, W. & CRANE, J., 1937. Deep-sea fishes of the Bermuda Oceanographic Expeditions. Family Nemichthyidae. *Zoologica, N.Y.*, 22 (4) 27: 349–383, 22 figs.

BERTIN, L., 1936. Nouvelle contribution à l'étude des larves poissons apodes. (Les types de Kaup et de Regan au British Museum.) *Bull. Inst. océanogr. Monaco*, 706: 1–14, 6 figs.

BRUUN, A., 1937. Contributions to the life histories of the deep sea eels: Synaphobranchidae. *Dana Rep.*, 9: 1–31, 17 figs., 1 pl.

CASTLE, P. H. J., 1961. Deep-water eels from Cook Strait, New Zealand. ***Zool. Publ. Vict. Univ. N.Z.***, 27: 1–30, 6 figs.

——— 1963a. Anguillid leptocephali in the south-west Pacific. *Zool. Publ. Vict. Univ. N.Z.*, 33: 1–14, 3 figs.

——— 1963b. The systematics, development and distribution of two eels of the genus *Gnathophis* (Congridae) in Australasian waters. *Zool. Publ. Vict. Univ. N.Z.*, 34: 15–47, 10 figs.

——— 1964a. Deep-sea eels: Synaphobranchidae. ***Galathea Rep.***, 7 (2): 29–42, 2 figs.

——— 1964b. Congrid leptocephali in Australasian waters with descriptions of *Conger wilsoni* (Bl. & Schn.) and *C. verreauxi* Kaup. *Zool. Publ. Vict. Univ. N.Z.*, 37: 1–45, 11 figs.

——— 1964c. Eels and eel-larvae of the *Tui* Oceanographic Cruise 1962 to the South Fiji Basin. *Trans. roy. Soc. N.Z., Zool.*, 5(7): 71–84, 1 fig.

GRASSI, G. B., 1910. Contribuzione allo studio dello sviluppo dei Muraenoidi. *Soc. Ital. Progr. Sci.*, Memoria 1.

Grey, M., 1956. The distribution of fishes found below a depth of 2000 metres. *Fieldiana, Zool.*, 36 (2): 75–337.

Pappenheim, P., 1914. Die Tiefseefische. *Dtsch. Südpol Exped.*, 15, Zoologie, 7 (2): 163–200, 2 pls.

Regan, C. T., 1916. Larval and post-larval fishes. *Brit. Antarct. Terra Nova Exped., 1910,* Zoology, 1 (4): 125–156, 5 figs, 10 pls.

Roule, L., and Bertin, L., 1929. Les poissons apodes appartenant au sous-ordre des Nemichthyidiformes. *Dana Rep.*, 1 (4): 1–113, 57 figs, 9 pls.

Whitley, G. P., 1935. Studies in ichthyology. No. 9. *Rec. Aust. Mus.*, 19 (4): 215–250, 11 figs, 1 pl.

P. H. J. Castle, M.Sc., Ph.D.,
Department of Zoology,
Victoria University of Wellington,
P.O. Box 196, Wellington, N.Z.