

Papers and Proceedings of the Royal Society of Tasmania, Volume 112, 1978.

(ms. received 5.1.1978)

OBSERVATIONS ON SOME TASMANIAN FISHES : PART XXIV

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(with six tables and three text-figures)

ABSTRACT

ISURIDAE. *Isurus oxyrinchus* Rafinesque, 1810: Tasmanian example described and figured; exhibits one feature stated to be diagnostic of *I. paucus* Guitart Manday, 1966; comparison with nominal species; some aspects of body form specified (some comparison with other species).

MELANOSTOMATIADAE. *Echiostoma barbatum* Lowe, 1843: first Australian report of species; Tasmanian specimen from alimentary canal of *Hyperoglyphe porosa* (Richardson, 1845), general description; also noted, two Australian Museum examples from New South Wales and Queensland or New South Wales.

GONORHYNCHIDAE. *Gonorhynchus greyi* (Richardson, 1845): general observations; location of paired and of unpaired fins at integral nodes along anteroposterior axis of fish in a loglog plot.

ANTENNARIIDAE. *Echinophyrne crassispina* McCulloch & Waite, 1918: first Tasmanian record; general observations; some aspects of body form specified : key to Tasmanian species.

CARAPIDAE. *Carapus homei* (Richardson, 1846): Tasmanian status doubtful. *Carapus rendahli* Whitley, 1941: first satisfactory Tasmanian record; specimen described : key to reported Tasmanian species.

PLESIOPIDAE. *Trachinops caudimaculatus* M'Coy, 1890: Tasmanian status doubtful. *Trachinops rodwayi* (Johnston, 1902): a local *Trachinops* described and figured; referred to Johnston's species, hitherto unrecognized since its description and hitherto treated as synonymic with M'Coy's Victorian species : key to reported Tasmanian species.

APOGONIDAE. *Gronovichthys lemprieri* (Johnston, 1883): generic status; observations on new material; scaly para-anal sheath reported; some aspects of growth and form examined.

CENTROLOPHIDAE. *Schedophilus huttoni* (Waite, 1910): first Tasmanian record (some earlier reports apparently based on (incorrect) synonymization with *Tubbia tasmanica* Whitley, 1943); general account of specimen, including aspects of body form. *Coroplopus dicologlossops* Smith, 1966, from South Africa, considered a synonym of Waite's species.

OSTRACIONTIDAE. *Laetoria diaphana* (Bloch & Schneider, 1801): second reported Tasmanian example; specimen described; some aspects of body form specified (some comparative data from undetermined Queensland species).

INTRODUCTION

This paper follows the general plan of others in the series: an exceptional feature is the inclusion, along with a Tasmanian record, of a notice of two extralimital examples of a species, *Echiostoma barbatum* Lowe, 1843, now first reported from Australia. Linear measurements are given throughout, unless otherwise specified, in millimetres, the name of the unit commonly being omitted. The symbols *Ls*, *Lt*, *TLs*, *TLt* denote standard length, total length, thousandths (permillages) of standard length, thousandths of total length, respectively. Registration numbers denoted by Q.V.M. are those of the Queen Victoria Museum and Art Gallery, Launceston. Certain other conventions are noted in earlier contributions.

## Observations on some Tasmanian Fishes

## Family ISURIDAE

Genus *ISURUS* Rafinesque, 1810

- Isurus* Rafinesque, 1810, CARATT. GEN. SPEC. SICIL., p.11. Type-species, *Isurus oxyrinchus* Rafinesque.  
*Oxyrhina* L. Agassiz, 1835, POISS. FOSS., FEUILL. ADDIT., pp.71-86. Type-species, '*Lamna oxyrhina* Cuvier and Valenciennes MSS' = *Isurus oxyrinchus* Rafinesque.  
*Oxyrrhina* Bonaparte, 1846, CAT. PESC. EUROP., p.17. Type-species, *Oxyrhina gomphodon* Müller & Henle = *Isurus oxyrinchus* Rafinesque.  
*Plectrosoma* Gistel, 1848, NATURG. TIER., p.10; to replace *Oxyrhina* L. Agassiz, 1835.  
*Isuropsis* Gill, 1862, Ann. Lyc. Nat. Hist. N.Y., 1, p.397. Type-species, *Oxyrhina glaucus* Müller & Henle.

*Isurus oxyrinchus* Rafinesque, 1810  
 (fig. 1)

- Isurus oxyrinchus* Rafinesque, 1810, CARATT. GEN. SPEC. SICIL., p.12, pl. 13, fig. 1.  
 Type locality: Sicily.  
*Isurus oxyrinchus* Garman, 1913, Mem. Mus. Comp. Zool. Harv., 36, p.37: Bigelow & Schroeder, 1948, *Sears Found. Mar. Res., Bull.*, 1, p.124, figs 18, 19: Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 1, p.94, pl. 1, and *ibid.*, 1958, 10, p.134, fig. 2: Garrick & Schultz, 1963, in SHARKS AND SURVIVAL (Gilbert ed.), p.17, fig. 5: Lineaweaver & Backus, 1970, NAT. HIST. SHARKS, p.97, unnumbered figs on pp.98, 99, 103: Scott, 1974, *Tasm. Fisher. Res.*, 8(1), p.7, fig. 2b: Garrick, 1967, *Proc. U.S. Nat. Mus.*, 118, p.674, figs 6, 9, pl. 2.  
*Isurus oxyrhynchus* [sic] Thomson, 1974, FISH OCEAN AND SHORE, p.113.  
*Isurus spallanzanii* Rafinesque, 1810, CARATT. GEN. SPEC. SICIL., pp.45, 60. Type locality: Sicily.  
*Oxyrhina gomphodon* Müller & Henle, 1838, SYST. BESCHR. PLAGIOST., pp.68, 191, pl. 28.  
*Oxyrhina gomphodon*: Cross, 1885, *Pap. Proc. R. Soc. Van Diemen's Land*, 3(1), p.81.  
*Oxyrhina glauca* Müller & Henle, 1838, SYST. BESCHR. PLAGIOST., p.69, pl. 29. Type locality: 'Java' = Japan. [There is good reason to believe the original locality record is an error: following comments by Schlegel (FAUN. JAP., 1842, p.302) it is now generally accepted the type came from Japan.]  
*Oxyrhina dekayi* Gill, 1861, *Proc. Acad. Nat. Sci. Philad.*, p.60.  
*Isurus glaucus*: Garman, 1913, *Mem. Mus. Comp. Zool. Harv.*, 36, p.38: Ogilby, 1916, *Mem. Qld. Mus.*, 5, p.74 ('to at least 3.66 mm!'): McCulloch, 1919, *Aust. Zool.*, 1(7), p.223, pl.17, fig.22a; and 1927, FISH. FISHLIKE ANIM. N.S.W., ed. 2, p.8, pl.2, fig.22a (text cites pl.17, which is plate number inadvertently retained from McCulloch, 1919); and 1929, *Aust. Mus. Mem.*, 5(1), p.15: Waite, 1921, *Rec. S. Aust. Mus.*, 2(1), p.21, not fig. 27, which is *Lamna nasus* (Bonnaterre, 1788); and 1923, FISH. S. AUST., p.39, not unnumbered fig. on p.39, which is *Lamna nasus* (Bonnaterre, 1788): Lord & Scott, 1924, SYNOP. VERT. ANIM. TASM., pp.6, 23, unnumbered fig. on p.23: McCulloch & Whitley, 1925, *Mem. Qld. Mus.*, 8(2), p.129: Philipps, 1926, *Trans. Proc. N.Z. Inst.*, 56, p.530, pl.87 (type specimen of *Isurus mako* Whitley, 1929); and 1927, *N.Z. Mar. Dept. Fisher. Bull.*, 1, p.8: Whitley, 1929 (*ex Johnston ms*), *Pap. Proc. R. Soc. Tasm.*, (1928), p.45: Moorhouse, 1938, *S. Aust. Nat.*, 19(2), p.245, not fig. 21, which is *Lamna nasus* (Bonnaterre, 1788): Roedel & Ripley, 1950, *Calif. Fish Game, Fish Bull.*, 75, p.44, fig.28: Munro, 1956, HANDBK AUST. FISH. in *Fisher. Newsl.* (now *Aust. Fisher.*) 15(7), p.3, fig. 13 (of HANDBK): Garrick & Schultz, 1963, in SHARKS AND SURVIVAL (Gilbert ed.), p.17, fig.6: Stead, 1963, SHARKS RAYS AUST. SEAS, pp.33, 199, fig.16: Marshall, 1964, FISH. GREAT BARRIER REEF AND COASTAL WAT. QLD, p.25, not pl.10, fig. 33, which is *Lamna nasus* (Bonnaterre, 1788); and 1966, TROP. FISH. GREAT BARRIER REEF, p.165, not pl.10, fig.33, which is *Lamna nasus* (Bonnaterre, 1788): Scott, Glover & Southcott, 1974, MAR. FRESHW. FISH. S. AUST., p.32, unnumbered fig. on p.32.

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- Isurus glacius* [sic]: Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p.62; and 1927, *J. Pan-Pac. Res. Inst.*, 2(4), p.12.
- Isurus mako* Whitley, 1929, *Rec. Aust. Mus.*, 17(3), p.101. Type locality: New Zealand. (Based on *Isurus glaucus*: Phillipps, 1926, *Trans. Proc. N.Z. Inst.*, 56, p. 530, pl. 87).
- Isurus mako*: Phillipps, 1932, *N.Z. J. Sci. Tech.*, 13, p.227. Type locality: South Africa.
- Isurus bideni*: Whitley, 1940, *FISH. AUST.*, 1, p.124; Barnard, 1949, *Ann. S. Afr. Mus.*, 36, p.342.
- Isurus cepedii*: Fowler, 1945, *Monogr. Acad. nat. Sci., Philad.*, 7, p.43, figs 3,4.
- Isurus tigris*: Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 6, pp. 91, 92, 93, 96, pl.1, text fig. 1.
- Isurus tigris tigris* Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 6, p.96 (habitat, Atlantic).
- Isurus tigris africanus* Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 6, p.96, pl. 1 (legend, *Isurus tigris* Atwood [= (Atwood)]). Type locality: Algoa Bay (habitat, South Africa).
- Isurus tigris mako* Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 6, p.96 (habitat, Australasia).
- Isurus africanus* Smith, 1958, *Rhodes Univ. Ichth. Bull.*, 10, p.134. Type locality : Algoa Bay.
- Isuropsis glaucus*: Gill, 1864, *Ann. N.Y. Lyc.*, 7, p.398.
- Isuropsis dekayi*: Gill, 1864, *Ann. N.Y. Lyc.*, 7, p.409.
- Isuropsis glauca*: Zeitz, 1908, *Trans. R. Soc. S. Aust.*, 32, p.321.
- Isuropsis* sp. Whitley, n.d. (1958?) *AUST. ENCY.*, 8, 82.
- Isuropsis mako*: Whitley, 1934, *Mem. Qld Mus.*, 10(4), p.194; and 1940, *FISH. AUST.*, 1, p.122, figs 129, 131, not fig. 130, which is *Lamna nasus* (Bonnaterre, 1788); and n.d. (1958?) *AUST. ENCY.*, 5, p.467, not unnumbered fig., which is *Lamna nasus* (Bonnaterre, 1788); and, 1963, in *SHARKS AND SURVIVAL* (Gilbert ed.), p. 337, fig. 2(6); and 1964, *Proc. Linn. Soc. N.S.W.*, 89(1), p.33; Phillipps, 1946, *Domin. Mus. Rec., Zool.*, 1(2), p.8, fig.2: Scott, 1962, *MAR. FRESH WAT. FISH. S. AUST.*, p.28, not unnumbered fig., which is *Lamna nasus* (Bonnaterre, 1788): Coppleson, 1962, *SHARK ATTACK*, 2nd ed., p.22, fig. 6 on p.22; Goadby, 1968, *SHARKS OTHER PRED.* *FISH. AUST.*, p.20, unnumbered figs on pp. 21, 59.
- Isuropsis oxyrinchus*: Whitley, 1968, *Aust. Zool.*, 15(1), p.8.
- Lamna oxyrhina*: L. Agassiz, 1838, *POISS. FOSS.*, 3, p.86.
- Lamna punctata* Storer, 1839, *REPT. FISH.*, p.185, pl.3, fig.2. Type locality : Bermuda. Not *Lamna punctata* De Kay, 1842, *ZOOL. N.Y.*, *FISH.*, p.352, pl.63, fig.206 (New York) = *Isurus paucus* Guitart Manday, 1966, *Poeyana* (ser. A), 15, p.1, 3 figs, nom. nov. for De Kay's species (Cuban waters).
- Lamna latro* Owen, 1853, *CAT. OSTEOL. ROY. COLL. SURGEONS*, 1, p.96.
- Lamna glauca*: Günther, 1870, *CAT. FISH. BRIT. MUS.*, 8, p.391; Ramsay, 1881, *Proc. Linn. Soc. N.S.W.*, 5(1), p.96; Macleay, 1882, *Proc. Linn. Soc. N.S.W.*, 6(2), p.357.
- Lamna spalanzanii*: Günther, 1870, *CAT. FISH. BRIT. MUS.*, 8, p.380; Day, 1878, *FISH. INDIA*, 4, p.722, pl.186, fig.2: Phillipps, 1926, *Trans. Proc. N.Z. Inst.*, 56, p.530.
- ? *Lamna cornubica*: Johnston, 1883, *Pap. Proc. R. Soc. Tasm.* (1882), p.138; and 1891, *ibid.*, p.17 (p.38 of reprint). Probably not *Squalus cornubicus* Gmelin, 1789 = *Squalus nasus* Bonnaterre, 1788 = *Lamna nasus* (Bonnaterre, 1788) : cf. Lord & Scott, 1924, p.23.
- Lamna guntheri* Murray, 1884, *Ann. Mag. Nat. Hist.*, ser. 5, 13, p.349. Type locality: India.
- Lamna huilobrii* Philippi, 1887, *Ann. Univ. Chile*, 71.
- Lamna guntheri*: Day, 1888, *FISH. INDIA, SUPPL.*, p.810: Smith, 1957, *Rhodes Univ. Ichth. Bull.*, 6, p.94.
- Lamia nasus* Lahille, 1928, *Ann. Mus. Nac. B. Aires*, 34, p.310.
- Squalus cepedii* Lesson: 1830, *VOY. 'COQUILLE', ZOOL.*, 2, p.93. Type locality: Equatorial Atlantic.

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*Carcharias tigris* Atwood, 1869, *Proc. Bost. Soc. nat. Hist.*, 12, p.268. Type locality: Gulf of Mexico.

Synonymy. No attempt has been made in the above table of synonymy to cope with the very extensive overseas literature, the material collated having the two limited aims, first, of presenting a tolerably representative selection of Australian sources, secondly, of enumerating (usually with citation of only a primary reference) the more important names that have at various times been given to this shark.

The several times repeated notation, 'not fig., which is *Lamna nasus* (Bonnaterre, 1788)' is occasioned by the reproduction in a number of Australian texts of a figure originally presented by Waite (1921, fig.27), the shark this depicts evidently being referable not to *Isurus* but to *Lamna*, as these genera are conventionally understood, since, as pointed out by Smith (1957, p.91) the dorsal origin is anterior to the hind pectoral angle, and, moreover, a secondary caudal keel, the presence of which is characteristic of the latter genus, is clearly visible in the original illustration — not always readily discernible in reproductions (Smith notes that in publishing a version of this figure as an illustration of *Isurus glaucus* Barnard (1927, pl. 1, fig. 6) deleted the extra keel).

Material. A male, length to origin of upper caudal lobe 698, total length 857, caught east of Cape Barren Island, Bass Strait, 16 February 1977, by Mr B. Bensemann, Q.V.M. Reg. No. 1977/5/11.

Detailed and accurate descriptions of *Isurus* species are rare (Smith, 1957, p.51) and reliable depictions are markedly less numerous in scientific works than as photographs in angling publications (on which latter some rather unsatisfactory systematic conclusions have been based). No comprehensive series of dimensions such as the 'set of standard measurements for comparative and biometric studies of Australian sharks' devised by Whitley (1943b) is available for any Australian isurid, and morphometric data for examples of *Isurus* from our waters are virtually confined to some measurements and proportions recorded in two papers by Whitley (1931, 1934a). A welcome addition to knowledge of *Isurus* in the Australasian region is the recent comprehensive review of the genus by Garrick (1967). A detailed description of the present specimen follows; further, opportunity has been taken to examine some aspects of general form, particularly those features exhibiting metrically specifiable patterns. Though identifiable as *I. oxyrinchus* Rafinesque, 1810, the specimen possesses one feature stated to be characteristic of *I. paucus* Guitart Manday, 1966.

Dimensions. A standard schedule of measurements of sharks has been proposed by Whitley (1943b, pp.114-115). Data for the present specimen in accordance with this scheme are set out in the next three paragraphs, all dimensions being in millimetres.

Head measurements:- H1-H8. Length of head to first gill slit 190. Length of head to last gill slit 230. Tip of snout to anterior margin of eye 65. Breadth of snout immediately before eyes 52. Snout [tip] to origin of pectorals 215. Snout [tip] to origin of ventrals 487. Eye, horizontal diameter 19. Eye, vertical diameter (outside nictitating membrane, where present) 20. Interorbital 59. Eye to spiracle [spiracle not detected]. Length of nostril [anteroposterior] 3.5 [oblique] 9. Internarial, between posterior angles 36. Preoral length 58. Width of mouth (distance between angles) 70. [H15, H16 upper, lower labial fold — no distinct folds present; a shallow groove, 8 long, running backward and slightly outward from angle of mouth]. Height of first gill opening 72.5. Height of last gill opening 67.

Body measurements:- B1-B9. Length, snout [tip] to upper caudal pit 698. Length, snout [tip] to vent (middle) 507. Predorsal length 327. Depth at origin of first dorsal 138. Breadth below origin of first dorsal 120. Depth of caudal

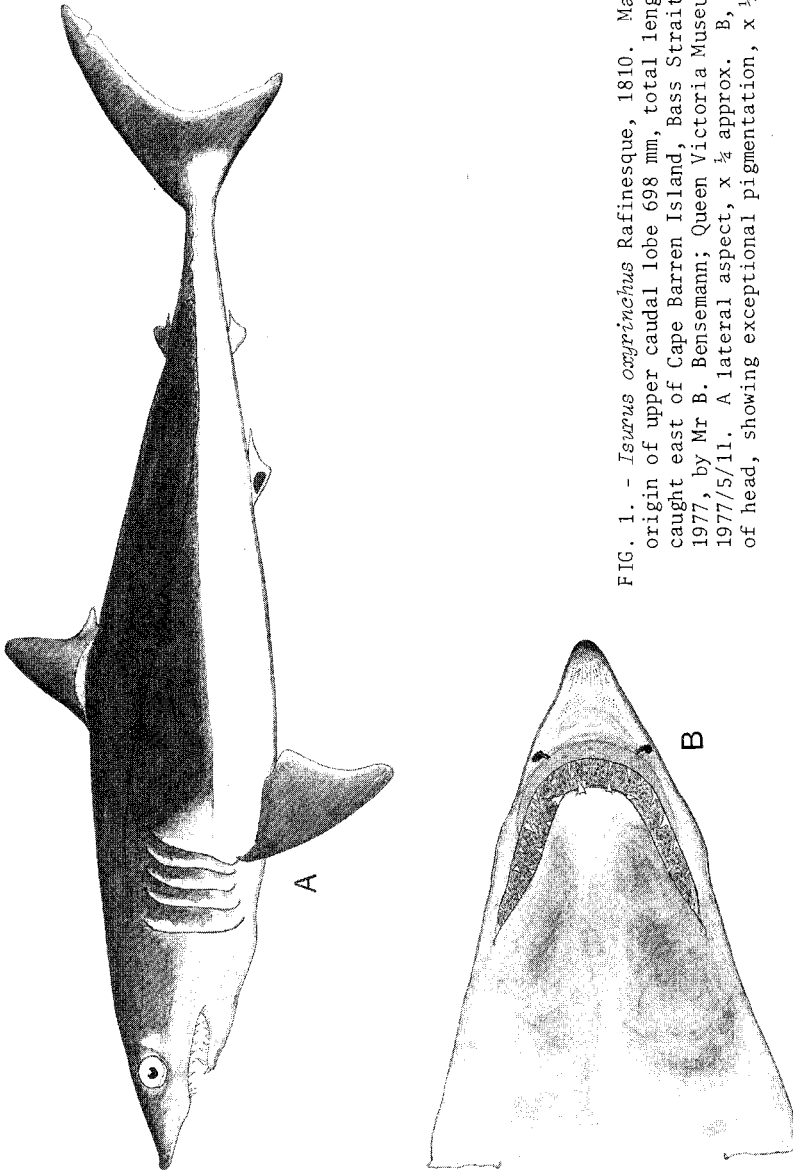


FIG. 1. - *Isurus oxyrinchus* Rafinesque, 1810. Male, length to origin of upper caudal lobe 698 mm, total length 857 mm, caught east of Cape Barren Island, Bass Strait, 16 February 1977, by Mr B. Bensemann; Queen Victoria Museum Reg. No. 1977/5/11. A lateral aspect, x  $\frac{1}{4}$  approx. B, ventral surface of head, showing exceptional pigmentation, x  $\frac{1}{2}$ .

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peduncle (immediately before pit) 49. Breadth of caudal peduncle (immediately before pit) 23. Claspers, outer margin 24. Claspers, inner margin to membrane at base 28.

Fins:- F1-F22, omitting F13 (sketch: see fig. 1). First dorsal, anterior margin 93. First dorsal, base 75. First dorsal, last ray 15. Interdorsal 212. Second dorsal, anterior margin 21. Second dorsal, base 11. Second dorsal, last ray 16.5. Second dorsal to caudal pit 71. Anal fin, anterior margin 23. Anal fin, base 14. Anal fin, last ray 20. Anal base to caudal pit 71. Pectoral, length 144. Pectoral base [anteroposterior] 42, [oblique] 45. Origin of pectoral to that of ventral 260. Ventral fin, length of anterior margin [right fin] 39, [left fin] 42. Ventral fin, base (to outer angle of clasper) 41. Ventral fin, length of last ray, measured externally (superiorly) 20. Ventral fin to anal origin 137. Caudal, from pit, upper lobe 180. Caudal, from pit, lower lobe 110.

Additional measurements:- In a later paper Whitley (1945) found it expedient to supplement his schedule in a description of an example of *Macolamia spallanzani* Le Sueur, 1822 by a dozen additional entries as follows. Total length 857 (see remarks below, under "Proportions", on problem presented by posture of caudal in preserved specimen). Distances between gill openings, measured anteroposteriorly between free margin of fold at middle 17.0, 11.0, 10.0, 6.4, measured directly with dividers between lower ends of clefts 14.8, 11.6, 10.5, 7.4. Eye to first gill opening 116. Snout [tip] to level of angle of mouth 121. Ramal length [direct] 94. Tip of snout to outer angle of nostril [direct] 47. Inner angle of nostril to mouth [direct] 23. Interval between pectoral and first dorsal origins 100; between first dorsal and ventral origins 160. Depth above ventral origin 96, termination [tip of fin] 72.

Some other dimensions recorded by other authors may be noted. Pectoral, distal margin (here, and in fins below, direct, as chord) 112, inner margin (chord) 38; length to end of adpressed fin 365. Interpectoral, anterior 101, posterior 65. First dorsal, distal margin 76, vertical height 70; second dorsal 15, 11; anal 15, 12. Caudal, posterior border (chord) 197; length (chord) from most anterior point on posterior border to origin of lower lobe 70, to tip of lower lobe 82, to tip of upper lobe 134. Width of caudal peduncle at caudal pit (without keel) 44. Measurements of girth at 10 equal intervals between snout tip and first gill slit are considered separately below (section, "Girth of head"). Girth at pectoral origin (virtually level of first gill slit) 383, first dorsal origin 427, first dorsal termination (end of base) 406, ventral origin 302, ventral termination (end of base) 266, end of adpressed fin 254, second dorsal origin 196, anal termination (end of fin) 167, origin of caudal (upper lobe) 100.

Proportions. The subjoined series of proportions covers all those reported by Phillipps (1926, p.530) for the New Zealand shark later nominated as the holotype of *Isurus mako* Whitley, 1929; Phillipps' variates being cited in parentheses. In recording proportions one term of which is to denote overall size of specimen Phillipps, following a general practice, takes as that term total length. In a general paper on *Isurus* Smith (1957, p.93) recommended the adoption of length to origin of upper caudal lobe. This convention has two advantages. First, of course, it takes cognizance of the less than basic nature of an appendage as a constituent element of total length, becoming closely comparable with the formal 'standard length' of teleost systematics (the measurement being here so named; symbol *Ls*); secondly, it has special practical relevance in cases such as the present where in a preserved specimen the normal posture in life of the caudal is difficult of precise determination — thus in our example it has been found that manipulation of the angles of the axes of the caudal lobes, effected without resulting in any obvious distortion, gives a total length ranging from 835 to 891 (adopted value 857). Accordingly, to permit direct comparison with data in either system both *Lt* and *Ls* values are here recorded,

the latter in square brackets.

