A Large Leptocephalid (Teleostei, Apodes) from off South Westland, New Zealand

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Abstract

Leptocephalus giganteus n.sp. from shallow water off South Westland, New Zealand, is based on a single specimen of 893 mm total length having 466 (+ ? 20) V-shaped myomeres; length of head equals greatest depth of body or one-fiftieth of total length; head compressed, dorsal profile without concavity and uniformly tapering before eye; snout elongate, compressed, length 1.6 in head; jaws powerful, teeth $\frac{22-24}{1+20-21}$; pigment in groups of chromatophores at intervals of two to four segments along ventral margin behind head; vent subterminal; fin-rays absent; dorsal fold commencing at about myomere 45.

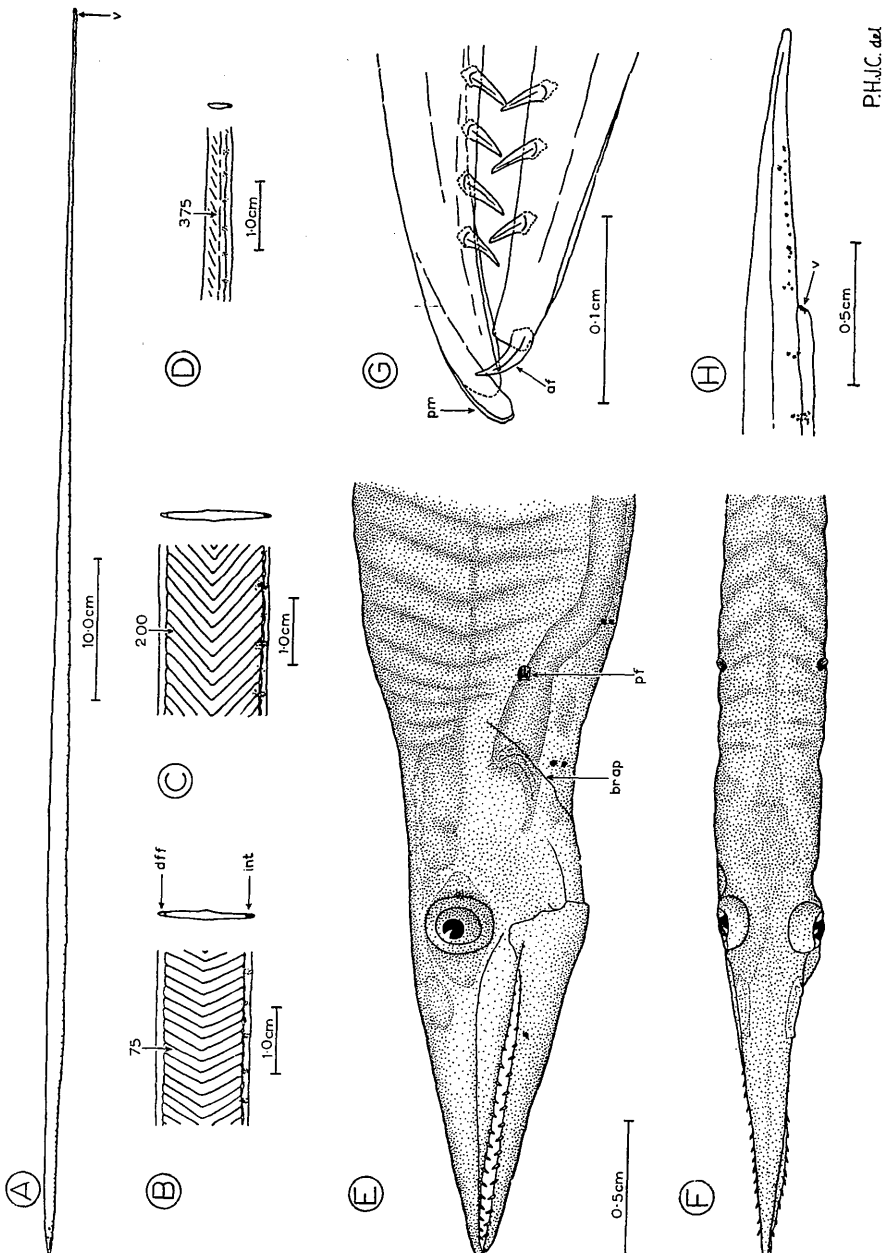
Leptocephali are seldom of great size. Those of *Anguilla* are about 45 mm just before metamorphosis. Those of *Nemichthys scolopaceus* Richardson, reaching in extreme cases about 253 mm before transition to the young eel takes place, are the largest commonly known leptocephali for whom the adult is known. Only a few eel larvae of a size greatly exceeding that for *N. scolopaceus* have ever been recorded. These so-called "giant" forms were taken by the Danish *Dana* Oceanographic Expeditions and were in the order of 1,800 mm in length. The adult is not yet identified. Two of these specimens were briefly mentioned by Bertin (1954, pp. 312–313) who considers that since they have about 450 myomeres, they might belong to the genus *Nemichthys*. Bertin gives no further data and the specimens have not been named.