Head to first gill slit 4.51 [3.67], to last gill slit 3.73 [3.03] in *Lt* [*Ls*], (head  $\frac{1}{4}$  length). Depth at pectoral origin 7.08 [5.77] (7.61), at first dorsal origin 6.21 [5.06] (under first dorsal 6.19) in *Lt* [*Ls*]. Snout in head to first gill slit 2.92, to last gill slit 3.54 (3 in head). Length to origin of first dorsal 2.62 [2.13] (2.47), to origin of pectoral 3.78 [3.07] (4.13) in *Lt* [*Ls*]. Length to first gill slit 1.39 times (equal to) interval between ventral and anal origins; or 3.28 (five times) preoral length. Pectoral in head to first gill slit 1.32, to second gill slit 1.60 (in head 1.3); its base 1.55 (1.38) in snout. Height of first dorsal 2.71 in length to first gill slit, 3.29 in length to last (about 2 in head). Secondary lobe of upper caudal lobe 6.92 in ('5.3 times' = 5.3 in) upper caudal lobe. Lower caudal lobe 1.64 in upper caudal lobe (1.27; also 'upper caudal lobe more than  $\frac{1}{4}$  [=  $1\frac{1}{4}$ ] lower caudal lobe'): on p.531 Phillipps observed Muller & Henle [1838] showed the relation of the lower to the upper lobe of caudal [i.e., times former is contained in latter] to be 1.44. In Waite's figure [1921, fig. 27] it is 1.36 and in the New Zealand examples [? example] 1.27 - note, however Waite's figure is not, as labelled, *Isurus glaucus*, but *Lamna nasus* (Bonnaterre, 1788).

As pointed out by Smith (1957, p.96), Phillipps' illustration (pl.87) and his text are not always in agreement. Thus text has 'snout (i.e., tip of snout) to first gill opening equals distance from origin of ventral to origin of anal, or five times pre-oral length'; approximate values derivable from plate 1.3, 2.8 [our specimen 1.39, 3.28]; head 4 in total length (4.24) [3.73]: height of first dorsal 'about 2' (2.2) [3.3] in head; depth at pectoral origin 7.61 (7.1) [7.08], below first dorsal 6.19 (about 4) [6.21] in *Lt*. The disposition of the gill slits as figured differs markedly from that in our specimen (slits subparallel, cf. diverging noticeably above; line joining lower ends subhorizontal, cf. sloping upward and forward: see section on gill slits, below); the depiction is probably incorrect. Indeed, 'there are few reliable illustrations of [*I*] *glaucus* other than photographs of anglers' catches' (Smith, p.94). Furthermore, continued confusion has occurred in Australia in the figuring of the present species, the illustration in Waite's South Australian catalogues (1921, fig.27; 1923, fig.27) as *Isurus glaucus* —reproduced, for example, as *Isuropsetta mako* by Whitley (1940, fig. 130); and, extralimitally, with some modification, as *I. glaucus* by Barnard (1927, pl. 1, fig. 6) —being, as noted by Smith, a representation of *Lamna nasus* (Bonnaterre, 1788), the characteristic secondary keel being clearly evident in the original figure.

Some additional proportions of diagnostic value may be noted. Eye 10.0 in length to first gill slit, 12.1 in length to fifth gill slit, 3.42 in snout, 3.11 in inter-orbital. Base of first dorsal 4.36 in length to fin, 1.07 vertical height of fin, 6.82 base of second dorsal, 5.36 base of anal, 1.79 base of pectoral, 2.03 base of ventral. Length to origin of second dorsal 1.40 (1.14), of anal 1.37 [1.12], of ventral 1.76 (1.43) in *Lt* [*Ls*]. Intervals between fin origins : pectoral-first dorsal 8.57 [6.98]; pectoral-ventral 3.30 [2.68], first dorsal-ventral 5.36 [4.36], ventral-anal 6.26 [5.09], second dorsal-caudal at upper pit 10.2 [8.31], anal-caudal at lower pit 10.1 [8.21] in *Lt* [*Ls*]. Girth at first gill slit 2.35 [1.98], pectoral origin 2.27 [1.85], first dorsal origin 2.06 [1.67], end of first dorsal base 2.12 [1.72], ventral origin 2.13 [1.74], end of ventral base 5.19 [4.23], second dorsal origin 4.20 [3.42], end of anal base 5.19 [4.23], lower caudal pit 8.40 [6.84] in *Lt* [*Ls*].

Location of certain morphological landmarks. It has been reported in Part XXIII (1977) that it has been found, for a number of sharks, that when the logarithms of the lengths from snout tip to certain notable morphological points are plotted against the logarithms of certain natural numbers within the range 1-10, the resultant graph is significantly linear; and data for two examples of *Sphyrna zygaena* (Linné, 1758) are there recorded, one affording the first Australian report of the species (Scott, 1973).

## Observations on some Tasmanian Fishes

With  $L$  = length, mm, from tip of snout to one of the following seven-member set {back of mouth, pectoral origin, first dorsal origin, ventral origin, anal origin, caudal origin (taken as upper caudal pit), total length} and with  $N$  = relevant natural number of the set {1,2,3,5,6,7,9}, the equation for the best straight line (sum of logarithmic, not arithmetic, deviations minimized) for the present specimen is  $\log L = 0.8961 \log N + 2.0837$ . Measured (in parentheses predicted) values of  $L$  at the seven points are 121 (121), 227 (226), 327 (325), 487 (513), 624 (604), 709 (693), 857 (867). As for similar graphs for other species, the fit is very satisfactory, with  $t = 56.932^{***}$  (cf. for the two specimens of the hammerhead 54.523<sup>\*\*\*</sup>, 40.105<sup>\*\*\*</sup>, d.f. 5).

As noted in Part XXIII (1977, p.122), in these length-number formulations the same morphological site may fall at different integers in different species, the general slope of the graph being largely determined by the location of the first member of the series, length to back of mouth, which is variously positioned in different families on log 1, log 2, or log 3. Whereas in the present specimen the integral abscissal values for the seven length-to measurements are 1,2,3,5,6,7,9, the corresponding numbers for the same set of dimensions in the two examples of *Sphyrna zygaena* were 2,3,4,6,7,8,10. The variable locus of the first datum serves of course as an index of preoral length relative to general length of head, a feature exhibiting notable intrafamilial stability. There is some evidence to suggest that the location of total length on log 9, instead of on log 10, may be associated with possession of a short caudal fin: it may perhaps be speculated that in such cases the log 10 point may be morphologically (and hydro-dynamically?) significant, representing the opisthion of Gregory (1928) or some similar space-datum. The *opisthion* is the point of intersection of the anteroposterior axis (*horizontal*), drawn from most anterior point of fish (*prosthion*) through midpoint of caudal peduncle (*pygidion*) and a line drawn from summit of dorsal profile (*apex*) through lowest point on dorsal border of caudal peduncle (*epipygidion*). It would seem possible this point may bear a significant relation to the boundary of the slipstream.

Two implications for taxonomy naturally suggest themselves. First, the character of the pattern as manifest in its particular combination of the members of the length and number sets would appear to be characteristic for taxa higher than species. Secondly, with the primary data standardized for overall length of individual (with which slope of graph shows positive correlation) it might well be the parameters of the equation would prove diagnostic at species level.

Fin borders. The measurements of fin borders recorded elsewhere in this paper represent, in accordance with common practice, the chord of the curve. (The chord of the anterior border is commonly taken as the length of the fin (in caudal, of relevant lobe, that of upper specifying length of fin), and no other convention is widely followed, at least for pectoral, first dorsal caudal; the usage, however, is not invariable, Garrick & Schultz (1963, fig. 1a), for example, defining length of second dorsal as distance, between parallels, from front of base to free hind tip). Examination of length following the curve shows that in the present specimen the fins fall into two well-defined categories. In the first group, comprising first and second dorsals and anal, two borders (not necessarily the same pair) are equal or subequal in length; the anterior, posterior (distal) and inner borders in these three fins being 91, 88, 38 mm; 19, 17, 19; 21, 17, 17. In the second group the three borders plotted (in different sequence) on logs 1,2,3 yield on approximately linear graph. For pectoral, with anterior, posterior, inner borders 152, 118, 41, the regression equation is  $L = 235.14 \log N + 42.68$ ;  $t = 14.403^*$ , predicted values being 155, 113, 43 : caudal, lower, upper, posterior borders 128, 187, 223;  $L = 198.78 \log N + 127.74$ ;  $t = 94.990^{**}$ ; predicted 128, 188, 223: pelvic, inner, posterior, anterior borders 16, 32, 47;  $L = 63.71 \log N + 14.90$ ;  $t = 7.600$  (significant only at  $P 0.1$ ); predicted 15, 34, 46. It would certainly be of interest to extend the investigation to other species: some preliminary trials suggest that of the logarithmic formulations here noted in the mako for pectoral, pelvic, caudal, those for the paired fins (but probably not that for the



caudal) are applicable to a number of other species.

Head in plan. The snout, regularly characterized in texts as pointed (*cf.* also the synonymic generic name *Oxyrhina*, the specific name *oxyrinchus*, and the vernacular name sharp-nosed mackerel shark) is indeed markedly so, its widths at its anterior one-third, middle, posterior two-thirds being 0.37, 0.60, 0.85 width at front of eyes, the corresponding relative depth values being 0.58, 0.68, 0.81. Its outline in plan continues forward much the same general sense of the outline of the rest of the head in advance of first gill slit.

In a study in Part XXIII (1977) of the head of a specimen of *Carcharhinus greyi* *greyi* (Owen, 1853) it was pointed out that while conventional specifications of the snout as 'long and pointed', 'bluntly rounded', 'moderately rounded', 'more broadly rounded than in preceding species' — these examples being successive entries in the Handbook (Munro, 1956a) — clearly have some value, equally clearly their significance would be enhanced by some degree of quantification; and this desideratum was provided for that specimen in the form of several polynomial equations. A tracing has been made of the outline of the head of the present specimen forward from first gill slit (here selected as origin in view of the existence of several local irregularities in outline — at least partly adventitious — in the interval between first and last gill slits), the anteroposterior axis has been stepped off in tenths, and widths at these intervals measured. With  $W$  = width, mm, and  $N$  = serial number of decile, counting caudad,  $W = 8.95 + 20.151 N - 0.7008 N^2$ . Measured widths (in parentheses estimated) are 28 (28.4), 47.5 (46.4), 62.5 (63.1), 78.0 (78.3), 91.5 (92.2), 107.0 (104.0), 114.5 (115.7), 124.0 (125.3), 135.0 (133.0), 140.0 (140.4). It will be seen the fit is a very satisfactory one;  $R = 0.9980$ .

To introduce a measure of generalization, making possible both intraspecific and interspecific comparison of individuals of differing overall size, the head widths, given above as absolute dimensions (mm), may be expressed in terms of some convenient morphometric unit. With widths as permillages of maximum width the equation is  $W = 63.62 + 144.022 N - 5.01114 N^2$ . As the head of the whaler shark mentioned above was severed slightly in advance of level of first gill slit, the use of length to the gill slit thus being ruled cut, decile widths were calculated as percentages of width at front of mouth, the second degree equation being  $W = 35.14 + 16.317 N - 0.66295 N^2$ : the comparable equation here is  $W = 14.36 + 31.896 N - 1.1042 N^2$ . The coefficient of  $N^2$  affords a measure of the pointedness of the curve, the markedly more acute form in the present specimen being evidenced by a value about one and two-thirds that for the carcharhinid.

For comparison with data that may in the future be obtained for other sharks for which length to first gill slit is available, the polynomial for this specimen, with widths as permillages of length to first gill slit is here noted,  $W = 40.63 + 106.29 N - 3.7045 N^2$ .

Some interesting comparative results are derivable from figures of the head in some standard texts, decile widths being measured along length to first gill slit, expressed as permillages of that length, and polynomials calculated. (a). *Isurus oxyrinchus* (Bigelow & Schroeder 1948, fig. 18, young male 1 690 mm long)  $W = 82.77 + 70.732 N - 3.1894 N^2$ ;  $W = 58.41 + 100.339 N - 7.9242 N^2 + 0.28393 N^3$ ; successive values of  $F$  213.70, 7.00, 5.99, of  $R$  0.9818, 0.9845, 0.9921; percentage deviations of predicted from given values  $0.0-3.9 \bar{x} 1.8$ ,  $0.3-3.4$ ,  $\bar{x} 1.6$ . (b). *I. paucus* (Guitart-Manday 1966, fig. 1B; length of head here measured to somewhat indeterminate end of figure, about at level of first slit)  $W = 108.12 + 116.620 N - 5.9280 N^2$ ;  $W = 91.63 + 131.242 N - 9.098 N^2 + 0.19214 N^3$ ;  $F$  92.75,  $\bar{7.0}$ , 6.0;  $R$  0.9595, 0.9994, 0.9997; percentage deviations  $0.0-3.4$ ,  $\bar{x} 1.18$ ,  $0.0-2.8$ ,  $\bar{x} 0.8$ . (c). *I. alatus* (= *I. paucus*) (Garrick 1966, fig. 7b)  $W = 88.98 + 110.04 N - 6.0492 N^2$ ;  $W = 29.30 + 162.97 N -$

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$17.557 N^2 + 0.69560 N^3$ ;  $W = 70.74 + 109.85 N - 1.883 N^2 - 1.9607 N^3 + 0.120842 N^4$ ;  $F$  58.64, 68.54, 18.73, 5.03,  $R$  0.9381, 0.9944, 0.9986, 0.9998; percentage deviations 0.8-9.0,  $\bar{x} = 3.1$ , 0.9-3.0,  $\bar{x}$  1.3, 0.2-3.8,  $x = 1.2$ . Garrick's figure shows the local sinuosity found just in advance of the gills, a feature not evident in Guitart-Manday's even curve, and a decrease in mean percentage deviation is here gained in passing beyond the third to the fourth degree equation (though the  $F$  value fails to reach formal significance at the 5% level).

For pragmatic taxonomic purposes a formulation leading to a straight line graph is in some respects more convenient than a polynomial, affording a more immediate visual estimate of parameters: the chief disadvantage of the procedure here adopted is that the graph presents two segments. Plotting the ten widths, proceeding caudad, on the integral numbers 1-10 along a logarithmic abscissa is found to yield one significantly straight line,  $A$ , covering logs 1-3 and a second,  $B$ , covering logs 4-10. With widths as permillages of length to first gill slit the regression equations are:  $A = \{1-3\}$ ,  $W = 3.77215 \log N + 144.16$ ;  $t = 13.427^*$ ; percentage deviations of estimated from observed values 3.2, 3.1,  $\bar{x}$  1.5;  $B = \{4-10\}$ ,  $W = 8.33.015 \log N - 93.76$ ;  $t = 36.892^{***}$ ; percentage deviations 0.7-1.6,  $\bar{x}$  1.0. For Bigelow & Schroeder's outline of the head of their specimen of *Isurus oxyrinchus* the corresponding data are:  $A = \{1-4\}$ ,  $W = 341.112 \log N + 141.72$ ;  $t = 7.936$ ; percentage deviations 2.9-13.9,  $\bar{x}$  8.9;  $B = \{5-10\}$ ,  $W = 548.752 \log N + 8.693$ ;  $t = 62.516^{***}$ ; percentage deviations 0.2-0.7,  $\bar{x} = 0.3$  (the much greater deviations in  $A$  are attributable to the presence in the set of one aberrant variate). A two-segment line was found also for the example of *Carcharhinus greyi greyi* reported in Part XXIII (1977, p.115), with  $A = \{1-6\}$ ,  $B = \{7-9\}$ . However, the approximate measurements derived from the figure of *Isurus paucus*, with obscure posterior boundary, involve three segments  $\{1-2\}$ ,  $\{3-8\}$ ,  $\{9-10\}$ .

Girth of head. The girth of the head has been measured at 10 equal intervals between tip of snout and level of first gill slit. It is found that for each of the decile sets  $\{1-6\}$   $\{7-10\}$  — deciles numbered caudad — the relation between girth,  $G$ , and decile number,  $N$ , is, to a significant approximation, of the form  $G = bN^x$ . With the relation rectified the best straight line for  $\{1-6\}$  is  $\log G = 0.6845 \log N + 1.9343$ ;  $t = 21.646^{***}$ ; for  $\{7-10\}$   $\log G = 0.3878 \log N + 2.1770$ ;  $t = 10.050^{**}$ . The 10 girths, mm, (with predicted values in parentheses) are 86 (86), 138 (138), 182 (182), 220 (222), 259 (259), 296 (293); 318 (319), 338 (337), 356 (352), 364 (367). In our example of *Carcharhinus greyi greyi* a single straight line was obtained for the complete decile set  $\{1-10\}$ .

Mouth. The anterior border of the crescentic mouth lies behind tip of snout by 0.92 of the mouth's anteroposterior extension, the latter being 0.90 chord at the angles, or 3.2 direct distance from mouth to nostril. The upper lip is of a somewhat unusual character, taking the form of a free stiffish lamelliiform fold, directed backwards and slightly downwards for a maximum (mesial) distance of 11 mm, covering much of the length of the anterior teeth, but decreasing regularly in extent backwards. Its free border is here taken as throughout defining the mouth curve. Externally it is indistinguishable in texture and color from the adjoining chin region, from which it is rather obscurely delimited by a groove, best developed in its anterior half. Overall it is quite unlike the usual flattish, moderately tumid or bluntly ridged shark upper lip. Some idea of its general character may be gathered from a photograph in Goadby (1959, unnumbered fig., p.59) of the open mouth of a mako caught at Tweed Heads, New South Wales, after taking snapper (*Chrysophrys* sp.) from hand lines. (A structure of comparable extent, but having more the character of a subrectangular flap, constitutes the posterior border of the mouth in the holocephalan *Callorhynchus milii* Bory de St Vincent, 1823: it completely hides the lower teeth).

The mouth curve has been examined by the methods employed in the analysis of the curve of the head in plan, and orthogonal polynomials have been calculated. For the

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upper lip the third degree equation is  $W = 19.72 + 8.189 N - 0.8975 N^2 + 0.058180 N^3$ ;  $R = 0.99916$ . Measured values, which it was not practical to read to better than the nearest half-millimetre, are here followed in parentheses by estimated values given to the nearest one-tenth millimetre: 27 (27.1), 33.5 (33.0), 37.5 (37.8), 42 (41.8), 45 (45.5), 48.5 (49.1), 54 (53.0), 57 (57.6), 63.5 (63.1), 70 (70.0). The equation in  $N^4$  is  $W = 21.04 + 6.487 N - 0.27507 N^2 - 0.26868 N^3 + 0.0038658 N^4$ .

Generalized for comparative purposes, with widths not absolute measurements as before but permillages of length to first gill slit, the third degree equation becomes  $W = 105.90 + 41.502 N - 4.4481 N^2 + 0.2925 N^3$  (giving calculated terminal values of 141.3, 368.6; observed 142, 368); while with widths taken as permillages of full width of mouth the equation is  $W = 287.73 + 113.346 N - 12.2852 N^2 + 0.80906 N^3$  (terminal values as calculated 389.6, 1011.7; actual 386, 1000). The second equation has been calculated to permit of comparison with a similar equation for *Carcharhinus greyi greyi*, namely,  $W = 157.68 + 159.732 N - 10.9677 N^2 + 0.34217 N^3$  (terminal values as calculated 306.8, 1000.4; actual 305, 1000). In Part XXIII the equation recorded for the whaler shark is for decile widths as percentages (not, as above, permillages) of width of mouth.

Except for a slight and brief widening shortly in advance of angle of mouth the lower jaw narrows regularly towards its rounded tip. For almost its entire length it fails to coincide with the upper jaw, lying wholly within it, having the appearance of being a stout dark-colored tongue. The third and fourth degree polynomials specifying its outline are  $W = 26.80 + 9.623 N - 0.9554 N^2 + 0.03506 N^3$  and  $W = 21.87 + 14.656 N - 2.7970 N^2 + 0.28671 N^3 - 0.011439 N^4$ . Measured values (calculated in parentheses, third degree first) are 35 (35.5, 34.1), 43 (42.5, 42.1), 49 (48.0, 47.5), 51.5 (52.4, 51.2), 55 (55.4, 53.9), 57.5 (57.7, 56.2), 59.5 (58.4, 58.3), 60.5 (60.6, 60.1), 62.5 (61.6, 61.2), 62 (62.6, 61.6). In all equations recorded so far decile numbers have been counted caudad (measurements thus increasing in magnitude from first to last). It is of interest to note that with the slightly different fit (actual equations, of course, with markedly different parameters) obtained when the calculation is made with the measurements for the lower jaw taken in reverse sequence the fourth degree equation picks up the slight increase in the second measurement shortly in advance of angle of mouth. This equation is  $W = 58.69 + 4.839 N - 1.9651 N^2 + 0.25093 N^3 - 0.12634 N^4$ , giving values of  $W$  as follows 61.8, 62.3, 61.3, 59.4, 57.2, 53.8, 52.0, 48.4, 43.1, 35.2.

Comparison of head and mouth curves. It may reasonably be predicated that a definable relation of some form subsists between the curvature of the head as a whole and that of the mouth cleft. An interesting ad hoc comparison of the two curves is obtained by plotting successive cumulated deciles of mouth width on successive cumulated deciles of head width, the resultant plot proving to be a straight line with one point of inflexion. For deciles {1-3}, numbered caudad, the regression equation is  $\text{cum } M = 0.6431 \text{ cum } H + 10.06$ ;  $t = 21.657^*$ ; for deciles {4-10}  $\text{cum } M = 0.4712 \text{ cum } H + 38.44$ ;  $t = 179.994^{***}$ ; measured (in parentheses estimated) values 27 (28.1), 60.5 (58.6), 98 (98.8), 140 (140.3), 185 (183.3), 233.5 (233.7), 287.5 (287.7), 344.5 (346.1), 408 (409.7), 478 (475.7).

A comparison of the graph for this species with that for *Carcharhinus greyi greyi* noted in Part XXIII reveals one notable point of agreement, both plots having the point of inflexion located between the third and fourth deciles (here at 17.8% of total abscissal length, in the whaler shark at 21.5%); however, whereas here the earlier segment has the greater slope, in the other species it has the lesser slope.

Gill slits. As in other isurids the gill slits in this species are large, being visible both when the shark is viewed from above and when it is viewed from below; the largest slit here occupies 0.40 of the semigirth at its level.

In the present specimen the lengths decrease from 1st to 4th, 5th being equal to

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2nd. However, Phillipps reports of the holotype of *Isurus mako* Whitley, 1929 'gill-slits regularly decreasing in size posteriorly'. Again, lengths of 1st, 3rd, 5th gill slits recorded by Garrick (1967, table 2) for 5 examples of *I. oxyrinchus* exhibit a surprising variety of pattern when arranged in order of magnitude, namely,  $1 > 5 > 3$  (2 specimens),  $1 > 3 > 5$ ,  $1 = 5 > 3$ ,  $5 > 1 > 3$ , while in 5 examples of *I. alatus* = *I. paucus* (table 3) the sequences are  $1 > 3 > 5$ ,  $3 > 5 > 1$ ,  $5 > 1 > 3$  (2),  $1 > 5 > 3$ .

The total system of slits is rather more than one and a half times as wide above (direct measurement in full to recurved last slit at tip 74) as below (45). In first slit upper end is directly above lower end, but becomes increasingly behind it in the rest, being in last 16, or about one-fourth length of slit, further back. The oblique line joining lower ends when produced forward reaches eye level about an eye diameter behind orbit; slope of line joining upper ends somewhat greater. In all slits except first both ends are recurved, most markedly so in fifth, where upper and lower ends extend backwards about 7.6 respectively, the lower curling right round pectoral base, ending about 8 behind the perceptible insertion of the fin, with tip of slit about 10 below level of anterior fin border. A quite different situation is presented in the illustration by Phillipps (1926, pl.87) of his New Zealand *I. glaucus* (holotype of *I. mako*), the slits there being depicted as being erect and subparallel, the last well in advance of pectoral insertion: the disposition of the slits as found in our specimen would appear to be more or less the normal one.

Dentition. All teeth without lateral cusps. In upper jaw teeth in anterior portion elongate, depressed, margins somewhat sinuous, posterior margin becoming increasingly concave, length up to two and a half times, occasionally a little more, width (at base of cusp); posteriorly becoming progressively shorter, wider, subtriangular, length subequal to basal width. On either side 12 teeth can be detected, ranging in height from 9.4 to about 3 mm or less; behind eighth tooth in either jaw an additional inner tooth, that on left considerably larger than, that on right subequal to, outer tooth. Third tooth, left 4.0, right 3.8, shorter than second, 9.0, 9.5, and than fourth, 5.6, 6.1: the fact that the third upper tooth on each side is smaller than the teeth flanking it is a characteristic of the Isuridae.

In the lower jaw 12 teeth are detectable in each ramus, long (first, right, 10.1, left imperfect), slender anteriorly, progressively shorter, relatively stouted posteriorly; interspace between first pair 9.6, between last pair about 2.5; first pair inserted well outside general line of lip, having almost the appearance of springing from the chin and curving upward towards the mouth cleft, the same being true, to a lesser degree, of next pair, set closer to general lip line and straighter (net effect, tip of jaw 'bristly'); remaining teeth with bases internad of lip line; each of main, outer row with a second tooth, in general similar, behind it; a third tooth behind the anterior two in each ramus.

Cutting edge on lateral margin of first tooth in each jaw incomplete. In upper jaw distance (mean of left and right) of third tooth from second 6.95, from fourth 11.5; in lower jaw 8.5, 10.05.

The marked irregularity in the insertion and orientation of the teeth of the lower jaw and the contrasting relative uniformity of these features in those of the upper jaw are well seen in a photograph of a New South Wales specimen reproduced by Goadby (1959, unnumbered fig., p.59): see also Garrick (1967, pl.2), in which photograph, however, the anterior teeth appear to be inserted more internad than in our example.

Other features. The general form of the shark is tolerably well specified, expressly or by implication, in the foregoing description. Some miscellaneous points not elsewhere dealt with are here noted.

*Nictitans*: absent (family character). *Spiracle*: either minute or absent in isurids, not detected in specimen. *Pupil*: virtually circular, in one eye a trifle more extensive vertically. *Oral groove*: at junction of lips a groove 8 long, deepest anteriorly, extending backward and slightly outward. *Labial folds*: inconspicuous, tapering, length of upper 10, lower 13. *Naris*: external angle virtually on (about 1mm from) lateral profile, overall slightly oblique inward and backward, anterior dumbbell aperture more so, oblique length 7, tragus small, wider than long, fairly acute, no cirrus. *Interdorsal ridge*: traceable as a low rounded ridge for more than half distance between fins, thereafter a median slightly depressed area widening backward to about 10 at second dorsal origin. *Lateral line*: first detectable 55 behind eye; an upwardly convex arc, chord 95, to a point 18 above interspace between third and fourth gill slits, here 30 below dorsal profile; gently convex to first dorsal termination, here one and two-thirds as far from ventral as from dorsal profile, slowly downward almost straight, about to end of ventral base, here a little below middle of flank, about 5 above junction of light and dark regions; briefly somewhat downward then almost horizontal, along line of color demarcation, to meet caudal keel, apparently ending there. *Caudal keel*: from caudal base, 55 behind origin of fin (anterior extension of fin here 25) forward as a strongly scalloped flexible fold, maximum height about 5, to level of second dorsal origin, thereafter still traceable as a low, continuously lapsing ridge almost to level of hind end of ventral base, a total length of round 220; segment on fin sigmoid. *Myomeres*: from level of first gill slit to first dorsal origin 28, to second dorsal origin 75. *Pores on head*: (a) on either side of ventral surface, about midway between nostril and tip of snout, a patch, about 15 x 15 mm, of some three to four score small dark pores with slightly elevated rims, patch extending inward from margin of head to within about 5 of its fellow, the internal border inwardly convex; (b) on dorsum, in two bands, each about 5mm wide, confluent about 10 behind snout tip, diverging backward for about 60 to terminate, 15 apart, just beyond level of front of orbit; (c) below eye, about two score on each side, widely separated, minute, mostly black. *Caudal pits*: similar in general shape and in size; a shallow groove, length upper 17, lower 16, front lip gently bisinuous, coplanar with adjacent part of peduncle; followed by shallow depressed region, about 4 anteroposteriorly, decreasing in depth to its forwardly concave border; this area in lower pit somewhat paler than surrounding off-white, in upper pit blackish, concolorous with surrounding region. *Subterminal caudal notch*: below tip of fin by 26, small, depth 6, greatest (external) width about 1; immediately followed below by a curious subrectangular tuft-like process, base 5.5, extending 4 beyond general level of fin border nearby (individual variation?). *Denticles*: minute, imbricate, tricarinate, median carina stoutest, longest; median free border with spur (continuation of keel), lateral elements each with spur (usually shorter than median) or merely shouldered.

Coloration. Those parts that in life presumably were the characteristic blue from which the species derives one of its vernacular names, blue pointer, present in the preserved specimen a somewhat indeterminate color perhaps best described as gun metal: in the observations below it is recorded simply as 'dark', or, where more intense, as 'very dark'.

Head, upper surface. Above a line back from tip of snout, passing below orbit by about one-fifth of distance of orbit from upper jaw more or less straight to a little below middle of first gill slit, thence obliquely back and down to near middle of fifth gill slit in general dark, darker on much, very dark on some, of dorsum; an oblique pennon backward from eye almost to first gill slit somewhat lighter, distinctly so for about half its width in a patch behind eye, being here light greyish. Head, lower surface. Snout at tip for about 12 ventrally, about 20 laterally, very dark, approaching black; thereafter to a forwardly convex arc joining backs of nostrils lighter, anteriorly brownish, posteriorly light horn or whitish; on either side of this region two patches each of 3-4 score black pores, the patches separated by a dusky horn poreless strip; rest of snout back to lower lip dark or very dark greyish,

or, particularly mesially, greyish brown; between lower jaw and level of first gill slit mostly dark greyish, with a small whitish area nearer mandibular symphysis, and, on right side, a large whitish patch from lower half of first gill slit forward about halfway to mouth; area on ventral surface between the two series of gill slits with irregularly disposed patches, mostly contiguous, of whitish and greyish. *Trunk*. Above a line briefly running obliquely down from middle of first gill slit to level of pectoral insertion, at about half a snout length above it, and then descending obliquely to horizontal level of fin insertion about halfway along fin base, thereafter continuing more or less straight back along midline of side to level of second dorsal almost uniform dark; below this more or less wholly whitish. *Tail*. The whitish and dark regions on the trunk continue back without interruption on the tail, sharply divided by the frill-like caudal ridge, the upper surface of which is whitish, the lower dark.

*Pectoral*. Upper surface dark, concolorous with upper flank; a narrow off-white strip along whole of inner border, widening outwards towards inner angle of fin, then continuing, decreasing in width, along inner one-third of distal border; under surface mostly off-white, a band of light grey along distal border. *First dorsal*. Very dark; somewhat lighter for 5-7mm along distal border. *Second dorsal*. Mostly very dark, a little lighter posteriorly; very narrow slip of light grey along lower border of the prolongation. *Pelvic*. Upper surface whitish, proximally, yellowish distally; a rather sharply delimited oval spot, about 12 by 20, just behind anterior border; lower surface off-white. *Anal*. Almost uniform very pale greyish; a narrow slip of white along inner border. *Caudal*. Mostly dark like body, or a little less intensely so, except for a light horn-colored rim 4-6 wide along whole of posterior border, and for a conspicuous continuation of white of lower half of caudal peduncle extending back on to fin more than halfway towards its hind border, this patch ending below in a downwardly convex arc and being delimited above by the continuation on to the fin of the peduncular ridge.

#### Discussion.

(i) Identification of a Tasmanian mako. A point of special interest in a local context centres round *Oxyrhina gomphodon* Müller & Henle, 1838; though enjoying page priority over *Oxyrhina glauca*, this name never achieved wide usage, being treated early as a junior synonym of *Isurus oxyrinchus*, from which on the other hand *O. glauca* has traditionally been regarded as distinct. In a communication sent from England to 'Hobart Town', published in the precursor to the present journal (*Papers and Proceedings of the Royal Society of Van Diemen's Land*, 1885, 3(1), p.81) A. Cross states he identified a shark in the Society's museum, marking it *Lamna cornubica*, but he now writes 'for the purpose of having the name which I placed on the specimen altered to *Oxyrhina gomphodon*, as I should be very sorry to mislead my friends in the Southern Hemisphere'.

(ii) Assessment by keys prior to 1966. The taxonomic status of the present specimen as determined by several of the more important keys published prior to 1966 is here examined, the period covered exhibiting a general trend towards reduction in the number of species regarded as valid.

Six species were keyed by Garman (1913), two *Lamna nasus* (Bonnaterre, 1788) and *Lamna guntheri* Murray, 1884, being referred to a subgenus *Lamna*. (Murray's species with its anomalous dentition, 22/28 in each side of the jaw has long presented a problem. Interpreting the recorded count as the total tally, Smith (1957, p.92) has suggested identity with *Carcharias tigris* Atwood, 1865; Garrick (1967, p.667) accepted this interpretation of the dentition, pointing out, however, that Murray's account (1884) stressed his species has many teeth. Features other than dentition by which *L. guntheri* was held to be distinct — position and shape of fins, length of caudal keel, presence of a prominent lateral line — are not expressly discussed by Smith, and are dismissed by Garrick as having no validity). The nominate subgenus is regarded as

comprising *Lamna punctata* Storer, 1839 (distinct from *L. punctata* De Kay, 1842 = *Isurus paucus* Guitart Manday, 1966; see below), *Carcharias tigris* Atwood, 1869, *Isurus oxyrinchus* Rafinesque, 1810 and *Oxyrhina glauca* Müller & Henle, 1838. Of these the first two are excluded by the criterion 'dorsal origin above the pectorals'. As determined by position of dorsal relative to pectoral (*I. oxyrinchus* 'near a vertical from end of pectoral base', *I. glaucus* 'near a vertical from the ends of pectorals') our specimen occupies an intermediate position, dorsal origin being about from level of inner end of distal border, i.e., axilla, and level of pectoral tip (perhaps nearer *I. glaucus*). The second criterion, that of relative position of second dorsal and anal bases, is not very clearly specified in the key, but reference to the text shows anal origin is 'a short distance' behind dorsal origin in *I. oxyrinchus*, with dorsal base almost wholly in front of anal base in *I. glaucus*: the latter more nearly describes the disposition in our shark.

Noting in their key to three species that the validity of *I. guntheri* is 'very doubtful' (see above), Bigelow & Schroeder (1948) separate *I. oxyrinchus* and *I. glaucus* by four criteria as follows (*I. oxyrinchus* here cited first): (a) height of first dorsal about half distance from eye to 4th gill opening, to 2nd gill opening; here 0.58, 0.44: (b) height of first dorsal greater, less than, its base; here 0.93: (c) length to pectoral origin about equal to distance from axil of pectoral to rear end of pelvic base, to pelvic origin; here 0.89, 1.04: (d) distance from pectoral axil to pelvic origin about length to 2nd gill opening, about length to pectoral; here 1.06, 0.96. Thus of four differentiae the first and last are indeterminate, while the other two favour *I. glaucus*.

Keying *I. bideni* Phillipps, 1932, *I. glaucus* and *I. mako* Whitley, 1939, Phillipps (1932) coupled the first two as having height of dorsal  $3\frac{1}{2}$  times or more (v. less than  $3\frac{1}{2}$ ) in length to first dorsal origin; in our specimen the value is large, 4.67. *I. glaucus* is characterized as having anal base (as in our specimen) partly under, instead of wholly behind, second dorsal base. Smith (1957, p.91) has expressed strong reservations regarding the taxonomic significance of relative positions of anal and dorsal as described for *I. bideni* (cf., however, diagnosis of *I. paucus* and the synonymic *I. alatus*): for our specimen see above.

Smith (1957) keys off *I. glaucus* on the one hand from *I. oxyrinchus* and *I. tigris* on the other as having top of first dorsal broadly rounded, not acute (as his diagram, fig. 1, showing typical forms of adults, depicts for *I. tigris*) or acutely rounded (from diagram *I. oxyrinchus*); in ours the shape of the fin is closest to that of *I. glaucus*: however, it has now been shown by Garrick (1967) that shape of dorsal varies with age, tip becoming more pointed in older individuals. There appears to be some confusion in the key with regard to specification of vertical height of first dorsal in terms of length to (level of) pectoral origin, but if we take the figures for the number of times the first is contained in the second we get 3.1-3.5 for *I. glaucus*, 2.6-3.0 for *I. oxyrinchus*, 2-2.4 for *I. tigris*: our specimen at 3.24 comes out at *I. glaucus*. Some ambiguity exists also in respect of the ratio of height to base in the first dorsal, but reference to the general text and to fig. 1 makes it evident height is equal to, or less than, base in *I. glaucus* (in our specimen less), greater than in the two other species (a scatter diagram presented by Garrick (1967, fig.4) shows the ratio base/height of fin correlated negatively with total length). Length to pectoral origin as compared to interval between hind margin of pectoral base and pelvic origin is given as 'not or a little more' in *I. glaucus*, 'usually distinctly more' in *I. oxyrinchus*, 'usually distinctly less' in *I. tigris*; our value, 1.04, is in best agreement with *I. glaucus*. Values, as percentages of length to origin of upper caudal lobe, of lengths from snout tip to fin origins and terminations as read off from fig. 1 (estimates accurate to round about 1%) in 'typical forms of adults' of *I. glaucus*, *I. oxyrinchus*, *I. tigris*, in that order: first dorsal origin 45, 44, 47 (ours 46.8), first dorsal termination 55, 54, 58 (57.6), second dorsal origin 88, 83,

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87 (88.0), anal origin 90, 83, 87 (89.4), pectoral origin 30, 31, 29 (32.5), pelvic origin 69, 63, 70 (69.8). In these 6 dimensions the Tasmanian specimen comes closest to *I. glaucus* in 2, to *I. oxyrinchus* in 1, to *I. tigris* in 3. However, the extent of the variation throughout is probably not sufficiently great to be of taxonomic significance. For the 4 variates the coefficients of variation (s calculated with degrees of freedom  $n + 1$ ) are 2.1-4.3: it is found by experience that in most comparable contexts a population homogeneous for species, age (sex if relevant) is likely to yield  $V \leq 10$ , modally round 5.

Though Garrick & Schultz (1963) recognize in the text only *I. oxyrinchus* and 'a second oceanic species in the Pacific, characterized by having considerably longer fins' (species twice described in 1960's; see below), they give separate figures of the 'Atlantic mako shark, *Isurus oxyrinchus*' (fig. 5) and the 'Pacific mako shark, *Isurus glaucus*' (fig. 6). Noticeable differences include (*I. oxyrinchus* taken as standard): first dorsal higher, relative to its base, much more pointed, its distal margin less deeply excavate; lower caudal lobe longer, relative to upper, fin thinner with most anterior point on hind border closer to level of origin of upper lobe. In these characters of dorsal and caudal our example approaches more closely fig. 6 (*I. glaucus*).

(iii). Assessment in terms of Garrick's 1967 revision of the genus. In his recent admirable revision of the genus *Isurus* Garrick (1967) after reviewing the status of the following nominal species, *Isurus oxyrinchus* Rafinesque, 1810, *Isurus spallanzani* Rafinesque, 1810, *Squalus (Lamna) cepedii* Lesson, 1830, *Oxyrhina gomphodon* Müller & Henle 1838, *Oxyrhina gomphodon* Müller & Henle, 1838, *Isaoropsis dekayi* Gill, 1862, *Carcharias tigris* Atwood, 1869, *Lamna guntheri* Murray, 1884, *Lamna huidobrii* Philippi, 1887, *Isurus mako* Whitley, 1929, *Isurus bideni* Phillipps, 1932, *Isurus africanus* Smith 1957 concluded these all relate to a single species, *Isurus oxyrinchus* Rafinesque, 1810. (The spelling of the second binomen has been emended by Garman (1913) and some other authors to *oxyrhinchus*, and this action has been defended by Tortonese (1956, p.106, fnt 1) on the ground that the original spelling was an 'inadvertent error' in terms of Article 19 of the Code, and hence requires emendation to the etymologically expectable form; Garrick, however (1967, p.665) considers the text affords no evidence such an error is involved.)

Whilst from the beginning it might have been expected by an independent observer that some of the characters on which nominal species have been based may be growth dependent, little contemporary evidence of such variation was available, and from time to time a new species has been established on proportional differences of form on a single individual. Garrick has now examined 35 specimens for which fairly complete measurements were taken and 8 for which only incomplete data were available; these data being supplemented by some proportions from published descriptions and illustrations.

Scatter diagrams show the position in regard to correlation of certain features with total length is as follows: (a) no clear correlation (among the traditional 'short-finned' forms, i.e., excluding *I. alatus* = *I. paucus*) for length of anterior margin of pectoral as percentage of prepectoral length (fig. 1), or for length of anterior margin of pectoral as percentage of total length (fig. 2); (b) positive correlation for the ratio base/height of first dorsal (fig. 4), and for the ratio prepectoral length/height of first dorsal (fig. 5). With abscissal coordinate (total length, mm) 857 throughout (close to diagram's origin at a little less than 600), and with ordinal coordinates for figs 1-5 of 68.4, 20.6, 8.2, 1.07, 3.2, respectively, our values are in general in good agreement with the plotted points, least so in the case of fig. 2, where our value of 20.6 is noticeably higher than any of the 12 points for  $Lt \geq 1600$ , though it is equalled or exceeded by later entries. Several other correlations between total length and relative dimensions (percentages of  $Lt$ ) or ratios not expressly noted by Garrick can, as he observed, be gathered from his tables 1,2.



Of the ten proportional dimensions set out in table 1 for three size classes, *Lt*, mm 605-1 400, 1 401-2 200, 2 201-3 200, mean values show progressive increase with increase of overall size in two instances, (a) pectoral axil to pelvic origin as % of *Lt* (17 specimens) and (b) pectoral origin to first dorsal origin/back of eye to first gill (19), and progressive decrease in one (c) back of eye to third gill/first dorsal height (18); there is, however, considerable overlap in all cases (range only recorded, no other measure of dispersion). Our values (range and mean for *Lt* 605-1 400 group in parentheses) are (a) 25.5 (20.7-27.6, 23.5), (b) 1.26 (0.70-1.38, 0.98), (c) 1.82 (1.74-2.20, 1.98). In spite of the existence of such correlations, indicative of allometric growth, as those noted above, the data of tables 1,2 would seem clearly to indicate that some conventionally recorded dimensions and proportions, while subject to noticeable variation, are not functions of size. Garrick encountered no sexual dimorphism in proportions.

(iv) Comparison with *Isurus paucus* Guitart Manday, 1966: Though the existence of 'a second oceanic species in the Pacific, characterized by having considerably longer pectoral fins' was noted by Garrick & Schultz in 1963 (see above), it was not till 1966 that this form received its present name of *Isurus paucus* Guitart Manday. Though Guitart Manday's account is based on actual material from Cuban waters - male 2 260, male 2 030, female 1 955 mm from snout tip to precaudal pit; the third designated 'ejemplar seleccionado', but pectoral of second illustrated in fig. 2 - his name is proposed as a *nomen novum* for *Lamna punctata* De Kay, 1842, from New York, preoccupied by *Lamna punctata* Storer, 1839, which is a different species, namely, *Lamna nasus* (Bonnaterre, 1788). He considered references to this species occur scattered through the literature, his table of synonymy comprising 12 entries, specimens being variously referred to *Oxyrhina* (*O. glauca*), *Isurus* (*I. glaucus*, *I. dekayi*, *I. tigris*, *I. oxyrinchus*) and *Isurus* (*I. dekayi*, *I. glaucus*), a dozen authors or author groups being involved.

The description of *I. paucus* (second binomen having reference to fewness of specimens — probably attributable partly to the species being oceanic, and partly to its likely occurrence, suggested by the eyes being somewhat larger than usual, in rather deep water) appeared while a description of the same form by Garrick under the name of *Isurus alatus* (second binomen having reference to the specially long pectorals) was in press (holotype male, paratype female, male from 'tropical Indian or Pacific Oceans', supplementary material from tropical Pacific). Garrick notes only two entries in his synonymy: *Isurus glaucus*: Strasburg (in part, 1958, p.357) and *Isurus oxyrinchus*: Fourmanoir (in part, 1961, p.79).

The accounts of Guitart Manday (1966, pp.1-9, figs 1-3) and Garrick (1967, pp.677-687, 689-690, pls 1-4) agree in distinguishing their species by three main features: (a) length of pectorals, (b) relative positions of second dorsal and anal, (c) coloration; both call attention to the character of the dentition, and these are possible further differences in shape of caudal, size of pelvics, depth of body. (a). Guitart Manday (table 1) gives length of pectoral as percentage of length to precaudal pit in *I. paucus* (3 examples) as 30.4, 30.0, 29.2 and in *I. oxyrinchus* (8) as 21.0-23.9 ( $\bar{x}$  22.3), while lengths as percentages of total length from Garrick (tables 1,2) are in *I. alatus* (5) 24.4-26.5 ( $\bar{x}$  25.98) and in *I. oxyrinchus* (5) 16.4-18.4 ( $\bar{x}$  17.32): in our shark the first value is 20.6, the second 16.8, i.e., within Garrick's and barely outside Guitart Manday's range for *I. oxyrinchus*. Guitart Manday institutes also a comparison of length of pectoral with length of upper caudal lobe, finding (table 2) for *I. paucus* 107.7 and for *I. oxyrinchus* (8) 80.1-94.6 ( $\bar{x}$  88.6); Garrick's tables yield 113.6-124.4 ( $\bar{x}$  119.5) and 80.0-86.7 ( $\bar{x}$  84.0); our specimen 80.0. (b). Both *I. paucus* and *I. alatus* are described and figured as having anal base immediately behind second dorsal base. In the Tasmanian specimen anal originates under 0.78 of second dorsal base. (c). 'The dusky coloration on the underside of the snout of *I. alatus* contrasts strongly

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with the immaculate whiteness of this region in *I. oxyrinchus*' (Garrick, p.678): the text goes on to note that the duskiness increases in both extent and intensity with age. In respect of this feature our specimen is quite anomalous, wholly departing from the above (and the general) specification for the short-finned species, and being on the contrary in good agreement (see notes on coloration above) with that for the long-finned species.

Guitart Manday points out that in the teeth of the upper jaw the posterior margin is flatter in *I. paucus*; however, his figure (3 C,D) shows the tooth of *I. paucus* more slender than that of *I. oxyrinchus*, in direct disagreement with both the statement and figures (8, 9) of Garrick, with which latter our material is in accord.

While Garrick's figure shows upper caudal lobe about 1.43 lower lobe (from his table 1.20-1.39,  $\bar{x}$  1.29: cf. *I. oxyrinchus* 1.22-1.43,  $\bar{x}$  1.37) Guitart Manday's figure shows about 1.27 (his measurements 1.35); values for Bigelow & Schroeder's figure (1948, fig. 18) about 1.30 for *I. oxyrinchus* (their measurements 1.33, 1.30); Müller & Henle's figure (1838, pl.29) of type of *I. glaucus* about 1.52; our value high, 1.64; see also above, in particular note on figures by Garrick & Schultz (1963, figs 5, 6) labelled *I. oxyrinchus* (about 1.33) and *I. glaucus* (about 1.44): the relation does not appear to be diagnostic. However, Garrick figures and comments on a relatively prominent terminal lobe of the dorsal lobe together with a particularly developed notch; these features, which may be age dependent, are evident, though to a lesser degree, in the figure of *I. paucus* by Guitart Manday. In our specimen these features show a moderate development. Attention may be called to the tuft-like process below the lower border of the subterminal notch in the Tasmanian shark, the nature of which remains uncertain.

Garrick reported 'In *I. alatus* the anterior margin of the pelvic fin is equal to or only slightly shorter than the distal margin, whereas in *I. oxyrinchus* the anterior margin is notably shorter'. Values of the ratio distal/anterior border for 2 examples of *I. alatus* are 1.00, 1.10, and for 5 examples of *I. oxyrinchus* 1.08-1.53,  $\bar{x}$  1.29: the data are thus scanty and the sets intersect. In our specimen the lengths of the anterior margins and the distal margins differ on the two sides (left 42mm, right 39), the ratio of the latter to the former being left 1.62, right 1.24.

Garrick was inclined, with some reservation, to consider *I. alatus* the more slender species. From his tables we find depth at pectoral as percentage of total length in *I. alatus* (4 specimens) 11.0, 12.5, 13.2, 11.8, in *I. oxyrinchus* (4) 15.3, 13.0, 12.9, 11.6 (Bigelow & Schroeder 11.3, 11.9). Thus while there is a difference in the means of Garrick's data (12.13, 13.20), only one example of *I. oxyrinchus* lies outside the range of *I. alatus*, and, on available data, the suggested distinction appears to be a doubtful one. Our specimen, 14.1.

Guitart Manday stated the eye of *I. paucus* is one-third of preoral length (type, Ls1 955), while Garrick observed of eye of *I. alatus* it is 'slightly larger at all sizes than that of *I. oxyrinchus*'. Since relative size of eye decreases with age, little is gained by direct comparison of data for the two species in his tables (specimens of *I. alatus* on the average noticeably larger); however, when the relevant *Lt* percentage values are plotted against *Lt* a clear distinction becomes apparent. The 5 entries for *I. oxyrinchus* show a progressive decrease with increase in overall length, and the plotting of these coordinates as  $y$ ,  $x$ , respectively, exhibits a good approach to linearity ( $y = -0.000735 x + 2.98$ ;  $t = 7.110^*$ ); a slightly better fit being obtained when  $\log Lt$  is plotted ( $y = 2.1396 \log x + 8.6006$ ;  $t = 8.496^*$ ). Our value is 2.22; as predicted by the two equations above 2.35, 2.33.

It should be noted that numerical results from Garrick's paper cited above are subject to some possible slight error, his tables 1, 2, from which these are derived,

setting out, not absolute measurements, but values calculated as percentages of total length (standard length would perhaps have been appropriate).

Definitive determination. The Tasmanian shark here described is clearly to be referred to *Isurus oxyrinchus* Rafinesque, 1810. However, in its possession of extensive and intense dark mental and gular pigmentation it exhibits a character hitherto believed to be diagnostic of the only other species of *Isurus* now generally recognized, *I. paucus* Guitart Manday, 1966.