In this account a leptocephalus of 893 mm total length, about half the length of the *Dana's* "giant" forms, is recorded and described from a specimen taken on July 16, 1958, in shallow water off the coast of South Westland, New Zealand, tangled in the edge of a commercial otter trawl. The depth can be presumed to be in the order of 20 to 50 fathoms. The author would here like to express his thanks to the Director of the Dominion Museum, Wellington, New Zealand, and to Mr. J. M. Moreland of this institution, by whom the specimen was communicated; also to Professor L. R. Richardson, Department of Zoology, Victoria University of Wellington, for his encouragement and help during the preparation of this account.

Leptocephalus giganteus n.sp.

Type. Dominion Museum No. 2603; 893 mm total length; off South Westland, New Zealand, July 16, 1958; shallow commercial otter trawl. Measurements in mm: preanal 883 (vent subterminal); head 18·1; snout 11·5; prepectoral 21·0; eye 2·2; depth 18·0; depth at neck 7·0; teeth $\frac{22-24}{1+20-21}$; myomeres approx. 486 (466 counted, about 20 by estimation).

Description. An extremely attenuated animal, considerably deeper and more ribbon-like along the anterior half than the posterior, and tapering posteriorly. Head small, very



TEXT-FIG. 1.—*Leptocephalus giganteus* n.sp. Type, 893 mm. T. L. Fig. A—Lateral view (level of vent indicated by arrow). Figs. B-D—Lateral view of representative sections of trunk (myomere levels indicated by arrows). Figs. E-F—Lateral and dorsal views of head. Fig. G—Lateral view of anterior tip of snout and lower jaw. Fig. H—Lateral view of vent and caudal region. af, anterior fang; br ap, branchial aperture; dff, dorsal fin-fold; int, intestine; pf, pectoral fin; pm, premaxillae; v, vent.

short in relation to length of body but conspicuous by its elongate, compressed, tapering snout with numerous fang-like teeth and large gape. Reduced, fleshy, flap-like pectorals present. Dorsal fin represented by a low fold without rays; anal and caudal fins not represented. Vent placed subterminally. Myomeres numerous, V-shaped, distinct along the anterior two-thirds of the body, less conspicuous posteriorly and not apparent from shortly before the vent to the tip of the tail.

Head 49 in total length, acutely tapering and compressed before the eye, snout 1.6 in head; dorsal profile of snout almost straight, not concave, with rostral cartilage forming a slight swelling in the dorsal profile just in advance of the eye. Jaws extended, compressed, acute anteriorly, bearing 22 to 24 teeth on each maxilla and 20 to 21 on each dentary. Teeth obtusely triangular in section with the base of the triangle medial; anterior 14–16 teeth on each element tall, acutely tapering, fang-like and tending to be directed forwards and outwards, especially the first eight; remaining teeth on each element similar in section but smaller and progressively reduced towards angle of gape. Three to four of the posterior teeth on the dentary are doubled so as to present a medially-directed and a laterally-directed tooth. Tip of lower jaw bearing a pair of anteriorly-directed fangs larger than any of the succeeding teeth (these are not included in the count of teeth previously given). Articulation of lower jaw just in advance of the level of posterior margin of eye; eye not telescopic, horizontal diameter 5.2 in snout, clearly less than the vertical. A large nasal organ distinct just in advance of the eye. Branchiostegal rays not developed. Branchial apertures about two-thirds of the way along the postorbital length, lateral, oblique, confluent below, free from the isthmus, extending to about the midlateral level on the head. Vent distinct, placed subterminally only 10 mm from the tip of the caudal region.