#### Family MELANOSTOMIATIDAE

Of the six families of Stomatoidei generally recognized (Greenwood *et al.*, 1966) two, Melanostomiidae and Malacostidae, have not hitherto been reported from Australia, though one species of the latter, *Malacosteus niger* Ayres, 1849, is recorded (Munro 1967) from off New Guinea. In May 1977 the Queen Victoria Museum, Launceston received a stromateoid fish taken from the alimentary canal of a deep-sea trevalla, *Hyperoglyphe porosa* (Richardson, 1845) caught off the east coast of Tasmania: the specimen was secured before digestion was well under way and was readily recognizable specifically. The literature needed for its identification not being available in Launceston, Dr J.R. Paxton, Curator of Fishes, the Australian Museum Sydney, kindly undertook to examine the specimen, and determined it as *Echiostoma barbatum* Lowe, 1843. In returning the specimen Dr. Paxton forwarded also, from the Museum's collection, two other examples taken in Australian waters, suggesting records of these might appropriately be included in a report on the Tasmanian specimen. The writer is deeply appreciative of Dr Paxton's courtesy in making the identification and in providing relevant literature. The range of *Echiostoma barbatum* is given by Morrow & Gibbs (1964) as 'Gulf of Mexico, Caribbean Sea, North and South Atlantic Ocean as far north and east as Madeira, as far south as Capetown'. The species occurs in the central Pacific, Indian Ocean (Legand and Rivaton 1967) and just north of New Guinea (Fourmanoir 1970) and may thus be said to be widely distributed in tropical waters (Parin 1968, Parin and Sokolovsky 1976 and Parin *et al.* 1976).

#### Genus *ECHIOSTOMA* Lowe, 1843

*Echiostoma* Lowe, 1843, *Proc. Zool. Soc. Lond.*, 2, p.88. Type-species, *Echiostoma barbatum* Lowe, 1848.

*Hyperchoristus* Gill, 1884, *Proc. U.S. Nat. Mus.*, 6, p.256. Type-species, *Hyperchoristus tanneri* Gill, 1884 (= *Echiostoma barbatum* Lowe, 1843).

#### *Echiostoma barbatum* Lowe, 1843

*Echiostoma barbatum* Lowe, 1843, *Proc. Zool. Soc. Lond.*, 2, p.88. Type locality: Madeira.

*Echiostoma barbatum*: Morrow & Gibbs, 1964, *Mem. Sears Found. Mar. Res.*, 1(4), p. 482 (synonymy and references, p.486): Krueger & Gibbs, 1966, *Copeia*, 1, p.43 (synonymy and references).

Material. Three specimens: (a) *Ls* approx. 44, *Lt* approx. 50, Port Kembla, New South Wales, F.R.V. *Kapala*, 22 July 1974, 125 fm (230 m), Australian Museum Sydney Reg. No. 1. 18 173 - 028; (b) *Ls* 144, *Lt* 156 (?+), off Paddy's Head, north of Bicheno, east coast, Tasmania, P. Armstrong, 7 May 1977, in alimentary canal of *Hyperoglyphe porosa* (Richardson, 1845), Queen Victoria Museum Reg. No. 1977/5/20; (c) *Ls* 265, *Lt* 286, off coast of Queensland or New South Wales, R. Pine, March 1971, Australian Museum Sydney Reg. No. 1. 19 386 - 001.

Proportions. In the next paragraph proportions of specimens (b) and (c) are recorded in accordance with the schedule adopted by Morrow & Gibbs (1964) in the presentation

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of data on 16 examples, *Ls* 27.2-323 mm (including types of four nominal species or subspecies), their range and mean values being noted in parentheses. Entries are given either as a percentage of standard length (without notation) or as a percentage of head length (marked *HLh*). Specimen (a) is rather strongly contorted and good measurements cannot be made on it.

Depth of body 12.8, 15.8 (10.2-16.8, 12.3). Length of the postocular organ (in present specimens the measurement — following the procedure of Krueger & Gibbs (1966) — is the greatest length of the light-colored portion, and does not include the black tissue surrounding, and closely applied to, the light portion), *HLh*, 37.9, 25.0 (10.2-34.2, 22.0), or 147.1, 201.3 (50-216, 77.0) percent of eye. Length of head 13.9, 16.0 (14.0-17.1, 15.6). Depth of head 12.5, 12.8 (9.5-11.1, 10.5), *HLh*, 85.0, 80.0 (62.6-75.4, 69.1). Snout 1.18, 2.12 (2.7-4.3, 3.3), *HLh*, 27.0, 21.2 (17.9-25.2, 21.5). Eye 2.36, 3.02 (2.2-3.2, 3.3), *HLh*, 17.0, 18.8 (14.2-21.2, 17.1). Interorbital 4.86, 6.79 (5.2-6.2, 5.6), *HLh* 35.0, 42.4 (-, -, -). Base of dorsal 8.08, 7.55 (6.7-9.8, 8.7). Base of anal 8.75, 8.68 (9.2-12.1, 10.5). Length to dorsal origin 86.0, 85.7 (80.9-85.2, 83.1). Length to anal origin 87.5, 86.8 (82.0-85.8, 83.4). Length to pelvic origin 61.1, 61.5 (55.6-62.6, 59.0). It will be seen some entries for one or both of the present specimens fall outside the range recorded by Morrow & Gibbs; however, these variations do not appear to be of particular significance.

Some additional proportions may be noted (all as percentages of standard length). Length to barbel 3.5 (middle of base), 4.2 (middle of socket). Length of barbel 12.5. -. Length to vent (middle 80.5, 84.9. Depth (in parentheses width) at front of eyes 7.6, 6.4 (4.9, 5.5), back of eyes 9.4, 8.3 (6.3, 6.2), end of mouth cleft 11.8, 12.8 (6.3, 5.5), pelvic origin 9.7, 12.1 (3.5, 3.2), vent 6.3, 7.5 (2.6, 3.2); maximum 12.8, 15.8 (6.3, 6.2); depth of caudal peduncle 2.7, 2.3: some dimensions of width may have decreased as the result of preservation. Longest ray, dorsal 5.6, 4.7, anal 5.9, 5.1, pelvic 13.2, 12.1. Isolated pectoral ray 22.9, 32.1 (Krueger & Gibbs (1966), with 40 specimens, *Ls* 51.1-281.7, record 19.6-48.7); other pectoral rays (b) 4.2, 4.9, 5.6, (c) 4.5, 6.2, 7.0. Length (oblique) of upper jaw 13.9, 14.5, of lower jaw 12.5, 13.2. Length of mouth cleft between parallels 11.1, 11.7.

Meristic characters. Ranges of Atlantic examples given by Morrow & Gibbs (1964) are noted in parentheses: Parin & Sokolovsky (1976) have recorded comparable counts in material from the Kurisho Current zone in the western Pacific. D. 11, 11 (11-14). A. 13, 13, 13 (13-18). P. 1 + 3 (1 + 3). V. 8 (8). Serial photophores: *IP* 8 + 2, 8 + 2 (8 + 2), *PV* 26, ca 25 (28), *VAV* 16, - (14-16), *AC* -, - (12-13), *OV* ca 26, ca 24 (24-27), *VAL* 12+, - (13-17): no data for (a).

General observations. (a). Dentition. While the general dental plan is that typical for the species, several variations on published accounts occur: some differences are found between the two specimens and between the two sides of a fish. Premaxillary teeth: (b) 11/8 (left/right) curved barbed fangs, (c) 12/13; (b) 3rd, 5th, 3rd, 5th smaller, inserted externad of neighbours, 1st, 3rd, 5th, 6th/3rd, 5th, 6th, 7th rigid; (c) 4th, 7th, 8th/7th, 8th smaller set externally, 1st, 2nd, 4th/1st, 3rd rigid. Maxillary teeth: (b) 4/2, (c) 7/6 all small, depressible; (b) 16/16, (c) 36/31 minute denticles along sharp ventral edge of posterior portion. Mandibular teeth: all depressible, (b) 8 (4 large)/7 (3 large) moderate or large fangs (2 very small at base of 7th left), (c) 14 (9 large)/13 (8 large); (b) 8/4 smaller teeth in 2/2 rows, (c) 20/15 in 2/2-3 rows (in left jaw these smaller teeth extend forward outside larger teeth to 5th larger). Vomerine teeth: in both specimens 1 moderate, backwardly directed depressible tooth at each outer angle. In both specimens palatine with a single anterior tooth; after a diastema (b) 4/3, (c) 6/6 other teeth of subequal size. On first basibranchial (b) 1 + 2, (c) 1 + 2 + 2; on second basibranchial (b) 1 + 1 + 1, (c) 1 + 2 + 2, on both basibranchials increasing in size backward to large, in all cases first unpaired tooth on left side. In (c) a few minute teeth, not observed in

(b), occur on the first branchial arch. Two contiguous clusters each of 6 fairly stout somewhat recurved teeth are present in (b) on the roof of the oral cavity just behind the level of the end of the mouth cleft; these are not apparent in (c), and are not expressly noted in the published accounts of the dentition at hand.

(b). Cranial spines. Morrow & Gibbs observe 'interorbital nearly flat, with a spiny ridge above each eye, the ridges meeting anteriorly to form a V'. In none of our 3 specimens do the ridges quite meet, being briefly separated by the interposition of the origin of a forwardly directed median ridge. In (b) the structure on each side consists of two ridges of approximately equal anteroposterior extent (about one and a half eye diameters), the hinder bowing outwards markedly at its anterior end, with the front segment originating well inside this curve and running forward, about in the same sense as the straight portion of the hind segment, to about the middle of the snout. On each side the ridge (composite or single) is beset with 9-13 small, compressed, pungent, mostly forwardly directed spines. Other spines on the head include: (i) shortly behind, and external of, each of the ridges just mentioned a short line of 3 spines running backward and outward; (ii) an arc of several spines pointing forward and a similar set overhanging the eye, all arising from an ovoid bony lamina on the orbit near 10 o'clock (left side viewed); a similar group near 3 o'clock.

(c). Barbel. The structure is missing in (c); its position being marked by a conspicuous socket in the form of a deep groove bounded laterally and behind by thick subtranslucent walls of cartilaginous appearance and consistency, and ending anteriorly at a small fleshy knob, probably part of the barbel stem, the fairly firm off-white tissue marked on its flattish distal surface by 8 blackish well-rounded spots, and largely sheathed in thin black integument. In (b) the stem is somewhat flattened proximally, becoming more rounded and increasingly slender for some 15 mm; proximal bulb ovoid, about 2 mm long, more than twice as long as wide, pale orange with blue longitudinal line; next a somewhat flattened segment of comparable length, but narrower, more than half its width occupied by a continuation of the blue streak, rest white (this segment with the appearance of being a stout cord issuing from the concave end of this region), the narrowing distal end followed by two elongate bulblets, side by side, their free ends secondarily bulbous; arising from this region a small lateral bulblet and two filaments, the shorter with its termination minutely bulbous. In (a) the barbel has a total length subequal to that of head. It comprises: a stout stem successively flesh-colored, dark brown, dusky, and, very briefly, yellowish; proximal bulb large, ovoid, arising directly from stem, brownish; distal bulb transversely ovoid, slightly flattened, about two-thirds first bulb, light brown; attached to distal end a group of three small subequal yellow bulblets and two fine terminal filaments, one golden, one, a little longer, subequal to length of proximal bulb, brownish.

Together with size of postocular organ, the structure of the bulb has provided the basis for the establishment of *Hyperchoristus tanneri* Gill, 1884, *Echiostoma etenobarba* Parr, 1927, *E. guntheri* Regan & Trewawas, 1930, *E. calliobarba* Parr 1934, and *E. etenobarba ramifera* Parr, 1934. Studies of long series of specimens has confirmed the existence of only a single species of *Echiostoma*, *E. barbatum* Lowe, 1843, changes in the form of the barbel occurring more or less regularly with age (Morrow and Gibbs 1964, fig. 135, Krueger & Gibbs 1966, fig. 1). While the absence of lateral filaments on the stem in (a), *Ls* about 44 mm, is normal for a specimen of this size, the plain stem of (b), *Ls* 144, is noteworthy, Krueger & Gibbs having found 1-4 filaments on each side near the distal end of the stem in individuals of *Ls* 112-118, increasing to 12-22 at *Ls* about 200: there is of course a possibility lateral stem filaments may have been present in (b), but have been digested off.

(d). Other features. (i) Isolated pectoral ray. Morrow & Gibbs state cleared and stained material shows the isolated first pectoral ray to be composed of 2 rays in a single sheath, with a minute subdermal ray in front of them, all arising from a single

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actinost. In both (b) and (c) the existence of two elements in a common membrane is clearly evident in the proximal portion of the process. (ii) Sex. In their investigation of sexual dimorphism in this species Krueger & Gibbs have found that in individuals of  $Ls \geq 225$  the sex may be determined, with a high degree of probability, by the shape of the postocular organ, which in males of this size has the form of an elongated triangle, whereas in females it retains the pyriform outline characterizing the young of both sexes. On this basis (c) is clearly a male. (iii) Paired light organ. In both (b) and (c) a small white subcircular light organ occurs at the angle of the deep notch between the operculum and the fluted and crenulate suboperculum.

Coloration. General color of (a) dark brown approaching black. Dorsal, anal pelvic, caudal fawn, some dorsal rays with indications of spaced russet cross bars. Postocular organ grey. Inside of mouth black. General color of (b) almost uniform dead black. Dorsal and anal rays and the three grouped pectoral rays greyish, reddish brown cross bars marking the septa, isolated pectoral ray dusky proximally, becoming somewhat lighter distally, lacking pronounced markings. Inside of mouth black. Serial photophores white. General color of (c) mole, rather darker on right side; darkest on occiput and immediately behind head on lower half of body; some darkening behind level of pelvic, least developed along middle of side; indications of a narrow dark streak from occiput along side, more or less following dorsal profile to about level of dorsal origin; whole of body and much of head with numerous small dark spots. Fins mostly light brown with reddish brown cross bars. Postocular organ light yellow. Inside of mouth dark brown. Serial photophores bluish, mostly with more or less definite dark annulus.

Location of fin origins. When lengths,  $L$ , along anteroposterior axis of fish to the origins of the pectoral, pelvic, dorsal, caudal fins are graphed against  $N$ , the natural numbers 1, 6, 8, 10 in a loglog plot, a significantly straight line is obtained. For (b) the regression equation is  $\log L = 0.8622 \log N + 1.2958$ ;  $t = 33.043$  \*\*\*; measured (estimated) lengths, mm, 19.9 (19.9), 88.0 (92.6), 123.9 (118.7), 144.0 (143.9). For (c)  $\log L = 0.9076 \log N + 1.5362$ ;  $t = 19.773$  \*\*; lengths 34.2 (34.4), 163.0 (174.7), 247.0 (226.9), 265.0 (277.8).

## Family GONORYNCHIDAE

Genus *GONORYNCHUS* Scopoli, 1777

*Gonorynchus* Scopoli, 1777, INTROD. HIST. NAT., p. 450. Ex Gronow, 1763, non-binomial. Type-species, *G. gonorynchus* Meuschen.  
*Rhynchana* Richardson, 1845, Zool. VOY. EREBUS AND TERROR, FISH., p.45. Type-species, *R. greyi* Richardson.

*Gonorynchus greyi* (Richardson, 1845)

*Rhynchana greyi* Richardson, 1845, Zool. VOY. EREBUS AND TERROR, FISH., p.45, pl. 25, figs 1-6 and one text fig. Type locality: Western Australia.

Remarks. This species, found in all Australian states (and, if *G. forsteri* Ogilby, 1911 is not distinct, in New Zealand), appears in all published Tasmanian lists, and earlier in the MS list of Allport, on which Johnston's first catalogue (1883) was based. While the original spelling of the generic name is retained in the Check-list (McCulloch 1929) and was regularly employed by Whitley (1962, 1964, 1968), the emendation to *Gonorhynchus* proposed by Cuvier (1816, p.196) has been adopted in all local lists (Johnston 1883, 1891, Lord 1923, 1927, Lord & Scott 1924) and in a number of recent Australian texts (e.g., McCulloch & Whitley 1925, Munro 1956b, Marshall 1964, Scott *et al.*, 1974), and is accepted (in the form of the family name) by Greenwood *et al.* in their provisional classification of living teleosts (1966). In

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Tasmania this species is usually known by the vernacular name of Beaked Salmon (Lord, Lord & Scott) but is also spoken of as the Sand Eel (Johnston); Marshall (1964) notes both these are used in some other States, adding Mouse-fish (Southern Queensland, New South Wales) and Rat fish (Western Australia), while Scott *et al.* in their South Australian Catalogue give Sand Fish.

Material. The present observations are based on an example, (a), *Ls* 215.5, *Lt* 241.5, taken by Mr Shane Downe in 32 fm (about 60m) at Eddystone, east coast, 10 July 1977 (Q.V.M. Reg. No. 1977/5/29), and an example, (b) *Ls* 240, *Lt* 273, collected by Mr Charles Andrews at George Town, north coast, in 1939 (Q.V.M. Reg. No. 1939/0053).

Dimensions as *TLs*. In this species some commonly recorded proportions exhibit wide variation — thus the Handbook (Munro 1956, p.28) gives depth 9-14.8, head 5-6.3 in length without caudal (in our specimens, 9.4, 8.0; 4.9, 5.1). The principal dimensions of our examples are here noted, given as permillages of standard length; smaller individual recorded first.

Length to dorsal origin 689,696, termination 763,771; to anal origin 828,848, termination 884, 919. Length to pectoral origin, front of base 200,203, insertion of rays 209,221; length of fin, from front of base 148,171, from insertion of rays 125,158. Length to pelvic 647, 688; total length of fin 111, 109. Length to vent 817,835. Head 205.198. Snout 74,78. Eye 44,35. Interorbital 41,49. Length to mouth, front 43,42, back 58,54; width of mouth 19,20. Depth (in parentheses width) at front of eye 65 (58), 56 (60), back of eye 74 (67), 69 (66), operculum 95 (104), 117 (96), pelvic origin 97 (88), 108 (77), vent 77 (60), 88 (63); maximum 107 (head 104, trunk 102), 125 (head 96, trunk 98); caudal peduncle 52 (16), 54 (14).

Meristic characters. D. 12, last divided to base; 10, last divided to base. A. 9, last divided to base. V.IV.P.10, 11. C. 20.

Location of unpaired fins. The dorsal and anal fins are set far back: in the course of the handling of Mr Downe's specimen the impression was gained that there subsists an exponential relation between their location and overall length of fish. The plots of the logarithms of the four measurements length to origin of dorsal, to origin of anal, to origin of caudal (*Ls*), end of caudal (*Lt*) on logs 7,8,9,10 were found to be virtually collinear with each other and also with the plot on log 1 of log length to back of mouth. The relevance of the last dimension in a set of which all the other members involve fins is not apparent: trial was made of it here on purely pragmatic grounds, it having been found earlier, in a number of species of sharks, to be appropriately incorporated in similar fin plots. With  $L$  = length from the tip of snout to designated point on anteroposterior axis of fish and  $N$  = appropriate natural number the equation thus is  $L = bN^k$ , rectifiable as  $\log L = k \log N + \log b$ . The best straight line (sum of squares of logarithmic, not arithmetic, deviations minimized) for specimen (a) is highly significant, with  $t = 103.953^{***}$ . With  $L$  measured in millimetres and  $N$  the relevant member of the set {1,7,8,9,10} the equation is  $\log L = 1.2746 \log N + 1.1056$ , giving estimated (in parentheses, measured) lengths as follows, 12.8 (12.8), 153.2 (148.5), 180.6 (178.5), 210.0 (215.5), 240.0 (241.5). The equation for (b) also is highly significant, with  $t = 171.395^{***}$ :  $\log L = 1.3225 \log N + 1.1130$ ; 13.0 (13.0), 170.5 (167), 202.5 (203.5), 237.1 (240), 272.6 (273).

Location of paired fins. The insertions of the paired fins are similarly located at what may be termed integral nodes, represented by natural numbers along a logarithmic scale. As for the fins, that scale covers the range 1-10. Again as before, the anterior point on the morphological scale is provided by back of mouth, and the posterior point remains a morphologically significant terminal entity, being here, however, not the end of the whole fish, but the end of the precaudal region. With  $L$  = length to a member of the set {back of mouth, pectoral origin, pelvic origin, vent}

## Observations on some Tasmanian Fishes

and  $N$  = relevant member of the set {1,3,8,10} the best straight line for specimen (a) is  $\log L = 1.1423 \log N + 1.1079$ ;  $t = 153.988^{***}$ ; estimated (measured) lengths 12.8 (12.8), 44.9 (45.0), 137.9 (139.5), 177.9 (176.0): for (b)  $\log L = 1.2021 \log N + 1.1145$ ;  $t = 34.520^{**}$ ; 13.0 (13.0), 48.8 (48.5), 158.5 (165.0), 207.3 (200.5).

It will be seen the correspondence between predicted and measured values is in both cases quite good, and it would seem probable the exponential relation as formulated, like that for the paired fins, specifies a definite pattern of fin placement in this fish, the natural numbers here represented by their logarithms being characteristic at species (or genus) level, the magnitude of the numerical parameters being correlated positively with overall length of specimen.

## Family ANTENNARIIDAE

Only a single antennariid is credited to Tasmania in the Check-list (McCulloch 1929), *Trichophryne mitchellii* (Morton, 1897), described from this State and since found in South Australia, Victoria and New South Wales. In Part II (1935, p.71, pl. 5, fig. 2) an example from the Tamar Heads, north coast, of the widely distributed *Rhycherus filamentatus* (Castelnau, 1872) was noted and figured: it has since been taken here on several occasions. A third species, *Echinophryne crassispina* McCulloch & Waite, 1918, previously known only from South Australia and Victoria, is here added to the local list. The following key will serve to separate the Tasmanian representatives, all of the subfamily Antennariinae.

## KEY TO ANTENNARIIDAE RECORDED FROM TASMANIA

1. Skin smooth. Body with numerous fleshy processes (some branched). First dorsal spine smooth; illicium large, including two vermiform processes. Third dorsal spine mobile, rodlike. Second and third dorsal spines with fleshy processes. Size larger, to about 0.25 m ..... *Rhycherus filamentatus*  
 Skin with spines or bristles. Body without fleshy processes. First dorsal spine spiny; illicium small, filamentous or a group of small spines or processes. Third dorsal spine enveloped in skin, knoblike. Second and third dorsal spines without fleshy processes. Size smaller, to about 0.15 m ..... 2
2. Dorsal rays 13-14. First dorsal spine rodlike, slender, as long as, or longer than, dorsal rays. Second dorsal spine similar to first, its length < 3 in soft dorsal base ..... *Trichophryne mitchellii*  
 Dorsal rays 15. First dorsal spine rather stout, shorter than dorsal rays. Second dorsal spine stouter than first, conical, wholly enveloped in skin, its length > 3 in soft dorsal base ..... *Echinophryne crassispina*

Genus *ECHINOPHRYNE* McCulloch & Waite, 1918

*Echinophryne* McCulloch & Waite, 1918, *Rec. S. Aust. Mus.*, 1(1), p.66. Type-species, *Echinophryne crassispina* McCulloch & Waite, 1918.

*Echinophryne crassispina* McCulloch & Waite, 1918

*Echinophryne crassispina* McCulloch & Waite, 1918, *Rec. S. Aust. Mus.*, 1(1), p.67, pl. 6, fig. 2. Type locality: Spencer Gulf, South Australia (holotype), Western Port, Victoria (paratypes).

*Echinophryne crassispina*: McCulloch, 1929, *Mem. Aust. Mus.*, 5(3), p.408: Schultz, 1966,



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*U.S. Nat. Mus. Bull.*, 202(3), p.140: Scott, Glover & Southcott, 1974, MAR.  
FRESHW. FISH. S. AUST., p. 298, unnumbered fig. on p.299.

Material. A specimen, *Ls* 44, *Lt* 57, east coast of Flinders Island, Bass Strait, September 1974, Mr J. O'Shea, Queen Victoria Museum Reg. No. 1975/5/13.

Meristic characters. D. I, I, I, 15. A.9. P.11. V.5. C.9.

Proportions. No set of measurements of this species appears to be available. The following entries are all expressed as permillages of standard length; 'length to' connotes length from most advanced point (chin), which is in front of tip of upper jaw by 2 mm. Total length 295. Length to first dorsal spine 73, second dorsal spine 104, origin, termination of mounded base of third spine 266, 386. Length to origin, termination of soft dorsal 455, 966, of anal 761, 989. Length of first dorsal spine 161, second dorsal spine 136. Height of third dorsal spine above its posterior insertion 45; basal diameter, longitudinal 148, transverse 91. Length of longest dorsal ray 132, last ray 116; longest anal ray 136, last ray 45. Length to origin of pectoral, at embedded base of pseudobranchium 364, at external base 420; length of fin (including elbow) 220; length of longest ray 116; interval between pectoral bases 409. Length to origin of pelvic 750; length of longest ray 114; anteroposterior extent of base 91; interval between bases, at anterior border 136, at posterior border 148. Length to vent 750. Head, to end of operculum 443, to gill opening 477. Eye 54. Inter-orbital 116. Snout, from most advanced point (chin) 125, from tip of upper jaw 80. Depth (in parentheses width) at front of eyes 341 (250), back of eyes 386 (273), pelvic origin 420 (341), vent 386 (182); maximum 451 (354); caudal peduncle 134.

General observations. Though the present specimen exhibits some differences when compared with the original account and figure of *Echinophryne crassispina*, it appears to be satisfactorily referable to this species. Accordingly, no full description is here provided, the points noted either complementing the original account or representing some variation from it (where appropriate, original data are cited in parentheses). Depth 2.2 (1.7) in *Ls*; head 2.3 (2.6-2.9) in *Ls*; eye in snout, from tip of upper jaw 1.46, full 2.29 (1.2-1.5); first dorsal spine 2.75 (7) in head [7', but figure suggests 2.5-3.0; later 'about as long as the distance between the snout and the hinder border of the eye', i.e. from figure, 2-3 in head: is 7 in *Ls* intended?], laid back, reaches more than halfway up second spine. 'Nostrils superolateral, the anterior with a low skinny margin' — the only narial element identifiable in our specimen is a depressed flat longitudinally elliptical yellowish membrane about midway between snout tip and eye, at level of upper half of latter; it has a slightly elevated fleshy rim: internarial distance about half interorbital. There is a well developed palatal frenum. Teeth in the jaws confined to the anterior two-thirds of jaw, mostly uniserial in upper jaw, in at least three rows in front of lower jaw. Orbit surmounted by spines tending to form groups of 2-3. A local concavity below, and largely external of, the eye. Gill opening small, immediately below outer border of base of pseudobranchium.

Apart from variations in proportions noted above, the chief differences exhibited by the Tasmanian fish are the following. Maxilla barely reaching to front (posterior) margin of eye. It is noted of the first dorsal spine that 'only the extreme tip is fleshy'. Here the spine (slender, spinulose throughout), after narrowing slightly and briefly near its distal one-fifth, expands somewhat to an ovoid termination beset with a score or so spinules, slender, erect, pungent, noticeably larger than those immediately preceding them and many times more massive than most in the proximal part of the fin spine. The presence of spinules differentiates this species from *E. glauerti* Whitley, 1944; cf. Schultz (1966, p.140). The nature of the terminal portion of the first dorsal spine has been accorded taxonomic significance (generic diagnosis of *Echinophryne*, spine 'terminated by a minute fleshy process'): the matter would seem to call for further investigation. The general appearance of the fins is here very

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different from that presented in McCulloch & Waite's figure, in which the rays are clearly evident throughout their length: in our specimen the dorsal, anal and caudal rays are enveloped in thick, opaque, abundantly spinose skin to within a millimetre, or less, of the tip; beyond the sheath they project, still enveloped in spinose membrane, as short triangles, a feature shown in the figure in the dorsal (triangles less conspicuous), but not indicated at all in the anal or the caudal. The dorsal terminates in advance of (slightly behind) anal termination: the fin is much lower here, length of longest ray about equal to (approaching twice) combined eye and snout. The anal is much more pointed, rays in the posterior half of the fin decidedly longer than (subequal to) those in the anterior half. The second dorsal spine is more slender. The region between the bases of the second and third dorsal spines, figured as mounded, is strongly excavate.

Coloration. Body dark (on left side chestnut, on right dark brown) above a line from upper angle of operculum to just above pectoral base; elsewhere mostly (on ventral surface wholly) whitish: none of the six white patches reported by Waite & Hale are evident. Head with upper half mostly dark brown (left) or chestnut with a yellow patch behind eye; lower half of lateral surface yellow; ventral surface white, in places faintly yellowish. Dorsal spines pale brownish; soft dorsal greyish or brownish in proximal four-fifths, rest pale yellow. Anal mostly very pale yellow, with some proximal duskiness. Pectoral chiefly pale yellow; a small dark smudge at tip of each ray. Pelvic concolorous with ventral surface. Caudal pale yellow. Inside of mouth, including frenum, white; small rounded red-brown spots along whole length of upper jaw; lower jaw yellowish below; somewhat dusky along its oral border.

Location of fins. The location of the insertion of the fins along the anteroposterior axis of the fish is a function of an arbitrary set of integers of increasing magnitude, being specified by  $L = bN^k$ , where  $L$  = length to fin origin and  $N$  = an appropriate natural number. Log lengths to origin of {first dorsal (first spine), pelvic, pectoral (embedded anterior end of pseudobranchium), second (soft) dorsal, anal, caudal} yield a statistically significant straight line when plotted against logs {1,2,4,5,8,10}, the regression equation ( $L$  in mm) being  $\log L = 1.1363 \log N + 0.5068$ . The fit is very satisfactory;  $t = 210.333^{***}$ . Measured (predicted) lengths are 3.2 (3.2), 7.0 (7.1), 16.0 (16.5), 20.0 (20.0), 33.5 (34.1), 44.0 (44.0).

Head and trunk in plan. As in some other antennariids the greater part of the ventral surface is not far from plane. The head and body together form a nearly complete ovoid, followed by the rapidly narrowing tail. The outline has been traced, discounting the partial interruption to the general outline occasioned by the pectoral bases, and 10 measurements have been made at equal intervals between vent and snout tip; these are found to be very satisfactorily fitted by a fourth degree polynomial ( $R$  0.9985). With  $W$  = width as permillage of length to vent and  $N$  = serial number of dimension, counting cephalad, the equation is  $W = -18.57 + 230.22 N - 33.4460 N^2 + 2.17485 N^3 - 0.083031 N^4$ . Observed (in parentheses estimated) widths are 180 (181), 326 (324), 420 (423), 486 (485), 517 (516), 523 (521), 497 (501), 457 (456), 386 (385), 283 (284); percentage discrepancy between given and calculated values 0.1-0.8,  $\bar{x}$  0.4. The third degree equation, with  $R$  0.9979, is  $W = 9.93 + 193.68 N - 20.0779 N^2 + 0.348158 N^3$ .

## Family CARAPIDAE

Though Fierasferidae is favoured by some authors, e.g., Boulenger (1910), Berg (1940), the name Carapidae is now in general use among both Australian and overseas writers. In earlier texts, e.g., Johnston (1883, 1891), Macleay (1882a), species now referred to the present family were included (along with, among Australian genera, *Genypterus*) in Ophidiidae. Two species, *Carapus homei* (Richardson, 1846) and *Carapus rendahli* Whitley, 1941, have been reported from Tasmanian waters: these records, however, may be regarded as doubtful (see below).

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Members of this family, known vernacularly as Messmate Fish or Pearlfish, are small forms, found usually in littoral waters, particularly around coral reefs, where they live mostly in sponges, in ascidians, in the mantle cavities of molluscs, and in the intestines of asteroids and holothurians, entering the cavity of the host tail first. The relation appears to be one of messmateism, rather than commensalism, the fish emerging at night to feed on crustacea. The planktonic young, which are said to float upside down, possess a long dorsal filament, and have the coils of the intestine outside the body.

## KEY TO CARAPIDAE REPORTED FROM TASMANIAN WATERS

1. Vent in advance of pectoral base, Interorbital somewhat convex.  
Predorsal length > 1.5 (1.7-1.9) head length behind snout tip.  
Head < 8.5 (6-7.5) in total length. Depth < 16 (9-14) in total length. Vomer with 1-4 centrally placed canines .....*Carapus homei*
2. Vent behind pectoral base. Interorbital flat or concave, with median ridge. Predorsal length < 1.5 (1.1-1.2) head length behind snout tip. Head > 8.5 (10-11) in total length. Depth > 16 (18.5-19.5) in total length. Vomer without canines.....*Carapus rendahli*

Genus *CARAPUS* Rafinesque, 1810

*Carapus* Rafinesque, 1810, INDICE D'ITTIOLOGIA SICILIANA..., pp.37,57. Type-species, fixed by Intern. Comm. Zool. Nomencl., *Gymnotus acus* Linné. Not *Carapo* Oken = *Carapus* Cuvier, 1816, nor *Carapeus* Valenciennes, 1847, different genera of fishes. *Fierasfer* Oken, 1817, *Isis*, p.1 182a. *Nom. nud.*, ex Cuvier vernac. ('Les Fierasfers'). *Fierasfers* Costa, 1834. CENNI ZOOLOG., p.46. Type-species, *Gymnotus acus* Gmelin. *Oxybeles* Richardson, 1846, ZOOLOG. VOY. EREBUS AND TERROR, FISH., p.73. Type-species, *Oxybeles Homei* Richardson.  
? *Jordanicus* Gilbert, 1905, *Bull. U.S. Fish. Comm.*, 23(2) (1903), p.659. Type-species, *Fierasfer umbratilis* Jordan & Evermann.  
*Echiodon* Thompson, 1837, *Proc. Zool. Soc. Lond.*, 5, p.55. Type-species, *Echiodon drummondii* Thompson. *Partim* = *Echiodon rendahli* (Whitley, 1941).  
? *Onuxodon* Smith, 1955, *Ann. Mag. Nat. Hist.*, ser. 12, 8, pp. 403-404. Type-species, *Carapus parvibrachium* Fowler.

*Carapus homei* (Richardson, 1846)

*Oxybeles Homei* Richardson 1846, ZOOLOG. VOY. EREBUS AND TERROR, FISH., p.74, pl.44, figs 7-18. Type locality: Timor.  
*Fierasfer Homei*: Macleay, 1882, *Proc. Linn. Soc. N.S.W.*, 6(1), p.120.  
? *Fierasfer Homei*: Johnston, 1883, *Pap. Proc. R. Soc. Tasm.*, (1882), p.127; *ibid.*, 1891 (1890), p.35 - Tasmanian record.  
*Carapus homei*: McCulloch, 1929, *Aust. Mus. Mem.* 5(3), p.359: de Beaufort & Chapman, 1951, FISH. INDO-AUST. ARCHIPELAGO, 9, p.450 (synonymy).  
*Oxybeles Brandesii* Bleeker, 1851, *Nat. Tijdschr. Nederl. Ind.*, 1, p.278. Type locality: Banda, East Indies.

Tasmanian status. In the first published list of Tasmanian fishes (Johnston 1883) the present species is included on the evidence of the manuscript list of Morton Allport on which Johnston's catalogue is based. Johnston observes 'Rare. I have not seen any specimens': he cites (in accordance with his regular practice) the catalogues of Günther (1862) and Macleay (1882b), and notes 'Tasm. (Rich.)'. This raises the matter of the type locality, about which there is some apparent confusion. Of the four specimens listed in the British Museum catalogue (Günther 1862, p.382), one, d, half-grown, is recorded as being from the Feejee Islands (Herald), two, b-c, from Amboyna,

## Observations on some Tasmanian Fishes

while the entry for a reads, 'Adult. Tasmania. Presented by Sir John Richardson — Type of the species'. However, Richardson's account of his *Oxybeles Homei* (1846, p.75) has 'Hab. Seas of Australia? and Timor'. Macleay's Australian catalogue, cited by Johnston (species 774) makes no mention of Tasmania, giving the (Australian) distribution as 'Torres Straits (Chevert Exp)'. The species appears, without comment, in Johnston's second catalogue (1891). Of possible explanations of the confusion the simplest would appear to be that the entry 'Tasmania' in the British Museum catalogue is an error (? slip for Timor). de Beaufort & Chapman (1951 p.452), who list some two score widely spread localities (e.g., Borneo, New Guinea, Madagascar, Philippines, Ceylon, Hawaii, Fiji), include Tasmania; however, they indicate this is not a locality from which they have examined examples, and it is probable their entry is based on the British Museum attribution.

Johnston's (or, rather, apparently, Allport's) record has been regarded by later writers as suspect. Tasmania is not included in the distribution in the Check-list (McCulloch, 1929), and the species was dropped earlier, without comment, from local lists (Lord 1923, 1927, Lord & Scott 1924). While *Carapus homei* is known to occur — together with *C. houlti* (Ogilby, 1922) — in Queensland, there appear to be no reliable records of it in any other Australian State: *C. margaritiferae* (Rendahl, 1921), with type-locality north-western Australia, extending to New Guinea (Munro 1967) and to the Indo-Australian Archipelago (de Beaufort & Chapman, 1951), appears to be confined in Australia to the west of the continent. Thus, apart from entries in Johnston's catalogues, the only species of *Carapus* reported from our region — provisionally, on the basis of larval specimens, by Whitley (1941), and definitively on the evidence of the adult or subadult example noted below — is *C. rendahli*, Whitley, 1941. It is suggested it is probable Allport's reference is to that species, and hence *C. homei* (Richardson, 1846) has (as earlier local writers have concluded, though on somewhat different grounds) no satisfactory status in respect of the Tasmanian faunal list.

*Carapus rendahli* Whitley, 1941

- Fierasfer* sp. Rendahl, 1925, *Vidensk. Medd. Dansk. Nat. Foren.*, 81, p.13. Type locality: From surface at 36°S, 150°20' E (*Endeavour*), New South Wales.
- Carapus* sp. Whitley, 1934, *FISH. AND FISHLIKE ANIM. N.S.W.* (McCulloch), ed. 3, suppl. Type locality: off Green Cape, New South Wales.
- Carapus rendahli* Whitley, 1941, *Aust. Zool.* 10(1), p.40, fig. 27. Type locality: Port Jackson, New South Wales.
- Echiodon rendahli*: Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89(1), p.54; 1968, *Aust. Zool.* 15(1), p.82.
- ? *Carapus rendahli* Whitley, 1941, *Aust. Zool.*, 10(1), p.41; larval specimens 'provisionally identified' as this species, netted by the C.S.I.R. vessel *Wareen* at six stations in the Tasman Sea, five off New South Wales, one (station 284/39, 42°15' S, 148°38' E) off eastern Tasmania.
- ? *Fierasfer Homei*: Johnston, 1883, *Pap. Proc. R. Soc. Tasm.*, (1882), p.127; *ibid.*, 1890 (1889), p.35. Not *Oxybeles* (= *Fierasfer*) *Homei* Richardson, 1846.

Tasmanian status. The type locality of *Carapus rendahli* is Port Jackson, New South Wales, the species being based on a specimen of total length 193 (but end of tail truncately broken off), purchased by the Australian Museum in 1889 (Aust. Mus. Regd. no. 1 2 411). At the conclusion of his account of this specimen Whitley (1941) mentions also two specimens trawled by the *Endeavour* off Tuross River, N.S.W., in 1914, one specimen from Green Cape, N.S.W. and 'many small examples in various stages of metamorphosis' netted by the C.S.I.R. vessel *Wareen* in 1939-39. Of the six stations at which material was obtained, five are in the Tasman Sea off N.S.W. (at 30°-36°S, 150°-153°E) and one station 284/39) off eastern Tasmania — the position recorded (42° 15' S, 148°38' E) would locate the point of collection round about 25 km east of the lower half of Freycinet Peninsula. This record provides the only association known

to date of *C. rendahli* with Tasmania (and no great reliance can of course be placed on a provisional specific determination of larval material). An adult or subadult example is here reported from a locality some 130-150 km northward of the *Wareen* station.

*Carapus rendahli* appears in the New Zealand Check-list (Whitley 1968), the entry being based on *Fierasfer* sp. Rendahl, 1925, and being referred to the genus *Echiodon* Thompson, 1837. In the course of a note on Rendahl's fish (obtained by Dr Mortensen from shepherds, who found it on the shore of Perseverance Harbour) Whitley notes that in his catalogue Günther (1862) wrongly listed New Zealand (error for New Ireland) under the genus *Fierasfer* (*Carapus*).

Present material. A specimen Lt 125, was taken at Eddystone, near the north-eastern corner of Tasmania, in 32 fathoms (60 m) by Mr Shane Downe on 10 July 1977 (Q.V.M. Reg. No. 1977/5/32). There has been some loss of tissue from the postorbital portion of the head, and the left pectoral is missing (result of maceration?).

Dimensions and proportions. Where proportions for the holotype, total length 93 mm, imperfect near tip of tail, are given or are calculable from measurements recorded these are here shown in square brackets. Some variates in total length (125): head (12.5 mm) 10 [8.4]; depth, maximum for head (6.4) 19.5 [18.5], maximum for trunk (6.1) 20.5; maximum for tail (5.4) 23.1; length to middle of vent (16.5) 7.6, to dorsal origin (15) 8.3 [7.8], to pectoral origin (13.3) 9.4, to anal origin (19.5) 6.4. Some variates in length of head (12.5): eye (2.9) 4.3 [2.8], snout (2.0) 6.3 [4.2], interorbital (1.6) 7.8 [8.4], greatest width of head (4.9) 2.6 [2.1], length of upper jaw (7.5) 1.7 [ $\geq 1.4$ ], length of pectoral (4.1) 3.0 [3.4]; depth at front of eyes (3.8) 3.3, at back of eyes (5.2) 2.4, at operculum (6.1) 2.0, at middle of length of tail (4.8) 2.6; width at same points (3.1) 4.0, (3.6) 3.5 (4.3) 2.9, (1.5) 8.3.

Other Features. Body compressed, tapering, stiletto-like, becoming highly attenuate posteriorly, the last half-head length or so almost filamentous; not gibbous, dorsal profile not noticeably more arched than ventral. Head moderate; compressed, but thicker than body. Snout broad, bluntly pointed; dorsal profile immediately above mouth subvertical (slightly proconvex) to about level of middle of height of orbit, behind this overall gently convex, the curve less pronounced backward from about level of preopercular border; lower profile much the same as general dorsal sweep in reverse. Mouth terminal, cleft somewhat oblique, at front just below level of lower border of orbit, sloping back and down, at rather less than  $10^\circ$ , extending beyond eye by about two-thirds eye diameter. Upper jaw the longer, lower received within it. Whole extent of upper margin of gape provided by the long slender non-protractile premaxilla; maxilla slender, extending shortly past angle of gape, broadening backward, rounded terminally. Eye large, about one and a half snout, approximately equidistant from gape and dorsal profile. Interorbital narrow, a little more than half eye, bounded by high supraorbital ridges and divided by a median ridge (see below), between ridges convex anteroposteriorly concave transversely. Lower jaw with fleshy lip, not hidden under skin; lips united at symphysis by broad fleshy fold.

The account of the holotype describes the snout as 'with bony crests', but provides no details of a complex system of cephalic crests and ridges, particularly well developed on the snout where it accounts for something like one-third of the total lateral and dorsal preorbital area, but extending also on to the postrostral head. The chief elements are: (a) a high ocular crest embracing the eye above from 2 o'clock (left side viewed), where its effective termination is marked by its junction with two other ridges, to about 10 o'clock, where it makes contact with the antero-posterior angle of the (much inflated) preopercular region, below which point it begins to lose height rapidly, but remains traceable downwards and forwards almost to 6 o'clock; (b) just above upper lip a small subrectangular area, its borders elevated; (c) above (b) and contiguous with it a smaller trapezium, widest anteriorly; (d) from

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midpoint of hind border of (c) a median ridge running back to near middle of antero-posterior extension of eye, where it divaricates briefly to embrace a minute forwardly directed median spur from the anterior border of the brain, visible as an opaque mainly whitish, partly yellowish mass through the cranial wall (subelliptical, its length, which is about twice its width, somewhat exceeding an eye diameter, its minor axis occupying half width of dorsum at that level; no obvious division into regions); (e) a very fine median ridge traversing most of region through which brain is apparent; (f) immediately behind brain a ypsiliform system, paired elements anterior, unpaired obscurely traceable back almost to end of head, lapsing to extinction a little in advance of the minute point indicating the site of the remarkable dorsal spine developed in the larval stage and later lost; (g) two strong rather blunt crests (showing some signs of developing two subparallel ridges) arising from near middle of sides of (b), running out and back to meet orbital ridge, (a), at its effective anterior termination; (h) from posterior angles of (c) short paired forwardly convex areas to orbital crest briefly in advance of its junction with (g), both these points wholly on the dorsal surface; (i) from point of junction of (a) and (g) a high straight double ridge running obliquely down and forward on side of head about to level of lower border of pupil (this is fully continuous with the main ocular crest, and could be interpreted as being a direct continuation of it; however, its course represents a marked change of direction, and this, in conjunction with its difference in general character, suggests it may conveniently be regarded as a distinct element); (j) an obscure ridge running down and forward from (i) at its lower end; (k) a ridge down and somewhat back from anterior end of (g) subparallel with (i), almost making contact with (h) at its lower end. In several places the ridge pattern is such as to result in the demarcation of four-sided or somewhat rounded regions.

In the upper jaw the teeth form a villiform band, widest in its middle half or more, where there are some 5-6 rows, but not varying greatly in width throughout most of its length: outermost teeth somewhat larger than rest, subulate, closely set, visible from the exterior along whole length of premaxilla in a row of about three score; in the front of the jaw two pairs of relatively enormous teeth curve right down over the external surface of lower jaw; they can readily be traced into the upper jaw for a distance subequal to their exposed length; their total length, about 0.7 mm, subequal to interval between the pairs. Teeth in the lower jaw in villiform bands similar to those in upper jaw: in front on each side a pair of very large canines, inner larger, straighter than those of upper jaw and inserted just outside them, a small medial point (fleshy?) between the two inner. Palatine with a narrow band of villiform teeth somewhat larger than those in jaws. Vomerine teeth in a low broad mound, somewhat coarser than those in jaws, larger near the middle, but none distinctly caniniform.

Skin smooth. Branchiostegals probably 7 (region damaged). Gill openings wide, extending forward nearly to level of eye, united across isthmus. Lateral line originating on dorsum at upper angle of preoperculum, dipping down quickly to straighten out immediately behind vent, where its distance from ventral profile is 1.3 that from dorsal profile; thereafter continuous to tip of tail, its later portion virtually equidistant from upper and lower borders of body. Its nature is difficult to determine; anteriorly it appears to be nothing more than a simple groove, while in the last quarter of its length, where the shrunken condition of the fish makes it possible to recognize the outlines of the vertebrae, there are indications of its being divided into short linear segments by rather stout transverse septa, but these structures may be adventitious. Vent an elliptical aperture, its major (anteroposterior) axis 1.3 eye; anterior border behind anterior insertion of pectoral by twice oblique width of pectoral base; adpressed pectoral reaching back to about one-fourth of vent; whole opening filled by slightly exserted intestine, pale yellowish with some black peripherally (in the larval stage the intestine is evident in the form of extrasomatic loops).

The dorsal appears to originate about an eye diameter behind head, the anal begins shortly behind the vent; both continuing back uninterrupted to meet in an acute point at tip of tail there thus being no caudal fin. It is difficult to obtain a clear idea of their vertical extent, the finrays being either missing or so closely adherent to the skin as to be almost impossible to tease out (*cf.* Richardson's figures of the types of *C. homei*). An anal ray in the last one-fourth of the length of the fin is 4.7 mm, or 1.6 eye diameter, in length, a dorsal ray in the same region 3.0. Rays unbranched, tapering, flexible. Only right pectoral present; base slightly oblique downward and backward, a little closer to dorsal than to ventral profile; fin slender, pointed, its length 1.4 eye; 15 rays can be counted, but it is possible some may be missing.

Coloration. After preservation in alcohol, head and first one-sixth or so of body whitish (preoperculum dead white), thereafter becoming increasingly tinged with yellowish, color deepening in about last one-seventh to dark brownish. Brain, visible through cranial wall, mainly whitish, partly yellowish; an arc embracing hind border of brain and extending forward laterally for about half the length punctulated with minute melanophores, most densely set posteriorly; a few scattered melanophores in advance of this. Some melanophores on inner surface of posterior half of dorsal portion of orbital crest; continued around most of hind border of orbit. Along bases of both dorsal and anal over the last 60 or so vertebrae (representing a length of some 35 mm) a line of well-defined black dots. All fins whitish.

Discussion. Whitley (1941, p.42) has drawn attention to some differences between his species and its Australian congeners. His remarks are here noted, and subjected to some quantification and to some extension.

*Carapus houlti* (Ogilby, 1922); type locality off Double Island Point, South Queensland; distribution (McCulloch, 1929), Queensland. *C. rendahli* differs 'in being much more slender and in having different proportions in the parts of the head, also in having canine teeth'. Whitley's species has depth in total length 18.5-19.5; *cf.* 8.5-9.7; dorsal profile not arched, *cf.* strongly gibbous (hence Ogilby's suggested vernacular name, Hump-backed Messmate); eye in holotype, 2.8 in head, noticeably larger, but not so in Tasmanian specimen, 4.3, *cf.* 4.5-5; vomer without distinct canines, *cf.* 'with four strong, close-set caninoid teeth, situated one behind the other, the third from the front the largest'; head thicker, *cf.* thinner, than body.

*Carapus margaritiferae* (Rendahl, 1921); type locality, Cape Jaubert, North-western Australia; distribution (McCulloch, 1929), North-western Australia (and extralimital, including coast of Flores, Saleyer) (referred by Munro (1967) to *Onuxodon* Smith, 1955). Resembles *C. rendahli* in having 'similar dentition' (= broadly similar), but 'differs in proportions of head and body and has longer pectoral fins'. Present species has depth in total length 18.5-19.5; *cf.* 9.4-11.6; interorbital concave with median ridge, *cf.* convex; greatest width in greatest height 1.3 (Tasmanian specimen), *cf.* 2.2-3.4; pectoral 3.0-3.4 in head, *cf.* 1.7-2.

*Carapus homei* (Richardson, 1846); type locality, Timor (see remarks above on British Museum entry, Tasmania), distribution (McCulloch, 1929), Queensland, East Indies, Western Pacific (extralimital distribution very wide; includes, e.g., New Guinea, Madagascar, Philippines, Ceylon). Differs from *C. rendahli* in having 'enlarged teeth on vomer and jaws quite unlike my species' (in *C. rendahli* no caniniform teeth on vomer; in *C. homei* 1-4 centrally placed canines, which may be more or less coalescent, flanked or ringed with smaller teeth: in upper and lower jaws in *C. rendahli* on each side one (type-specimen) or two (Tasmanian example) fang-like teeth near symphysis; in *C. homei* one or two small canine-like teeth in upper jaw near symphysis, teeth in lower jaw larger than those in upper, some lateral ones enlarged; depth in total length 18.5-19.5, *cf.* 8.5-14; head in total length 8.5-11.1, *cf.* 6-8; vent

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behind, *cf.* before, pectoral base; interorbital concave with median ridge, *cf.* convex; pectoral 3.0-3.4 in head, *cf.* 1.5-2.2.

Data here cited additional to information set out by Whitley are derived from the following sources, ranges being a conflation of values there given: *C. rendahli*, original description (Whitley, 1941), present specimen; *C. houlti*, original description (Ogilby, 1922); *C. margaritiferae* de Beaufort & Chapman (1951), Munro (1967); *C. homei*, original description (Richardson, 1846), de Beaufort & Chapman (1951), Schultz (1960), Munro (1967).