Dorsal fin present as a low fold, without rays, originating rather indeterminately some distance behind the level of the pectoral fin, that is, at about the level of the 45th myomere; anal and caudal fins not represented; pectoral fin a minute, reduced, fleshy flap with numerous delicate actinotrichi.

Established myomeres 466 counted, but a space equivalent to 20 myomeres from shortly before the level of the vent to the tip of the tail lacks myomeres, so that the fully-developed larva may have at least 486; myomeres V-shaped with only the extreme dorsal and ventral ends of the myosepta turning slightly forwards. Angle between dorsal and ventral halves of each segment obtuse anteriorly, diminishing posteriorly so that at the level of the 200th segment the angle is about 80°. Myomeres about 1.75 mm wide at the 75th segment, wider in the middle of the body where they are about 2.25 mm wide at the 200th myomere, progressively narrower posteriorly.

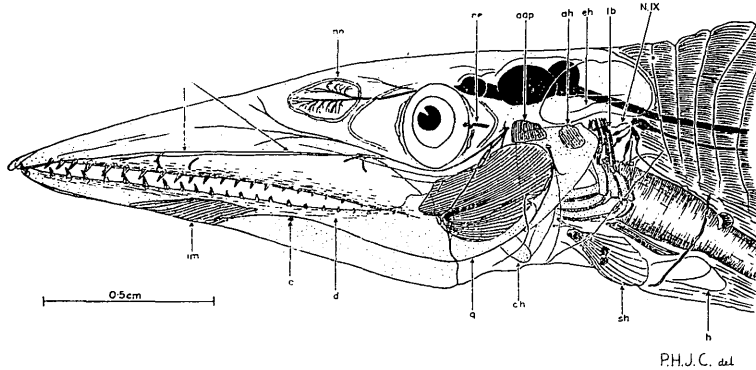
Body translucent in formalin, with pigment confined to a regular, ventrolateral series of grouped chromatophores before the level of the vent and an irregular series postanally. The anterior 15 groups of chromatophores before the level of the 45th myomere are separated by intervals of three segments, are bandlike in appearance, each band placed transversely across the ventral aspect, continuing on to the ventrolateral aspect and not extending above the gut. The succeeding 40 groups of chromatophores to the level of about the 210th myomere are separated by intervals of about four segments; along this section there is a tendency for the anterior groups to continue the banded appearance of those of the preceding section but posteriorly the pairs of grouped chromatophores on each ventrolateral aspect fail to coalesce ventrally and intervening smaller groups are present. The latter gradually increase in size relative to the former until the groups are very nearly equal in size near the vent. From the 210th myomere to the 300th, the groups of chromatophores are separated by intervals of three myomeres; posterior to this by about two segments. Postanally there are 19 separated chromatophores, irregularly spaced. On the head one large chromatophore is placed halfway along the lateral surface of the right mandible, a smaller one on the left. A few small chromatophores are scattered over the branchial region on the right side. No lateral line pores are present and lateral line organs are not apparent.

The posterior position of the vent, the lack of fin-rays, the numerous larval teeth, the single naris and the abundance of larval pigment indicate that the specimen of *Leptocephalus giganteus* is at an early stage in larval development as is shown also by the general lack of ossification in the skeleton. The entire neurocranium and most of the splanchnocranium are cartilaginous with vertebral column and supporting elements of the median fins not apparent. The elongate rostral cartilage seems massive, makes up the major portion of the snout, and is excavated posterodorsally to receive the large, undivided nasal organ on either side. Roofing the cranial vault there is a solid plate of cartilage continuous anteriorly with the rostral cartilage and laterally with the rather indistinct supraorbital ridges. On the posterolateral aspect of the neurocranium a large and conspicuous otic capsule is developed, but the external horizontal semicircular canal is distinct. Except for the rectangular quadrate which articulates directly with meckel's cartilage anteriorly, the cartilaginous upper jaw cannot be recognised and may be reduced or absent as in adult Nemichthyidae. Small, paired, ossified premaxillae are firmly attached to the anterior end of the rostral cartilage. The maxillae are