*C. rendahli* would thus appear to be a tolerably distinct species, having as its nearest ally *C. margaritiferae*, while being trenchantly separated from *C. homei* and *C. houlti* by their having vent behind pectoral base and lacking canine teeth. From all Australian species it is distinguished by its markedly more slender body. From the Indo-Australian Archipelago *C. gracilis* (Bleeker, 1856) it differs in having the maxilla not hidden by skin (*cf.* hidden), also in having the lower lip developed, with the lips united anteriorly by a wide transverse band — the opposite features characterizing the genus *Jordanicus* Gilbert, 1905, in which Bleeker's species is placed by Munro, being referred, however, to *Carapus* by Weber & de Beaufort. From the imperfectly known *Oxybeles lumbricoides* Bleeker, 1854 (type locality, near Ceram), for which Gill created a new genus, *Helminthoides*, 1864 (preoccupied = *Pirellinus* Whitley, 1928) it is distinguished by the much greater attenuation of the latter (depth > 40, head about 21 in, imperfect, total length), and by the end of the maxilla being under (instead of well behind) eye.

Mr Downe's Tasmanian fish seems clearly referable to *C. rendahli*, its characters being in good overall agreement with those reported for the holotype; the chief departures from these being the smaller eye (4.3, *cf.* 2.8, in head) and the shorter snout (6.3, *cf.* 4.2, in head) of the present specimen.

## Family PLESIOPIDAE

Of the ten species of Plesiopidae, representing four genera, in the Australian Check-list (McCulloch 1929), one only is credited to Tasmania, namely, *Trachinops caudimaculatus* McCoy, 1890, of which *Pseudochromis rodwayi* Johnston, 1902 is treated as a synonym. It is not evident, at this distance in time, whether the attribution to Tasmania of McCoy's species (otherwise known only from Victoria) was based on observed material or simply on Johnston's paper. The relevant local catalogues (Lord 1923, 1927, Lord & Scott 1924) list only McCoy's species (second binomen consistently misspelt *caudomaculatus*). In a recent review of the genus *Trachinops*, Allen (1977) has reported *T. caudimaculatus* from Tasmania, basing his account on eight examples from Oyster Cove, east coast; however, these specimens appear to be referable to another species here described.

Examples of a *Trachinops* from our north-west coast that differ in several features from the members of the genus generally recognized are here regarded as representing another species. As Johnston's 1902 name would appear to be available, it has been deemed expeditious (though with some reservations — see below) to refer them to his *Pseudochromis rodwayi*. The Oyster Cove specimens reported on by Allen are found to exhibit the characteristic features of the north-west coast fish, and are here treated as conspecific with them. There thus exists at present some uncertainty as to whether one or two species of *Trachinops* occur in our waters.

In the subjoined key entries for *Trachinops caudimaculatus* are based on the original description of the species, not on examined material.



## KEY TO PLESIOPIDAE RECORDED FROM TASMANIA

1. Caudal fin lanceolate; behind greatest width, at  $\leq 0.5$  total length of fin, extending as a pennon, tip of which may be produced as a filament; middle rays longer than head,  $< 4$  in standard length. Patch of small predorsal scales delimited by proconcave arc across head, short oblique segment of superior lateral line and a subhorizontal segment intercalated between these above operculum. Teeth in lower jaw uniserial throughout; palatine teeth biserial throughout. Greatest depth of anal fin behind middle of fin length...*Trachinops caudimaculatus*
2. Caudal fin cuneiform, behind greatest width, at  $\geq 0.5$  (ca 0.8) total length of fin, ending almost at once in a subvertical border, with short median spur; middle rays shorter than head,  $> 4$  in standard length. Patch of small predorsal scales wholly delimited by proconcave arc across head and short oblique segment of superior lateral line. Teeth in lower jaw briefly biserial (or triserial) anteriorly; palatine teeth biserial anteriorly, uniserial posteriorly. Greatest depth of anal fin at, or in advance of, middle of fin length.....*Trachinops rodwayi*

Genus *TRACHINOPS* Günther, 1861

*Trachinops* Günther, 1861, CAT. FISH. BRIT. MUS., 3, p. 366. Type-species, *Trachinops taeniatus* Günther, 1861.

*Trachinops rodwayi* (Johnston, 1902)  
(fig. 2)

*Pseudochromis rodwayi* Johnston, 1902, *Abstr. Proc. R. Soc. Tasm.*, April 29, p.vi. Type locality: 'in or near' Macquarie Harbour, Tasmania [in Check-list (McCulloch, 1929, p. 166), in error, George's Bay - now known as George Bay; east coast.] McCulloch (1929, p.166) states 'name published slightly earlier in a newspaper, probably "Hobart Mercury"'.  
? *Trachinops caudomaculatus* [sic]: Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p.67; and 1927, *J. Pan-Pac. Res. Inst.*, 2(4), p. 14: Lord & Scott, 1924, SYNOP. VERT. ANIM. TASM., pp. 10, 55 (in synonymy, *Pseudorhombus rodwayi* Johnston, *Pseudorhombus lapsus calami pro Pseudochromis*). Not *Trachinops caudimaculatus* McCoy, 1890.

*Trachinops caudimaculatus*: McCulloch, 1929, *Aust. Mus. Mem.*, 5(2), p. 166; *partim*, *Pseudochromis rodwayi* Johnston, 1902.

*Trachinops caudimaculatus*: Allen, 1977, *Rec. W. Aust. Mus.*, 5(1), p. 68; eight specimens from Oyster Cove, Tasmania; not semidiagrammatic fig. 1c.

**Material.** Specimens (a), (b), (c), (d), *LS* 48.5, 55.5, 55.0, 58.0 mm, Wynyard, north-west coast, Tasmania, H.J. Griffith, 8 April 1974 (Q.V.M. Reg. No. 1974/5/120); (e), *LS* 53.5, Boat Harbour, north-west coast, N.W. Coast Scuba Club, 17 March 1974 (Reg. No. 1974/5/124); (f), (g), *LS* 58.0, 61.0, same origin as (e), but kept alive for some time in an aquarium, and registered separately (Reg. No. 1974/5/125). The present account is based on these specimens.

Through the courtesy of Mr A.P. Andrews, Curator of Fishes, the Tasmanian Museum, Hobart, and Dr J.R. Paxton, Curator of Fishes, the Australian Museum, Sydney, plesiopod material from their institutions has been made available for examination. The Tasmanian Museum material comprises seven series, totalling 15 fish, all from localities in the south of the State. It had been hoped this might yield decisive evidence

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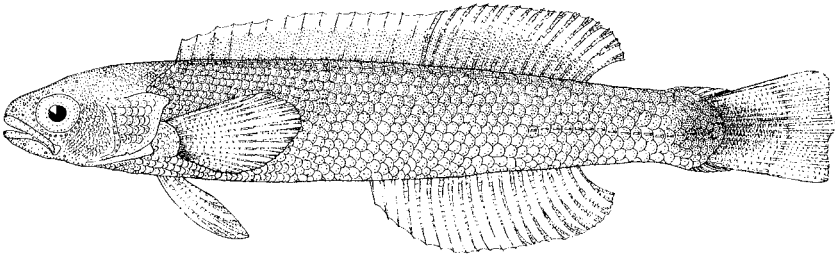


FIG. 2. - *Trachinops rodwayi* (Johnston, 1902). A specimen, standard length 58.0 mm, total length 73.5 mm, caught at Boat Harbour, north-west coast, Tasmania, 17 March 1974, by the North-West Coast Scuba Club; Queen Victoria Museum Reg. No. 1974/5/185. Lateral aspect, x 1½.

of the occurrence in Tasmania of *T. caudimaculatus*; though all the examples are so labelled, and though some of them may indeed be this species, unfortunately the imperfection of the distal border of the caudal fins is such as to preclude a definitive determination. The Australian Museum material comprising six of the eight individuals from Oyster Cove (Regd. No. I.17549-006; coll. D. Hoesse & W. Ivantsoff, 1 Dec. 1972), labelled *Trachinops caudimaculatus*, and providing the basis for Allen's account of that species (type, from Williamstown, Hobson's Bay, Victoria, not examined) prove to be referable to *T. rodwayi*.

**Meristic characters.** Considerable individual variation is encountered: in the circumstances the seven specimens on which the description is based are reported separately. Br. 6. D. XV, 18; XV, 18; XV, 18; XV, 17; XV, 16; XV, 17; XV, 16. A. III, 13; III, 18; III, 15; III, 18; III, 17; III, 18; II, 16 (in (g) only two anal spines developed, what would apparently have been the first being replaced by a small fleshy flap). P. (left/right) 16/17; 17/16; 17/16; 17/17; 16/16; 16/17; 17/17; 17/19. V. I, 4 (all specimens). C. 18 (15 branched) + 7/8 dorsal/ventral minor, procurent rays; 18(14) + 8/7; 18(14) + 7/6; 20(15) + 6/6; 19(15) + 7/5; 20(-) + 6/6; 19(-) + 7/5: 13 rays fully reaching hind border. Upper lateral line, left, 6 ascending obliquely to near dorsal profile + 45 bordering profile/right 6 + 48; 6 + 44/5+44; 6 + 43/6+43; 6 + 43/6+43; 6 + 41/5+44; 6 + 44/7+43; 7 + 49/7+49. Scales in longitudinal series 46; 44, 45; 46; 43; 42, plus in all cases about 4-6 on caudal base (and in some individuals additional scales, small, extending for a variable distance up rays). About 15 scales counted obliquely behind pectoral base. Gill rakers on anterior arch, specimen (g), 8 + 20.

The following counts are given by Allen (1977, p. 68, and tables 1, 2, p. 70) for the eight Australian Museum specimens, of which he observes they are 'essentially identical to McCoy's fish' - they are indeed quite similar, but are found to exhibit the characteristic differences set out in the key above. D. XIV (6 specimens), XV(2), 16 (3), 17 (5). A. III, 17 (1), 18 (4), 19 (3). P. 15 (1), 17 (4), 18 (3). Total rakers on first gill arch 29 (1), 30 (3), 31 (3). Anterior lateral-line scales 45-49 (7), 50-54 (1). Posterior lateral-line scales 13 (3), 15 (1), 16 (2), 17 (1), 18 (1).

**Proportions.** A set of eighteen dimensions for each specimen, expressed as permillages of standard length, is set out in table 1. Table 1 covers the larger dimensions: twenty-three smaller measurements, of such magnitude that they are conveniently reported in the form dimension-in-head, are exhibited in table 2.

**Description.** As the relevant data are directly derivable from tables 1 and 2 proportional dimensions customarily included in a general description are not given here.

Elongate, slender, moderately compressed, greatest depth of body modally about one and two-thirds greatest width, occurring shortly behind head, subequal to that of

TABLE 1

*Trachinops rodwayi* (Johnston, 1902). Large dimensions: first line absolute, standard length, mm; all other lines relative, permillages of standard length. Specimens (a) - (d) Wynyard, north-west Tasmania, (e) - (g) Boat Harbour, north-west Tasmania.

Feature	Specimen						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Standard length	48.5	55.5	55.0	58.0	53.5	58.0	61.0
Total length	1235	1207	1209	1267	-	-	1230
Length to origin of first dorsal	285	268	256	262	280	257	272
Base of first dorsal	348	323	327	336	346	283	328
Length to origin of second dorsal	633	611	602	617	645	600	613
Base of second dorsal	212	245	275	245	290	247	280
Length to origin of anal	571	541	527	553	579	552	607
Base of anal	282	288	318	309	355	293	287
Length to vent	495	486	455	490	520	474	549
Length to origin of pectoral, base	229	225	229	226	226	212	213
Length to origin of pectoral, first ray	270	265	255	259	273	262	250
Length of pectoral, total	231	229	242	242	-	212	-
Length of pectoral, longest ray	186	180	182	205	-	179	-
Length to origin of ventral	247	218	227	226	236	207	230
Length of ventral, total	175	173	178	179	-	171	-
Length of head	268	263	255	259	275	260	246
Maximum depth of head	190	177	180	172	204	172	182
Maximum depth of body	190	180	182	172	209	174	166

head; dorsal profile decreasing more or less evenly caudad, ventral profile slightly more convex posteriorly. Snout in lateral view very bluntly rounded, a trifle more pointed in plan. Eye large, at its middle twice, or more, as far from ventral as from dorsal profile, the former distance subequal to pupil. Interorbital moderately convex, the curvature mainly lateral. Orbital rim smooth. Preorbital entire. Anterior nostril a short tube, the posterior part of the free rim higher than the anterior; nearer to border of preorbital than to orbit; internarial rather less than interorbital. Posterior nostril a simple opening, somewhat larger than largest of nearby cephalic pores, situated against orbit on same horizontal level as tubular nostril. Cleft of mouth oblique, opening dorsally, middle of upper lip about on horizontal level of middle of eye, tip of premaxilla almost, at times quite, reaching ventral profile. Maxilla reaching to below 0.5-0.9, modally 0.7, eye, greatest distance of its broadly rounded tip from orbit about half its maximum depth. Upper lip rather narrow, of equal width throughout much of its length, very briefly narrower near the symphysis, very slightly wider in its last one-third. Lower lip widest at about anterior one-third of its length, its width there slightly exceeding that of upper lip; behind this narrowing rapidly to a fine point; in advance of this upper border flattening and continuously approximating lower border, which is still evenly convex, resulting in the formation of a pronounced notch at symphysis. Gill rakers, specimen (g), 8 + 20 on anterior arch, all slender, slightly flattened, of virtually equal width almost to tip, mostly straight, several at base of series briefly curved forward proximally; longest (lowest) on upper limb of arch two-thirds first of upper limb, which is little shorter than longest (middle), which is subequal to longest branchial filament and to eye.

In either side of upper jaw a row of conical teeth, about 8-12 in hind part minute, about 8-12 in front part several times larger; some still larger retrorse teeth on either side of the symphysis, either forming two separate clusters or being contiguous; in the latter case each tooth-line may dip backward, the two lines thus becoming continuous as a proconcave arc, behind which the patch may be more or less

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TABLE 2

*Trachinops rodwayi* (Johnston, 1902). Small dimensions: first line absolute, length of head, mm; all other lines relative, dimension in head. Specimens (a) - (d) Wynyard, north-west Tasmania, (e) - (g) Boat Harbour, north-west Tasmania.

Feature	Specimen						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Length of head	13.0	14.6	14.0	15.0	14.7	15.1	15.0
Eye	3.3	3.5	3.5	3.8	3.0	3.1	3.3
Snout	4.5	4.9	4.7	5.0	5.3	5.6	5.4
Interorbital	3.7	3.9	3.6	3.7	3.8	4.1	3.8
Length of longest pectoral ray	1.4	1.5	1.4	1.4	-	1.8	-
Length of ventral spine	3.7	3.7	3.5	3.2	-	3.7	3.1
Length of longest ventral ray	1.8	1.8	1.5	1.6	-	1.9	1.6
Length of first dorsal spine	7.5	7.7	7.0	7.1	7.4	7.9	7.1
Length of median dorsal spine	3.7	3.7	4.5	3.8	3.8	3.1	3.3
Length of last dorsal spine	3.0	2.9	4.0	3.8	3.9	3.1	3.1
Length of first dorsal ray	2.8	2.9	2.9	3.0	2.9	2.8	3.0
Length of last dorsal ray	2.1	2.4	3.3	2.4	2.8	3.0	2.4
Length of first anal ray	3.2	3.0	3.5	2.9	-	2.5	2.1
Length of fourth anal ray	2.4	2.4	2.3	2.5	-	2.2	2.1
Length of last anal ray	4.3	4.8	2.3	2.9	-	3.9	2.7
Length of longest anal ray	2.2	2.3	2.0	2.4	-	2.2	1.9
Caudal, total length	0.94	0.97	0.93	0.86	-	-	-
Caudal, length from base of median ray	1.3	1.3	1.2	1.2	-	-	-
Caudal, oblique length to lateral angle	1.1	1.1	1.1	1.2	-	-	-
Caudal, length of median projection	5.0	12.2	5.8	6.0	-	-	-
Depth at operculum	1.4	1.5	1.4	1.5	1.3	1.5	1.4
Depth at vent	1.4	1.5	1.4	1.5	1.3	1.5	1.5
Depth of caudal peduncle	2.1	2.1	2.3	2.2	2.2	2.5	2.2

rounded or somewhat pointed posteriorly. Teeth in lower jaw in a row quite, or almost, continuous across mandibular symphysis; usually large in front; mostly smaller behind, but with 1-3 enlarged caniniform, sometimes recurved teeth in anterior one-third of jaw, the complement not necessarily the same on the two sides; for some distance on either side of symphysis, around terminal anterior arc of jaw, small teeth in two, or very briefly three, irregular rows. Teeth on palatines small, sometimes becoming moderate anteriorly, uniserial in posterior half or so, biserial anteriorly; sub-continuous with vomerine series. Vomerine teeth somewhat variable, of moderate to large size, in two clusters, sometimes coalescent. Tongue small, bluntly pointed, smooth.

No opercular or preopercular spines. Operculum entire; with flat rounded fleshy angular lobe, its tip reaching to, very briefly short of, or very briefly beyond, level of insertion of uppermost pectoral ray; margin not, or very shallowly, notched immediately beneath lobe. Preoperculum entire; hind margin very slightly oblique downwardly and backwardly, its least distance from orbit 2 to 2.5 times in its greatest distance from opercular border. Preopercular ridge parallel with border, distant from it by about width of upper lip at middle. Gill opening wide; upper end about on horizontal level of upper orbital rim; distant from orbit by about an eye diameter, or by an interval equal to, or a little in excess of, its direct distance from insertion of uppermost pectoral ray. Branchiostegal membranes not united across isthmus; extending forward to within a pupil diameter of lower lip. Lateral line in two sections; anterior originating near upper angle of gill opening, running upward and backward in a straight or slightly sigmoid line to within 1-2 pore lengths of dorsal profile at, or very shortly behind, base of first dorsal spine; continuing back along dorsal base,

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one pore length or so below it, modally to below last dorsal ray, at times to one or two pores short of, or beyond, that point; tubules 5-7 + 41-49, modally 43, subrectangular, longer than high, anteriorly sometimes becoming somewhat longer relatively near hind end of series, a small pore at posteroinferior angle of scale or sometimes at end of a downwardly directed tube here: posterior (inferior) portion comprising 16-21 scales (right and left totals may differ), running along middle of flank to caudal origin, or continuing by 1-2 scales on to base of fin; length highly variable, origin ranging from below about middle to below about last one-sixth of total dorsal base; tubules usually somewhat rounded in front, becoming longer, less deep, subrectangular behind, each with a small posteriorly placed rounded aperture. Three complete scales (oblique count) between last scale of upper section of lateral line and scale of lower section below it.

Head with very numerous circular or subcircular pores, roughly classifiable as small and very small. Where these occur in extensive aggregations the number and disposition vary widely between individuals, often, less widely, between two sides of same specimen. More or less constant series include : (a) a pair, widely separated, on dorsum just internad, and slightly in advance, of anterior nostrils (in some individuals a line of 4-8 smaller pores linking, or slightly in advance of, these are detectable); (b) between posterior nostrils a proconcave arc of 4, the outermost partly in front of, almost in contact with, the nostril, the interval between inner and outer about 4 times interval between outer and nostril; (c) behind (b), just before level of middle of pupil, a proconcave arc of 3, the outer about twice as far from median as from orbit; (d) a line of 7-12 between vertical segment of preopercular border and preopercular ridge, often also one or several irregularly disposed pores behind, or, more commonly, in front of, this line; (e) usually 3, evenly spaced, on lower limb of preoperculum; (f) a small group, commonly 2-4, regularly followed by 2 side by side, at mandibular symphysis; behind these constantly 3 in each jaw, evenly spaced, hindmost below expanded end of maxilla, these 3 an extension of arc formed by (e); (g) very variably developed circumocular series, the most regularly detectable about 12-14 between 2 o'clock (left side viewed) down and round very close to orbit to about 8 o'clock, first 3-4 decidedly larger than rest, often about 8 between 8 o'clock and 11 o'clock, several of uppermost larger; rarely a pore close to orbit between 11 o'clock and 2 o'clock; (h) an extensive series of pores at or near the proconvex arc running across dorsum from origins of left and right upper lateral lines that delimits anterior boundary of the conspicuous patch of small predorsal scales; comprising as its primary feature some 15-20 pores, following, with some local irregularities and interruptions, the line of cessation of the scales, in advance of this highly variable, supplemented here by an array of from numerous to very numerous pores, the closer of which may form parts of one or more imperfect arcs more or less following course of main arc, or may scarcely be organized into linear arrangements, with those further forward, numbering from less than a score to upwards of two score, extending along lateral portion of dorsum and upper part of lateral surface in a subtriangular region with apex near posterosuperior angle of orbit; median area of dorsum between these regions and level of series (b) either lacking pores or having 2-3 only.

No scales on interorbital, any part of snout, lower jaw, chin, isthmus. Small obscure largely embedded scales covering most of preoperculum, extending forward beneath orbit over most of upper part here, absent from a strip along inferior border. Moderate sized scales on most of operculum, obscure, embedded, some 4-5 vertical rows, longest (anterior) with about 6-8 scales. A conspicuous predorsal patch of scales, markedly smaller than adjacent scales, one-sixth or less size of large scales of flanks; sharply delimited, in front by a forwardly convex arc extending across nape from upper angle of gill opening on either side, behind, to within a distance equal to one or two pore lengths of insertion of first dorsal fin, by short oblique ascending segments of superior lateral line, either ceasing at dorsal origin or continuing beside the bases of several spines; the junction between these two borders forming a sharp angle (no

intercalated subhorizontal border segment as depicted by M'Coy (1890, pl. 194, fig. 1b) for *Trachinops caudimaculatus*). Pectoral base with embedded scales of moderate size in about 5 downwardly and backwardly oblique rows. A proconcave arc delimits a series of scales continuing from caudal peduncle on to caudal fin, mesial number modally about 5, tending to decrease in size laterally and posteriorly; in some individuals additional scales, small, extending briefly up rays. Dorsal, anal, ventral bases naked.

First dorsal with 14-15 spines, originating above pectoral base, slightly behind level of insertion of uppermost ray, terminating in advance of hypural joint by about combined eye and snout; spines flexible, slender, straight, acute (but with the enveloping integument blunt and tending to be recurved); first spine shortest, lengths increasing for about one-third of base, thereafter remaining subequal or regularly increasing somewhat posteriad. Second dorsal with 16-18 rays; height of fin increasing to about middle, thereafter much the same; rays in about hind half of fin branched, others simple. First dorsal base longer than second, ratio of lengths, however, decidedly variable, ranging in specimens (b)-(d) from 1.1 to 1.4, mean  $1.22 \pm 0.0532$ , but in (a) reaching 1.64. Anal with 3 spines (specimen (2) abnormal, 2 only), 15 (one specimen 13)-18 rays, of which last 4-6 are branched; broadly oval; originating below 2nd-9th last dorsal spine, ending below, or slightly in advance of, last dorsal ray; with fin normally erect lowest point on border occurs at from first one-third to just in advance of middle of length. Pectoral with 16-19, modally 17, rays, uppermost 1-2 lowermost 1-2 simple, rest branched, mesial one for upwards of half length; originating barely in advance of, below, or barely behind top of soft opercular lobe; total length from four-fifths of head to just less than head; when adpressed reaching halfway, or a little more, along first dorsal base; oblique length of base subequal to eye. Ventral with I spine, 4 rays; pointed; two rays adjacent to spine longest, subequal, about twice spine; all rays branched, middle two doubly divided; originating in advance of bases of pectoral rays, length two-thirds that of pectoral, extending about halfway to anal origin. Caudal with 18-20 main rays, 14-15 branched, about half a dozen smaller procurrent accessory rays at base above and below; bluntly cuneiform, width of subvertical hind border twice distance between insertions of uppermost and lowermost ray; at hind border a short mesial triangular spur, involving 3-5 rays; all 13 rays characteristically reaching fully to hind border subequal, except those of median spur; length of middle caudal ray less than (0.8-0.9) head, 4.3-5.0 in standard length.

Coloration. The following brief notes were made on living examples. General color olivaceous above, lightening below midlateral line, whitish below. Considerable difference between darkest and lightest individuals, latter more yellowish above. Indications on flank of one or more specimens of a line of darker markings in the form of rounded cross-hatched patches separated by intervals somewhat greater than their diameter; other examples more or less mottled. First dorsal more or less colorless. Second dorsal pale orange with darker bars, chiefly presented by rays. Caudal orange, deeper at base. Anal from almost colorless to very pale yellow. Pectoral somewhat dusky basally, lighter distally.

In preserved specimens each scale on flank with a central ovoid or diamond-shaped area of numerous midbrown to dark brown chromatophores, surrounded by lighter, so that scale-rows are clearly delimited by oblique lines of whitish, one series running up and forward crossing another series up and backward; for a short distance below dorsal profile pigmentation may be sufficiently extensive to lead to loss of light dividing lines; pigmentation becomes increasingly less extensive and less intense towards ventral profile, becoming absent on all or most of mesial portion of ventral surface of trunk, and in some individuals in a narrow strip along anal base: no major marking discernible on side of body. Upper part of head almost uniform dark brown except for broad, much darker interorbital bar; lower part lighter, pale brown or light grey,

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sometimes with small areas of yellowish. Lips very variable, ranging from mostly dark brown to almost wholly whitish. Lower surface whitish or dark grey, several individuals with touches of yellow on isthmus.

Along whole of dorsal base a narrow yellowish line; above this a well marked band of dark brown, of even height throughout whole, or virtually whole, of its extent; typically occupying proximal three-fourths or four-fifths of height of spinous dorsal, at middle of soft about two-fifths; both fins presenting a conspicuous distal band of white. Pectoral with very narrow basal are of brown, otherwise whitish. Anal, ventral wholly white. Caudal white; broad basal patch of dark brown, approaching black; pigment deposited in membrane, forming sharply defined lines, most intense proximally; main region of pigmentation ceasing at about middle of fin, but 3-5 lines usually extending further to reach to, sometimes beyond, last one-fourth of length.

Anal spines. The anal spines exhibit a length-position relationship frequently found among these elements, namely,  $L = b N^k$ , where  $L$  = length of spine,  $N$  = its serial number, counting caudad. The following are the rectified equations,  $\log L = k \log N + \log b$ , together with  $t$ , and with observed (in parentheses estimated) lengths (mm) for specimens (a)-(f): (g) abnormal, 2 spines only.

- (a)  $\log L = 1.0115 \log N + 0.1216$ ;  $t = 13.256^*$ ; 1.3(1.3), 2.8(2.7), 3.9(4.0).
- (b)  $\log L = 1.0267 \log N + 0.1161$ ;  $t = 165.293^{**}$ ; 1.3(1.3), 2.7(2.7), 4.0(4.0).
- (c)  $\log L = 0.7982 \log N + 0.2282$ ;  $t = 38.221^*$ ; 1.7(1.7), 2.9(2.9), 4.1(4.0).
- (d)  $\log L = 0.5263 \log N + 0.4462$ ;  $t = 54.346^*$ ; 2.8(2.8), 4.0(4.0), 5.0(5.0).
- (e)  $\log L = 0.7934 \log N + 0.2762$ ;  $t = 28.088^*$ ; 1.9(1.9), 3.1(3.2), 4.3(4.3).
- (f)  $\log L = 1.0979 \log N + 0.0806$ ;  $t = 77.941^{**}$ ; 1.2(1.2), 2.6(2.6), 4.0(4.0).

Discussion. Johnston's account of his *Pseudochromis rodwayi* has never seen the light of publication in a formal scientific paper, having remained buried in the relative obscurity of the minutes of the Society's meeting of 29 April 1902. It touches on several features critical for the assessment, even at the familial level, of the taxonomic status of his fish, and the reader is referred to it for a description.

The view adopted by Lord, Lord & Scott and McCulloch that this account should be interpreted as referring to *Trachinops caudimaculatus* M'Coy (species name regularly misspelt *caudomaculatus* by Tasmanian authors) was presumably based on two main considerations, first, the general overall agreement in features (for exceptions, see below); secondly, the probable (or, it may well have been, known) occurrence of the Victorian species in Tasmania, and the lack of material of *Pseudochromis rodwayi* other than the holotype; together, perhaps, with the more likely occurrence in our waters of a plesiopid than a pseudochromid. On the weight of the evidence, this identification would seem reasonable; and with its adoption in the literature now a part of history, it is probably expedient it should be accepted. However, attention should be called to three points of discordance — dorsal fin formula, relation of branchiostegal membrane to isthmus, and shape of dorsal and anal. In the Pseudochromidae dorsal spines are notably outnumbered by rays (about II-VII — characteristically III (Greenwood *et al* 1966, fig. on p. 424) — 19-28), whereas in the Plesiopidae rays are about as numerous as, or more numerous than, spines. Hence if Johnston's III, 26-27 is reliable, his clearly expressed conviction that his specimen is a pseudochromid is justified, and, concomitantly a plesiopid attribution is negated. However, against this conclusion it may be contented, first, that Johnston himself characterized the dorsal count as unsatisfactory; secondly, that his total count of 29-30 is in good agreement with 31 noted by M'Coy for *P. caudimaculatus* and with about 30-31 by Allen (1977) for the present species (identified as *P. caudimaculatus*), as well as with 31-33 in our specimens. Though Johnston took no note of the branchiostegal membranes in his specimen, the generic diagnosis of *Pseudochromis*, cited by him, specifies 'gill membranes joined inferiorly': on the other hand, as noted by M'Coy (1890, p.341), following Günther (1861, p.366), in *Trachinops* they are not thus united, and this is the case in our

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material (however, M'Coy's illustration, pl. 194, fig. 1f, is in disagreement with his text). Johnston's notation 'dorsal and anal fins produced posteriorly' scarcely seems applicable either to the example of *P. caudimaculatus* as figured by M'Coy or to our material, certainly not in the sense it is, for instance, to the one plesiopid, other than the one *Trachinops*, *T. noarlungae* Glover, 1974, noted from waters adjacent to Tasmania, namely, *Paraplesiops meleagris* (Peters, 1870), recorded from South Australia, in which the fins extend back about to level of end of caudal.

Species of *Trachinops*. To the two species of *Trachinops* Günther, 1861 (a wholly Australian marine genus) appearing in the Check-list, *T. taeniatus* Günther, 1861 (type-species; New South Wales), *T. caudimaculatus* M'Coy, 1890 (Victoria, Tasmania) are now to be added *T. noarlungae* Glover, 1974 (South Australia, Western Australia), *T. brauni* Allen, 1977 (Western Australia), *T. rodwayi* (Johnston, 1902) (Tasmania). The first four species have been keyed by Allen (1977, p.31) in his review of the genus, *T. brauni* being placed in a new subgenus, *Paratrachinops*, characterized chiefly by small number of dorsal spines (10-11, cf. 14-15 in nominate subgenus), larger ventral fins (0.7-1.2, cf. 1.4-2.0 in head), fewer gill rakers on anterior arch (23-24, cf. 26-31).

In general, fin counts in the subgenus *Trachinops* show considerable intraspecific variation, associated with conjoint interspecific classes, obliging the key maker to qualify even ranges with 'usually'. Frequency distributions for fin ray and gill raker counts given by Allen (table 1) exhibit some modal differences, but samples are somewhat small for statistical analysis. Some disjunct distributions are encountered, however, in lateral line scale counts (table 2). One of the most immediately useful criteria for species separation in this genus is the color pattern, a diagram in Allen's paper (fig. 1) serving to differentiate the four species with which he deals.

*T. rodwayi* may be distinguished from *T. brauni*, *T. taeniatus* and *T. noarlungae* as follows. From *T. brauni* by the subgeneric characters; also by its greater number of posterior lateral line scales (16-25, cf. 3-6), and by color pattern (absence of broad dark band along whole length of side, presence of isolated large dark spot on caudal). From *T. taeniatus*, which has narrow blackish stripe from eye to caudal tip, caudal without basal marking, lanceolate, its middle rays 2.4-3.4 in *Ls*, 0-7 posterior lateral line scales, in having flank plain, caudal cuneiform, with basal marking, its middle rays 4.6-5.0 in *Ls*, posterior lateral line scales 16-20. From *T. noarlungae*, which has caudal plain, its middle rays 2.2-3.1 in *Ls*, anal rays 22-23, anterior lateral line scales 73-90, posterior lateral line scales 9-14, vertical scale rows about 80-85, in having caudal ornamented, its middle rays 4.6-5.0 in *Ls*, anal rays 13-18, anterior lateral line scales 47-56, posterior lateral line scales 16-25, vertical scale rows about 42-46 (plus about 4-6 on caudal base).

*T. rodwayi* most nearly approaches *T. caudimaculatus*, which has essentially the same color pattern, and with which it has perhaps been confused. Chief differences (characters of *T. caudimaculatus* in parentheses) : teeth in anterior part of lower jaw briefly biserial, or more briefly triserial (uniserial); palatine teeth biserial, in about anterior half of series, thereafter uniserial (biserial throughout); caudal fin cuneiform (lanceolate), behind level of greatest depth, at about four-fifths (about half) total length, almost at once subvertical with short median spur (produced as pennon, tip of which may be filamentous); patch of small predorsal scales wholly delimited by proconcave arc across head and on each side by short oblique segment of upper lateral line (border with an additional subhorizontal segment intercalated between these above operculum); anal deepest in front of, or at (behind) its middle.

After pointing out that while Günther (1861) in establishing *Trachinops* for *T. taeniatus* gave 'scales cycloid' as a generic character, later Kner (1865) described the scales in this species as being cycloid anteriorly ctenoid posteriorly, M'Coy



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observed, "In the present species, I think all the large scales are ctenoid". In our fish while the great majority of the large scales are ctenoid (those at middle of body with spinules more numerous, in three rows, two of which are complete, and much stouter than in M'Coy's figure 1m), in an area on upper part of trunk just behind head they are cycloid (a similar disposition has been reported by Allen for *T. brauni*); this small region, however, may well have been overlooked in M'Coy's material of *T. caudimaculatus*. M'Coy's illustration (pl. 144, fig. 1d) depicts the palatine teeth as being in two closely apposed rows of equal length, but in our fish the arrangement is characteristically uniserial, sometimes briefly biserial anteriorly; while the vomerine patch tends to be more diffuse than as figured. The dorsal cephalic pores as depicted for *T. caudimaculatus* are disposed symmetrically: in our fish they are irregularly scattered and are noticeably more numerous behind middle of eye; in front of this they are patterned as in the illustration, but in the group of 4 between posterior nostrils (series (b) in description above) the interval between inner and outer is about 4 times (instead of subequal to) interval between outer and nostril.

In general, proportions recorded by Allen for the Oyster Cove examples examined by him do not differ significantly from those of our north-west coast specimens: there is, however, one marked discrepancy. For eight fish Allen notes middle caudal rays in standard length as 2.8-3.3. For five of the six individuals at our disposal (one imperfect) we find this ratio, measuring, as before, from origin of longest ray (often beneath basal scales) to extreme tip, 4.6, 5.5, 4.3, 5.1, 5.0 (specimens in ascending order of *Ls* from 36.0 to 55.0); compatible with the range 4.3-5.0 reported above for our north-west coast material. When measured between levels of origin of the caudal ridge carrying the procurrent rays and of longest ray tip, caudal length in *Ls* is 4.1, 3.8, 3.4, 4.1, 3.9. It may be noted that in Allen's fig. 1, which provides a comparison of color patterns in species of *Trachinops*, and in which the fish outlines are perhaps to be regarded as being more or less diagrammatic, the caudal of *T. caudimaculatus* is depicted as lanceolate, much as in M'Coy's illustration, quite unlike that of the Oyster Cove specimens. (As a possible indication that not too much significance was intended to be attached to these outline figures it may be remarked the caudal outline shown for *T. brauni* differs noticeably from that in a photograph, fig. 2, of a paratype of that species.)

Species name. Robert Mackenzie Johnston (1844-1918), doyen of Tasmanian ichthyology named his species in honor of Leonard Rodway (1853-1936), doyen of Tasmanian botany. Rodway presented the specimen to Johnston, but it was 'captured by Mr. Hinsby, an enthusiastic collector' - this was doubtless the George Hinsby for whom Johnston, at the next (May) meeting of the Society, named his *Gobius hinsbyi*; *nomen nudum* = *Nesogobius hinsbyi* (McCulloch & Ogilby, 1912).

## Family APOGONIDAE

The local list comprises 5 species: (i) *Dinolestes lewini* (Griffith, 1834), (ii) *Siphamia cephalotes* (Castelnau, 1875), (iii) *Lovamia fasciata* (Shaw, 1790), (iv) *Vincentia novaehollandiae* (Valenciennes, 1832), (v) *Gronovichthys lemprieri* (Johnston, 1883). Of these, (i) is in some recent texts - e.g., Marshall (1964), Scott (1962), Scott, Glover & Southcott (1974) - referred to the monotypic family Dinolestidae; this is, however, not recognised as distinct by Greenwood *et al.* (1966) in their provisional classification of living teleosts.

The rediscovery noted in Part xii (1964, p.99, fig.1) of Johnston's species raised the possibility that records in published Tasmanian lists of *Apogon novaehollandiae* Valenciennes and (the synonymic) *Apogon guntheri* Castelnau, 1872 may have related to that form. However, Part XX (1974b) reported an example of Valenciennes' species.

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Johnston's 1883 species, placed first in *Apogon* Lacépède, 1802, later in *Vincentia* Castelnau, 1872, is here referred to *Gronovichthys* Whitley, 1929. Two further specimens are now reported, together with some general observations on the species.

Genus *GRONOVICHTYS* Whitley, 1929

*Gronovichthys* Whitley, 1929, *Rec. Aust. Mus.*, 17(6), p.302, footnote. Substitute name for *Amia* Gronow, 1763, non-binomial = *Amia* Meuschen, 1781 and *Amia* Gray, 1854, preoccupied by *Amia* Linné, 1766 (Amiidae, Lepidosteoidae). Type-species *Amia percaeformis* Gray.

*Gronovichthys lemprieri* (Johnston, 1883)

- Apogon lemprieri* Johnston, 1883, *Pap. Proc. R. Soc. Tasm.* (1882), p. 142. Type locality: Dunkley's Point, Sandy Bay, Tasmania.
- Apogon lemprieri* Johnston, 1891, *Pap. Proc. R. Soc. Tasm.* (1890), p.30.
- Apogon lemprieri*: Macleay, 1884, *Proc. Linn. Soc. N.S.W.*, 9(1), p. 67: Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p. 67: Lord & Scott, 1924, SYNOPSIS VERTEBRATE ANIMALS TASMANIA, pp. 10, 55: McCulloch, 1929, *Aust. Mus. Mem.*, 5(2), p.172: Whitley, 1929, *Pap. Proc. R. Soc. Tasm.* (1928), p.53, pl.3, fig.2 (ex Johnston MS).
- Apogon lemprieri* [sic]: Lord, 1927, *J. Pan-Pac. Res. Inst.*, 2(4), p.44.
- Vincentia novae-hollandiae*: Munro, 1960, HANDBOOK AUSTRALIAN FISHES, p.144, *partim* (*Apogon lemprieri* Johnston as synonym), not fig. 901: Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89(1), p.43, *partim*. Not *Apogon novae-hollandiae* Valenciennes, 1832.
- Vincentia lemprieri*: Scott, 1964, *Pap. Proc. R. Soc. Tasm.*, 98, p.99, fig. 1: *ibid*, 1970, 104, p.44.

**Status.** The generic status of Johnston's species has been the subject of considerable attention in Part XII (1964, pp.104-105), where the fish was referred 'with some reservation' to *Vincentia* Castelnau, 1872, the species-type of which, *V. waterhousii* Castelnau, 1872, is regarded by Whitley (1935, p.11) as a synonym of *Apogon conspersus* Klunzinger, 1872 (which has bare priority), a view accepted in the Handbook (Munro 1960, p.144) where synonymization is carried still further by the identification of both these species (together with *Apogon guntheri* Castelnau, 1872 and *Mionorus ramsayi* Fowler, 1908) with *Apogon novae-hollandiae* Valenciennes, 1832). The position adopted in Part XII, 'whether these two species [Johnston's and Valenciennes'] should remain in *Vincentia* or whether one or both of them should be relegated to *Gronovichthys* is a problem regarding the solution of which I have no firm opinion,' was in effect maintained in Parts XVII (1970) and XX (1974b), the first of which noted a further example of Johnston's species, while the second recorded a Tasmanian specimen of Valenciennes' (reported from all states except Queensland). The problem is indeed formally insoluble. As pointed out earlier (1964, p.104), Castelnau's genus *Vincentia* established for a species with edentulous palatines (and edentulous vomer?) and having two separate dorsal fins, has at the hands of later writers become, via the synonymization of the type-species with a species having the characters about to be mentioned, the repository for a form possessing toothed palatines and vomer, and differing from all its immediate allies in having the dorsals united.

In the paper in which he established *Lovamia* Whitley (1935) defined *Gronovichthys* thus, 'Similar to *Lovamia*, but with the maxillary reaching vertical of hinder margin of eye; no longitudinal bands on body; dorsal spines weak,' and observed of *Vincentia* 'it may be distinguished from *Lovamia* and *Gronovichthys* by its united dorsals and much greater depth of body, the depth being greater than length of head or about one-third total length.' The extension of the maxillary in *Gronovichthys* to, but in *Lovamia* short of, the vertical of hind margin of eye may be discounted: in the eleven species

of the former genus recognised in the Handbook the maxillary is reported as reaching to level of hind margin of eye only in one species, occurring modally beneath hind one-third or one-fourth of eye, and in one species reaching only to below hind half of pupil: in the seven species of the latter genus it ranges from below middle to below hind one-quarter of eye. Similarly, the depth specifications given as characteristic of *Vincentia* are not definitive, being matched in several species of *Gronovichthys*. We are effectively left with the conjunction of the dorsals as the prime character of *Vincentia*, and with the absence of longitudinal color bands as the main point separating *Gronovichthys* from *Lovamia*. On these bases, which appear to be those adopted in the Handbook, those species there synonymized with *Apogon novae-hollandiae*, other than Johnston's species, are to be accommodated with it in *Vincentia*, while species with dorsals separate and body not banded (and not exhibiting characters necessitating their placement in other genera altogether) are to be referred to *Gronovichthys*.

A totally satisfactory solution not being possible, it is felt the most appropriate course is to accept Whitley's 1945 dorsal-fins criterion. *Apogon lemprieri* Johnston, 1883 is accordingly here listed as *Gronovichthys lemprieri* (Johnston, 1883); as far is known endemic to Tasmania. The Tasmanian fish with conjoined dorsals reported in Part XX (1974b, p.179) as *Vincentia novaehollandiae* (Valenciennes, 1832) retains that designation; representing, through acceptable synonymy, the *Apogon guntheri* Castelnau, 1872 of the earlier local lists of Johnston (1883, 1891) and the *Apogon novaehollandiae* Valenciennes, 1832 of the later lists of Lord (1923, 1927) and Lord & Scott (1924).

Attention must be drawn, however, to the possible taxonomic issues raised by the presence, noted below, in the material here considered of the curious largely squamous ridges flanking the anal base.

Additional material. Johnston's single example is not included in the list of fish type-specimens in the Tasmanian Museum by Andrews (1971), and may be presumed lost. It would appear that material noted in the literature other than the type, total length 4 inches (102 mm), 'length of body' 3 1/5 inches (81 mm), from Dunkley's Point, Sandy Bay, southern Tasmania, is confined to two specimens from St Helens, east coast, *Ls* 68,78, detailed descriptions of which are given in Part XII (1964, p.99, fig.1), and one specimen, *Ls* 34, from the same general area reported in Part XVII (1970, p.44). Observations are here made on three additional examples: (a) *Ls* 85, *Lt* 107, (b) *Ls* 92, *Lt* 20, caught on a hook and line at night by Mr Tidey at Coles Bay, east coast, 7 June 1977 (Q.V.M. Reg. No. 1977/5/25), (c) a badly damaged specimen, approximate *Ls* 103, approximate *Lt* 135, speared at an interstate scuba-diving competition at Croppie's Point, north-east coast, 24 December 1973 (Q.V.M. Reg. No. 1974/5/141).

Meristic characters. D. vii; I, 10. A. II, 10 (a), (b); II, 9 (c). P.16 (a); 15 (b), (c). C.  $18+3/3$  (a);  $20+4/4$  (b); (c) imperfect. L. lat. 26 (a), 27 (c), 28 (b).

Dimensions at TLs. Apart from lengths of dorsal, anal and pelvic rays, which are noted separately in the sections below on length-serial number patterns, those dimensions reported for the 1970 specimen are here recorded (in all cases in which they can be measured satisfactorily) for the present examples (a), (b), (c), in that sequence; these data are followed, first by the overall range for the two 1964 individuals (*Ls* 68,73) and the 1970 individual (*Ls* 34, noted in parentheses, secondly, by some data for the holotype. Entries for the holotype are either calculated from Johnston's table of dimensions ('length of body', 3 1/5 inches (81 mm), being interpreted as standard length), or estimated from a figure made available by Whitley (1929a) from Johnston's memoranda. This figure (overlooked in earlier contributions in the present series) is of the nature of a sketch only: it presents some obvious inaccuracies

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in points of detail (e.g., lengths of dorsal spines) and values derived from it can be regarded merely as approximations: they are here marked with an asterisk.

Head 412,424, ---, (377-397),430. Snout 82,76,97(60-88),62. Eye 129,130,146, (136-147),135. Length to vent (middle) 618,631, ---, (571-610),596\*. Length to first dorsal origin 374,380, ---, (388-418),404\*; to termination, spine 560,587, ---, (543-555),590\*, membrane 576,609, ---, (--,--),610\*. Length to second dorsal origin 616,640, ---, (587-615),614\*; to termination, spine (no post-spine membrane) 744,755(706-734), 671\*. Length to anal origin 629,638, ---, (600,629),601\*. to termination, spine (no post-spine membrane) 753,772, ---, (748-753),714\*. Length to pectoral front of base, 394,391, ---, (365-393),361\*, insertion of rays 424,415, ---, (--, --,)398\*. Length of pectoral from front of base 280,283,321, (--,--)289\*, from insertion of rays 235, 260, 284,(259-265),265\*, Longest, 5th-6th, pectoral ray 222,251,238,(227-240),253\*. Length to pelvic origin 376,348,408,(353-382),386\*. Length of pelvic, total, 318,329,336, (239-324), length of longest ray 258; length of spine 184,185,213,(162-184), --. Length of first anal spine 60,27,140,(33-47),37; of second 140,152,284,(123-145),234. Depth at front of eye 188,207,184,(147-172), 181\*; at back of eye 294,337,340,(231-324),277\*; at operculum 364,424, ---, (370-424),361\*; at vent 341,391,437,(336-353),277\*; at termination of anal 188,196,224,(170-206),181\*; maximum depth 413,435,437,(384-404),373\*; depth (minimum) of caudal peduncle 164,163,184,(147-151),119\*.

Johnston recorded also the lengths of 6 first dorsal spines (7,16,15,13,8,3 mm; *Ls* 3 1/5 in. = 81 mm), overlooking the first and hence misnumbering the rest (cf. Part XII (1964, pp. 102, 105) and further discussion below); interestingly enough, his sketch shows 7, though the lengths as shown are well astray. Three further dimensions reported for the holotype (calculated as *TLs*) are here followed by the corresponding variates for the present specimens (a), (b), (c), fish thus in ascending order of *Ls*. Spine of second dorsal 160; 171, 183, 239. Longest ray of second dorsal 234; 259, 264, 286. Longest ray of anal 234; 212, 217, 245. In all three cases there is evident a trend towards increase in relative (*TLs*) length with increase in size of fish.

Other features. Maxilla to 0.8 eye (a); to 0.9 eye (b), (c). Upper jaw projecting slightly (a), (b); lower projecting very slightly (c).

An interorbital width of twice eye or more (2.0,2.4) recorded for the 1964 specimens and employed in Part XII in a key in contrast with 1.0-1.1 eye for *Vincentia novae-hollandiae*, as reported by Munro (1960, p.144), was not found in the 1970 fish (ratio 1.14). A ratio near unity is exhibited by the present examples (1.02, 0.89).

A curious feature of the present material is their possession of two ridges, squamous throughout almost their entire length, originating at a point about midway between vent and anal origin, quickly divaricating, each ridge then running back beside the insertion of the anal rays, extending the whole length of the fin base; close to it, and parallel with it except at its termination where it shows some indication of briefly swinging a little laterad. From its origin to shortly beyond the beginning of the anal the structure appears to be largely of a fleshy nature; however, while it probably continues to be of a similar character (though becoming more compressed) its visible outer surface soon becomes wholly ensheathed in scales, the free margins of which now constitute its somewhat obscurely scalloped outer border. In (a) and (b) it reaches a maximum height of almost 2 mm, in (c) of more than 3 mm; with the scales partly in a single partly in a double series. In (a) and (b) the basal scaly fin sheath thus constituted is not, in general, in contact with the fin and is in parts separated from it by more than a millimetre; in (c) it is in part closely applied to the ray bases.

This structure has apparently not previously been reported in this species — there is no mention of it in the diagnosis (Castelnau 1872) of *Vincentia*, and it is not noted

(Johnston 1883) or figured (Whitley 1929a; *ex* Johnston MS) for the holotype, nor in earlier contributions in this series (1964, 1970), nor in the Handbook (Munro 1960), where it appears (species No. 901) as a synonym of *Vincentia novaehollandiae* (Valenciennes, 1832). Its taxonomic significance has not so far been evaluated. While it appears to be clearly distinct from the subcutaneous gland, described (Lachner 1953) as a silvery tube extending from beneath the tongue along each side of the belly and continuing on to the tail, flanking the anal base, that is met with in *Siphamia* Weber, 1909 (including *Adenopogon* McCulloch, 1921) — a mainly tropical and subtropical genus, represented in Tasmania by a single species *S. cephalotes* (Castelnau, 1875) — its curious character, quite different from the usual anal scaly sheath, suggests it is perhaps not wholly unrelated to it.

Relative growth. Several dimensions expressed as *TLs* are found to exhibit a tendency to vary with *Ls*. The following correlations may be noted. Length to vent (middle)  $r + 0.982$  ( $z$  2.339),  $t$  8.906\*\*; length to anal origin  $r + 0.974$  ( $z$  2.170),  $t$  7.493\*\*; depth of caudal peduncle  $r + 0.833$  ( $z$  1.199),  $t$  3.015\*. The first two of these correlations are based on the two 1964 specimens, the 1970 specimen and specimens (a) and (b) of the present material; the third on these five individuals together with (c) of the present material. Fairly high values of  $r$ , + 0.739, + 0.840 ( $z$  0.948, 1.220) are found for length to origin, to termination of second dorsal, but these correlations are not formally significant ( $t$  1.899, 2.679).