ossified as thin sheets on either side of the rostrum and bear the conspicuous larval teeth of the upper jaw. A large meckel's cartilage makes up the major portion of the lower jaw, but is overlaid dorsolaterally by the narrow, thinly-ossified dentary bearing larval teeth. There is no obvious distinct articular element. The hyoid arch is represented by the hyomandibula, the epihyal and the ceratohyal with basihyal not observed; the hyomandibula is broadly triangular, directed obliquely forwards and perforated by the foramen for R. hyomandibularis N. VII. Opercular elements are not obvious. The branchial skeleton is cartilaginous, but nevertheless almost fully represented with gill filaments present on the epi- and ceratobranchials. The fifth branchial arch is reduced. A thin, elongate, curving cleithrum is present just in advance of the pectoral flap.

The muscular system is well developed at this stage. The large m. adductor mandibulae originates over the anterior third of the lateral surface of the hyomandibula and the upper half of the quadrate and is inserted on to the posterodorsal angle of the meckel's cartilage. Just above the most dorsal extremity of this muscle lies a small m. adductor arcus palatini and posterior to this the smaller m. dilator operculi rising from preotic and mesotic origins respectively. The eye muscles are distinct. The mm. levatores branchiales are conspicuous and consist of four elongate, narrow, external levators and one internal levator, this latter being attached to the first branchial arch. Ventral muscles present are the m. intermandibularis and the m. sternohyoideus (= claviculohyoideus). The latter has not yet established an observable skeletal origin.

With the exception of the tractus opticus, the nn. oculomotores and the n. opticus which are obscured and cannot be located, the cranial nerves are immediately apparent in lateral and dorsal views. T. olfactorius extends forwards above the eye as a thick trunk dividing terminally into two ramifying branches on the as yet undivided nasal organ. Nn. trigeminalis and facialis arise close together just behind the eye, N.V. dividing proximally into five branches. (1) R. cutaneous quinti, a short nerve passing dorsally, (2) R. orbitonasalis, passing forwards above the eye and nasal organ, (3) R. maxillaris, a long and much-divided nerve to the snout and maxilla, (4) R. mandibularis, to the posterior margin of meckel's cartilage, and (5) R. palatonasalis (distally obscured), to the parasphenoid region; N. VII is proximally obscured, but the perforation of the hyomandibula by the foramen for this nerve is clear, the nerve sending short branches to the hyoid arch and a long branch (R. mandibularis N. VII) to the lower jaw. N. glossopharyngeus is first apparent posterior to the levator muscles of the branchial arches and carries a small ganglion half-way along its path to the first branchial arch. The branches of N. vagus are conspicuous, and all except the innervation of the reduced fifth arch are ganglionated shortly after the exit of the vagus from the cranium. R. visceralis N. X turns ventrally at the level of the fifth arch to pass along the dorsal aspect of the oesophagus; R. lateralis N. X is thicker and can be traced to the level of about the 35th myomere. The spinal cord is rather indistinct but it can also be traced to about the same level.



TEXT-FIG. 2.—*Leptocephalus giganteus* n.sp. Type, 893 mm T. L. Lateral view of head region to show major anatomical structures. aap, m. adductor arcus palatini; c. chromatophore; ch, ceratohyal; d, edge of dentary; do, m. dilator operculi; eh, external horizontal semicircular canal; h, heart; im, m. intermandibularis; lb, mm. levatores branchiales; no, nasal organ; q, quadrate; r, edge of rostral cartilage; re, m. rectus externus; sh, m. sternohyoideus; N. IX, N. glossopharyngeus.

The heart is distinct and short lengths of the ventral and dorsal aortae as well as afferent and efferent branchial arteries can be traced.

DISCUSSION

Few external characters survive the metamorphosis from leptocephalus to juvenile eel. Typically, there is a loss of larval teeth, the snout becomes relatively shorter, the vent moves forwards, the body becomes rounder, segmentation becomes less obvious, and larval pigmentation is replaced by juvenile colouration. The morphological features of larvae diverge so markedly from those of the adult that the systematic determination of a leptocephalus can be made with our present knowledge only in terms of the number of myomeres. This number remains almost constant through the metamorphosis to the juvenile and to the adult and also appears to be constant within limits for each species although two or more species may have approximately the same number of myomeres. With the number at about 480, the leptocephalus described here can be referred at this time to only one known species in the whole of the Apodes, *Nemichthys scolopaceus,* in which the myomeres number from 450 to 500 or more in the adult. In all other eels the myomeres never exceed 300 in number, the majority having less than 200. *N. scolopaceus* has been recorded from New Zealand waters and is known from a single specimen of 835 mm from Cook Strait (Richardson and Garrick, 1953). Roule and Bertin (1929, pp. 61–67) and Beebe and Crane (1937, pp. 357–365) have fully described the leptocephalus of *N. scolopaceus.* This metamorphoses at a maximum of 253 mm. All the larval stages agree in having less than 450 W-shaped myomeres, of which 93–254 lie before the level of the vent, an elongate snout concave in lateral profile, subterminal vent only in the smaller specimens, and with large chromatophores scattered laterally on the body as well as minute ones along the dorsal aspect of the intestine, features which are not present in the leptocephalus described, so that the equivalence in the number of myomeres cannot be used to assign this larva to *N. scolopaceus.* Roule and Bertin also described a larger leptocephalus, designated Leptocephalus B, having 179–320 preanal myomeres and reaching 359 mm just before metamorphosis, characters which preclude the identification of this larva with *L. giganteus.* The adult of Leptocephalus B is at present unknown, though as Beebe and Crane suggest, it is probably a nemichthyid-like form.

The length of the specimen described above is sufficient to warrant speculation as to the size of the adult. *L. giganteus* shows no indication of approaching metamorphosis and its length may well be less than that at which metamorphosis should take place. It is most regrettable that the *Dana* "giant" leptocephalids have not been described in sufficient detail to allow comparison of the present specimen with one or other of these extremely large creatures. Bertin (1954, p. 313) records that there have been suggestions that the *Dana* "giant" leptocephali may represent the larvae of a giant eel. These suggestions were based on the known growth of *Anguilla* from a leptocephalus of 45 mm to an adult of about 800 mm, an increase in length in the order of about 18 times that of the leptocephalus. This would suggest that the 1,800 mm "giant" leptocephali would reach an adult length in the order of 30 metres, compatible with the length of some of the anguilliform "sea-monsters" which have been recorded. Bertin considers it improper in the present state of our knowledge to use the same ratio in what may be widely differing eels. Nevertheless, if we use the far lower ratio known in *Nemichthys scolopaceus,* in which the length of the grown adult is only three to six times that of the leptocephalus, the specimen here would develop to an eel of some 2·7 m to 5·4 m, approximately 9 to 18 feet. The Mediterranean and Indo-Pacific eel, *Ophisurus serpens* L. found also around the New Zealand coast is recognised as probably the largest known eel, and is reported to reach about 10 feet in length in tropical waters (Smith, 1953, p. 391). *O. serpens* has only 210 myomeres and a posteriorly-directed suspensorium, characters pre-

venting identification of *L. giganteus* with this eel as well as with other eels having the suspensorium directed in a like manner. Accordingly, the present specimen is described as the type of a new species, and it can be assumed that there is a very large and as yet unknown eel in our waters, possibly a bathypelagic animal as it has not been collected locally. It has been suggested that this specimen is pathologically gigantic, having failed for one reason or another to have metamorphosed normally. If this were the case, it would be reasonably expected that the specimen had approached metamorphosis at a smaller size, but the subterminal position of the vent, the V-shaped form of the myomeres, the strongly developed larval teeth, the simple form of the nasal organ, the absence of fin-rays, the undeveloped state of the pectoral girdle and of cranial elements, all agree with the conclusion that the specimen is not pathological and has not yet reached full larval growth.

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