Spines of first dorsal. (i). Complement.- Johnston's description of his specimen (1883, p.142), appearing among the addenda to his first catalogue, gave the dorsal formula as 6.1/10, noting the lengths of the first dorsal spines in sequence as 7,16, 15,13,8,3 mm. Each of our 1964 specimens had 7 spines, increasing in length from first to third, then regularly decreasing backward (the same pattern obtains in later material). It was suggested in Part XII (1964, p.102) that the first spine, which is minute, was overlooked by Johnston; and the matching of the 6 measurements recorded for the holotype with the measurements of spines II - VII of our example resulted in such good agreement as to make it fairly evident that spine I had indeed been missed. No figure accompanied the original description. The sketch found among Johnston's memoranda, to which reference has been made above (see *Dimensions as TLs*) shows, in disagreement with the description, the first dorsal with 7 spines. No attempt appears to have been made to delineate the spines with any precision, and the first spine, shown as rather more than twice as long as (instead of shorter than, or subequal to) the last, is very probably too long.

(ii). Ascendant series.- In Parts XII, XVII it was shown that for the ascendant set of spines ( $x/x = \text{I-III}$ ) the plotting of the logarithm of the length of the spine against the logarithm of the serial number of the spine (counting caudad) gives a significantly straight line, i.e., with  $L$  = length,  $N$  = serial number,  $\log L = k \log N + \log b$ , which is the convenient rectification of the exponential relation  $L = b N^k$ . This relation holds good for the present specimens. The parameters of the regression equations for all material examined together with a measure of significance, are set out in table 3 while measured and estimated spine lengths are given in table 4.

(iii). Descendant series.- Earlier, in Parts XII, XVII an attempt to arrive at a formal relationship between spine-length and spine-number in the case of the set ( $x/x = \text{IV-VII}$ ) resulted in a formulation in which the differences between the length of the longest spine (III) and the lengths of the spines of the descendant series appear as a first degree function of the (total) serial numbers of the spines, i.e.,  $\log (L_3 - L_i) = k \log N + \log b$ . Equations for this relation were presented, and were recorded as having  $t$  values of 6.38, 35.33\*\* (Part XII), 40.12\*\* (Part XVII). As a result of subsequent investigations into length-number patterns exhibited by dorsal spines (and other ray elements) it has been found (Part XIX, 1974a and later contributions) that over a range of widely diverse species a significantly linear graph

is obtained for descendant series by plotting the logarithm of the length of the spine against the logarithm of the serial number of the spine, counting *cephalad* (slope hence positive, as for ascendant series): if lengthy, the descendant suite may prove to be divisible into subsets, each of which is then treated independently, the last (posterior) spine of the subset being treated as the first and plotted on log 1. If  $N^1$  = serial number of spine of set or subset, counting forwards, the rectified equation is thus  $\log L - k \log N^1 + \log b$ . Equations for the spines of the descendant series have been calculated in accordance with this later (more elegant) formulation both for the earlier material and for the present examples. The parameters, together with  $t$  values, are shown in table 3; measured and estimated spine lengths appear in table 4.

(iv). Slopes and intercepts of graphs.- For slope and  $Ls$  there are tolerably high values of  $r$ . For  $\{x/x = I-III\}$  in five specimens  $r = +0.893$  ( $z = 1.439$ ),  $t = 3.447^*$ , for  $\{x/x = IV-VII\}$  in six specimens  $r = -0.864$  ( $z = 1.312$ ),  $t = 3.445^*$ . With the value of  $k$  held constant, the magnitude of the intercept would be a simple correlate of length of fish. Though such constancy does not obtain, the effective increase in the value of  $\log b$  in passing from smaller to larger individuals is such as to result in a significant positive correlation between the constant of the regression equation and  $Ls$ . For the ascendant series of spines in 6 specimens  $r = 0.922$  ( $z = 1.608$ ),  $t = 4.791^*$ , for the descendant set  $r = 0.976$  ( $z = 2.233$ ),  $t = 8.518^{**}$ .

(v). Relative growth of spines.- Table 5, the data for which covers our measured material, records the lengths of all spines of the first dorsal as permillages of standard length. A general tendency for relative length of spine to increase with age is evident. The table shows also the ratio in each fish of the length of the longest to the shortest spine in both the ascendant and descendant series. It will be seen that in the descendant set the last spine of the set is shorter relative to the first in small individuals (correlation in 6 individuals of the exhibited ratio with  $Ls$ :  $r = -0.868$ ,  $z = 1.326$ ,  $t = 4.406^*$ ). In the ascendant set also the ratio longest/shortest spine of set also presents a formal negative correlation with  $Ls$ . This, however, is very small (for 5 specimens  $r = -0.131$ ,  $z = 0.131$ ) and is not statistically significant. The sense of the correlation is in great part determined by the unexpectedly large value for the individual of  $Ls$  34: it could well be that the actual trend is that shown by the 4 remaining specimens, which, taken by themselves, yield  $r = +0.910$  ( $z = 1.527$ ),  $t = 4.387^*$ .

The general conformation of the first dorsal fin thus undergoes considerable change in the course of development, with (if the trend shown by our specimens of  $Ls$  65-92 is characteristic) the front spines not keeping pace, and the hind spines outstripping, the central spines in relative size.

(vi). Interspinous areas under graph.- Attention may be called to an interesting point of symmetry exhibited by the larger individuals. In the two Coles Bay examples the area under the graph of  $\{x/x = I-III\}$  — areal unit, logarithm of length of spine, mm, by interval between logarithms of relevant serial spine-numbers — is 0.4183 for specimen (a), 0.4379 for (b); for the graph of  $\{x/x = IV-VII\}$  the corresponding values are 0.6104, 0.6542. With 3,4 spines respectively in the two sets there are 2,3 interspinous areas (panels): for the ascendant set the mean areas for (a), (b) are 0.214, 0.219, respectively, and for the descendant set 0.203, 0.218. Thus in each fish the ratio of the mean panel area of the ascendant set to that of the descendant set is virtually unity. In the other large individual of the present series, (c) of  $Ls$  103 the spine was cut away in capture. By extrapolation of the line joining the plots of the logarithmic lengths of spines II, III on logs 2,3 the mean area comes out at 0.236 — giving, with mean area in descendant set 0.250, a ratio between these means of 1.06.

This virtual equality is not found in the other specimens examined. In the 1964 material the corresponding pairs of mean panels are for (a) 0.1882, 0.1438, for (b) 0.1913, 0.1596; for the 1970 specimen 1.014, 0.08603. With six specimens in ascending order of standard length the ratios of mean ascendant and descendant panels are thus 1.174, 1.278, 1.194, 1.054, 1.005, 1.057. The sample is of course a short one, and the data for the small 1970 individual stand outside the general trend manifest in the rest of the material of an approximation towards unity. The available data thus prompt the interesting speculation as to whether this equality found in the larger individuals (probably at, or close to, adult size) of the relevant mean areas in the ascendant and descendant sets of spines of the first dorsal is a norm, a geometrical ideal towards which through the course of development the fish tends, attaining it at full maturity — Aristotle and Plato syncretized.

Anal rays. The logarithmic length-number pattern of the anal rays has been examined in specimens (a), (b). In other species investigated it has hitherto been found that when a length-number pattern of the form  $\log L = k \log N + \log b$  obtains, all radial elements present are comprised in the two or more sets recognizable. The present material proves to be exceptional in that the sets exhibiting the relevant exponential relation are in (a) {1-3} and {6-10; possibly 5-10, 5 being imperfect} and in (b) {1-4} and {6-10}, i.e., in each specimen the ray occurring between the two sets is anomalous, lying outside either of them — in (a) this is ray 4 (17.0 mm) [no data for 5], and in (b) ray 5 (17.3 mm). The equations for the ascendant series are: (a)  $\log L = 0.06637 \log N + 1.2355$ , all lengths estimated from it being equal to the measured lengths 17.2, 18.0, 18.5;  $t = 9.381^*$ ; (b)  $\log L = 0.4058 \log N + 1.2770$ , estimated and measured lengths again being equal;  $t = 104.778^{***}$ . For the descendant series the equations are: (a)  $\log L = 0.3185 \log N + 0.9437$ , yielding estimated (measured) lengths 8.8(8.6), 12.5(13.3), 13.7(13.7), 14.7(14.0);  $t = 6.649^*$ ; (b)  $\log L = 0.1433 \log N + 1.0979$ , giving 12.5(12.5), 13.8(13.9), 14.7(14.7), 15.3(15.2), 15.8(15.8);  $t = 39.518^{***}$ .

For {log length spines I, II, ray 1} on {log 1,2,3} the graph is just above formal significance for the smaller specimen ( $t = 13.571^*$ ), just below it for the larger ( $t = 10.759$ ). Values of  $k$  are 1.1189, 0.9715, of  $\log b$  0.7160, 0.8287, respectively. Predicted (measured) lengths 5.2(5.1), 11.3(11.9), 17.8(17.2); 6.7(6.6), 13.2(14.0), 19.6(18.9).

Pelvic rays. Presenting a log length-log number pattern frequently encountered, the ray set {1-4} is specified thus: (a)  $\log L = 0.1758 \log N + 1.2556$ , estimated (measured) lengths 18.0(18.0), 20.3(20.4), 21.9(21.8), 23.0(23.0);  $t = 24.621^{**}$ ; (b)  $\log L = 0.1925 \log N + 1.3141$ , 20.6(21.0), 23.6(23.7), 25.5(25.7), 26.9(27.5);  $t = 22.178^{**}$ ; (c)  $\log L = 0.2719 \log N + 1.4391$ , 27.5(27.5), 33.2(33.1), 27.4(37.2), 40.1(40.0);  $t = 80.118^{***}$ .

Disposition of certain fins. (i). First dorsal, anal, caudal.- It is found, for both the 1978 specimens, that when the line with coordinates (log 1, log length to angle of mouth), (log 10, log length to caudal origin, i.e.,  $L_s$ ) is drawn, the ordinal values of the lengths, measured between parallels, from tip of snout to first dorsal origin, first dorsal termination, anal origin, anal termination fall on the line at, or significantly close to, abscissal values that are the logarithms of the natural numbers 3,5,6,7,10. For the two 1964 individuals, the measurement length to angle of mouth is not available. However, the remaining five points, plotted as before on logs 5,6,7,10, are significantly collinear; extrapolation of the best straight line back to log 1 yields a reasonable value for length to angle of mouth. The relevant data are set out in table 6.

(ii) Pectoral, second dorsal, caudal.- Again it is found, for both the present specimens, when the line with coordinates (log 1, log length to end of maxilla), (log 10, log length to caudal origin) is drawn, the logarithms of the lengths from tip of snout

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to pectoral origin, second dorsal origin, second dorsal termination fall on the line, at, or significantly close to, abscissal values that are the logarithms of the natural numbers 3,5,7. As before, the first dimension (length to end of maxilla) is not available for the 1964 material. However the remaining four points, plotted on logs 3,5,7,10 are significantly collinear: extrapolation of the best straight line back to log 1 yields a reasonable value for length to end of maxilla. The relevant data are set out in table 6.

The fundamental similarity of general pattern of the exponential relationships noted above to that found in a number of other fishes, with important morphological features located on a loglog measurement-count line at modes represented by natural numbers, would seem to indicate the formulations are not purely fortuitous.

TABLE 3

*GRONOVICHTHYS LEMPRIERI* (JOHNSTON, 1883). DORSAL SPINES.  
Parameters, and significance, for 7 specimens of the equations  $\log L = k \log N + \log b$ , specifying spines I-III,  $\log L = k \log N^1 + \log b$ , specifying spines IV-VII; where  $L$  = length of spines (mm),  $N$  = serial number of spine in the set, counting caudad,  $N^1$  = serial number of spine in the set, counting cephalad. The 6 lengths reported for the holotype are assumed to be those of spines II-VII; spine I of 1978 (c) missing.

Specimen	$\log L = k \log N + \log b$			$\log L = k \log N^1 + \log b$		
	$k$	$\log b$	$t$	$k$	$\log b$	$t$
Holotype	2.0388	0.2313	-	1.1981	0.5042	9.82*
1964 (a)	1.5071	0.4377	21.94*	1.1422	0.4159	8.32*
(b)	1.6617	0.4202	32.23*	1.0792	0.4941	15.52**
1970	1.8758	0.0043	46.80*	1.1814	0.1054	11.16**
1978 (a)	1.6657	0.4705	25.77*	0.7314	0.7861	29.07**
(b)	1.7772	0.4823	61.57*	0.8122	0.8252	16.41**
(c)	1.9706	0.5206	-	0.5649	1.0706	29.71**

TABLE 4

*GRONOVICHTHYS LEMPRIERI* (JOHNSTON, 1883). DORSAL SPINES.  
Lengths, mm, in 7 specimens, as measured and in parentheses as estimated from the equations of table 3. The 6 lengths reported for the holotype are assumed to be those of spines II-VII; spine 1 of 1978 (c) missing.

Spine	Specimen						
	Holotype	1964(a)	1964(b)	1970	1978(a)	1978(b)	1978(c)
I	-	2.7(2.7)	2.6(2.6)	1.0(1.0)	3.0(3.0)	3.1(3.0)	-
II	7 (-)	8.1(7.8)	8.4(8.3)	3.8(3.7)	9.0(9.4)	10.0(10.5)	13.0 (-)
III	16 (-)	14.0(14.3)	16.0(16.3)	7.8(7.9)	18.9(18.4)	22.1(22.5)	28.9 (-)
IV	15(16.8)	11.5(12.7)	13.0(13.9)	6.0(6.6)	17.2(16.8)	20.2(20.6)	26.0(25.4)
V	13(11.9)	9.4(9.1)	10.7(10.2)	4.9(4.7)	13.5(13.6)	16.1(16.3)	21.9(21.9)
VI	8(7.3)	6.7(5.8)	6.9(6.6)	3.2(2.9)	9.9(10.1)	12.5(11.7)	17.0(17.4)
VII	3(3.2)	2.4(2.6)	3.0(3.1)	1.2(1.3)	6.2(6.1)	6.5(6.7)	11.9(11.8)



E.O.G. Scott

TABLE 5

*GRONOVICHTHYS LEMPRIERI* (JOHNSTON, 1883). DORSAL SPINES.

Lengths as permillages of standard length for 6 specimens; also, for each set, the ratio of the length of the longest spine in the set to the length of the shortest in the set; for ascendant set third/first spine, for descendant set fourth/seventh spine.

Standard length mm	Ascendant set					Descendant set			
	I	II	III	III/I	IV	V	VI	VII	IV/VII
34	29	112	229	7.90	176	144	94	36	4.89
68	40	119	206	5.18	169	138	99	35	4.79
73	36	118	219	6.15	178	147	95	41	4.33
85	35	106	219	6.20	202	159	117	73	2.77
92	34	109	240	7.13	220	175	136	71	3.11
103	-	124	275	-	248	209	162	113	2.18

## Family CENTROLOPHIDAE

In Part XVI (1969) an account was given of the second reported local example of *Centrolophus maoricus* Ogilby, 1893, *Ls* 307, *Lt* 380 one of several individuals observed milling around a stranded sunfish (presumably *Mola ramsayi* Giglioli, 1883) at Garden Island, Tamar River, northern Tasmania, on 1 September 1966 — it may be observed that Ogilby's species, accepted hitherto by all Australian authors, is regarded by Haedrich (1967) as a synonym of *Centrolophus niger* (Gmelin, 1788); though later Haedrich & Horn (1972) have noted for *Centrolophus* 'one, perhaps two, species', keying both under the one specification. In the 1969 paper some general remarks were made on the Australian centrolophids, and a key to the Tasmanian members of the family, as it is recognized in the Handbook (Munro 1958), was provided. In recent reviews of the stromateoid fishes by Haedrich (1967) and Haedrich & Horn (1972) the genus *Serirolella* Gay, 1849, accommodated in the Handbook, as in the Check-list (McCulloch 1929) in the Nomeidae, is treated as a centrolophid (palate edentulous; toothed in typical nomeids). The three species acceptance of this position adds to the Tasmanian list of centrolophidae are *Serirolella brama* (Günther, 1860) — appearing in the local catalogues of Johnston (1883, 1891) both as *Neptonemus brama* Günther, 1860 and *Neptonemus? travale* Castelnau, 1872 — *S. maculata* (Forster, 1794) — in local catalogues from Lord's first (1923) onward as *S. punctata* (Bloch & Schneider, 1801), or referred to *Neptonemus* Günther, 1860 — and *S. porosa* Guichenot, 1849 — in all local lists as *S. dobula* (Günther, 1869), or referred to *Neptonemus*; Lord (1927, p.14) has *Serirolella* [*sic*]. These three species differ from the four covered by the 1969 key thus: from *Mupus imperialis* and *M. tasmanica* [the writer favors the retention for the second of the genus *Tubbia* Whitley, 1943, in which it was originally described: *Mupus* Cocco, 1840 is a junior synonym of *Schedophilus* Cocco, 1839; some confusion surrounding the dates of publication of Cocco's names has been cleared up by Tortonese (1959)] by having the spinous dorsal originating behind, instead of above, the head and in being distinct from the rayed dorsal (though the two may be contiguous), instead of being fully united to form a single fin; from *Centrolophus maoricus* [this Australasian species is treated by Haedrich (1967) as synonymic with *C. niger* (Gmelin, 1788), type locality, 'Rivers of Cornwall'] by having dorsal origin over pectoral base or just behind axilla, instead of over tip of pectoral fin; from *Hyperglyphe porosa* [*Eurumetopus johnstonii* Morton, 1888, type locality, near Bridgewater, Tasmania, has generally been regarded as a synonym of this species of Richardson's, type locality, 'Coasts of Australia'; both are identified by Haedrich with *H. antarctica* (Carmichael, 1818), type locality, Tristan da Cunha] by having lateral line follow dorsal profile, instead of arching anteriorly and straightening out over anal fin.



*Schedophilus huttoni* (Waite, 1910), described from New Zealand, is here reported from Tasmania. It is at once distinguishable from the seven species enumerated above as follows: lateral line scales more than 200 (maximum among other species about 160, *Centrolophus maoricus*), spines plus rays in dorsal 57-59 (maximum 50, *Serirolella porosa*), spines plus rays in anal 38-39 (maximum 35, *Mupus tasmanica* = *Tubbia tasmanica* Whitley, 1943).

An early Australian review of *Schedophilus* and its allies was that of Ogilby (1893).

Genus *SCHEDOPHILUS* Cocco, 1839

- Leirus* Lowe, 1833, *Proc. R. Soc. Lond.*, 1, p.143. Type-species, *Leirus bennettii*, 1833 (= *Centrolophus ovalis* Cuvier, 1833). Preoccupied by *Leirus* Dahl, 1823, Coleoptera.
- Schedophilus* Cocco, 1839, *Innom. Messina*, 3(7), p. 57. Type-species, *Schedophilus medusophagus* Cocco, 1839.
- Mupus* Cocco, 1840, *Maurolico Messina*, 4, p.237. Type-species, *Mupus imperialis* Cocco, 1840 (= *Centrolophus ovalis* Cuvier, 1833).
- Lirus* Agassiz, 1846, *NOMENCLATORIS ZOOLOGICI*, p.213. Emendation of *Leirus* Lowe, 1833 (hence same type-species).
- Crius* Valenciennes, 1848 in *HIST. NAT. DES CANARIES*, Webb & Berthelot, 1835-1850, p.43. Type-species, *Crius bertheloti* Valenciennes, 1848 (= *Centrolophus ovalis* Cuvier, 1833).
- Haplocoryphus* Gill, 1862, *Proc. Acad. Nat. Sci. Philad.*, 14, p.127. Type-species, *Schedophilus maculatus* Günther, 1860.
- Eucrotus* Bean, 1912, *Proc. Biol. Soc. Wash.*, 25, p.123. Type-species, *Eucrotus ventralis* Bean, 1912.
- Coroplopus* Smith, 1966, *Ann. Mag. Nat. Hist.*, ser. 13, 4(1), p.1. Type-species, *Coroplopus dicologlossus* Smith, 1966 (= *Centrolophus huttoni* Waite, 1910).

*Schedophilus huttoni* (Waite, 1910)  
(fig. 3)

- Centrolophus britannicus*: Hutton, 1904, *Trans. N.Z. Inst.*, 36, p.149 (Summer specimen). Not *Centrolophus britannicus* Günther, 1860.
- Centrolophus huttoni* Waite, 1910, *Proc. N.Z. Inst.*, 4, p.109 (11 May); and *Trans. N.Z. Inst.*, 42, p.387 (1 June). Type locality: Kaikoura, South Island of New Zealand — accompanying sunfish (*Mola*).
- Centrolophus huttoni* Waite, 1912, *Rec. Canterb. Mus.*, 1(4), p. 318; Phillipps, 1927, *N.Z. Fisher. Bull.*, 1, p.32; Smith, 1966, *Ann. Mag. Nat. Hist.*, ser. 13, 9, p.2, pl.1B (photograph of holotype); Whitley, 1968, *Aust. Zool.*, 25(1), p.51.
- Coroplopus dicologlossus* Smith, 1966, *Ann. Mag. Nat. Hist.*, ser. 13, 9, p.1., pl.1A (2 figs). Type locality: Off Cape of Good Hope; deepish water.
- Schedophilus huttoni*: Haedrich, 1967, *Bull. Mus. Comp. Zool.*, 135, p.62 (not *Tubbia tasmanica* Whitley, 1943, in synonymy); Haedrich & Horn, 1972, A key to the stromiateoid fishes, 2nd ed., *WHOI-72-15*; unpublished manuscript: Trunov, 1969, *J. Ichth.*, 9(3), p.443.

Material. A specimen 231 mm in standard length, 281 + (caudal imperfect distally) in total length, collected by Mr S. Garcia in the Little Piper River, north coast, Tasmania, 7 April 1974; Q.V.M. Reg. No. 1974/5/118.

Meristic characters. Dorsal with 59 radial elements, spines and rays differentiable with difficulty; first 4 elements seem clearly classifiable as spines (first 2

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more rigid, and as preserved without terminal fleshy filaments); the nature of the elements beyond these remains uncertain. Anal with 39 radials, first 3 spinous. Pectoral, left/right 20/20. Pelvic I, 5. Caudal 20 + 5/5, 16 branched. L. lat. *ca.* 220. L. tr., at dorsal origin *ca* 40 + *ca* 80. Gill rakers on anterior arch 5 + 10. Branchiostegals VII. A radiograph made to obtain a count of vertebrae showed observable optical differentiation near the hypurals, but not elsewhere.

Dimensions. The dimensions are recorded as permillages of standard length (231). Length to origin, termination of dorsal 182, 909; of anal 524, 903. Length to pectoral, origin of uppermost ray 214, origin of middle ray 234; length from origin of uppermost ray direct to furthest tip of fin 152; base, direct between insertions of uppermost, lowermost rays 61; shortest direct distance from insertion of lowermost ray to ventral profile (about at pelvic insertion) 83, from insertion of uppermost ray to dorsal profile (above eye) 182; length of longest (7th) ray 134. Length to pelvic 203, length from base of fin to furthest tip 100; length of spine, without filament 26, with filament 43, of longest (4th from spine) ray 95. Length to vent, front, 485, back 502. Head to hind opercular border with, without soft spine 208, 216. Eye 39, snout 61. Interorbital, between uppermost points on eyes 65, across 'hard' dorsum here 48. Oblique length of mouth cleft 56, of maxilla 80. Depth (in parentheses width) at front of eye 139 (69), back of eye 196 (91), operculum 329 (100), vent 385 (89); maximum 390 (113); caudal peduncle, minimum 87 (maximum 35, minimum 17). Lengths of dorsal radials, first 21, second 31, third 39 with filament 52, fourth 48 with filament 70, middle 110, last 41, last but one 55. Lengths of anal radials, first 12 with sheath 22, second 68, third 84, middle 100, last 49, last but one 61.

Description. Elongate, compressed, suboval, sole-like, greatest depth, occurring just in advance of vent, 4.3 thickness there, or 3.4 greatest thickness, or 3.7 in *Ls*. Dorsal profile between mouth and dorsal origin overall moderately convex, with two small gibbosities, first with its centre at level of upper half of eye, second somewhat more distant from first than from insertion of dorsal; chord from front of mouth cleft to dorsal origin at about 45° to anteroposterior axis of fish, height of arc decreasing more or less regularly backward; rest of dorsal profile moderately convex, virtually symmetrical above a line joining base of first dorsal spine to base of last ray, the greatest (median) height of arc slightly more than snout length, or about two-thirds depth of caudal peduncle. The continuation forward of the opercle constitutes a small gently convex segment of the ventral profile in advance of level of middle of eye; behind this, whole profile presents an even, fairly strongly convex sweep (see further, below, under "Some aspects of body form"). Caudal peduncle stout, its depth 1.1 in its length to hypural joint, 1.8 its length to origin of lateral caudal ridge, 2.5 in head.

Fish as a whole decidedly limp, flabby; with a curious capacity to absorb and shortly thereafter to release a liquid. In general when a fish is removed from its jar and held suspended, some excess liquid drains off rapidly in a small stream, sooner or later decreasing to a succession of drops, usually little or no additional liquid later gathering in a dry dish in which the specimen is kept during examination. When this fish is taken out of alcohol, no liquid at all drips off: however, within 10-20 seconds of its being laid flat in a dish some 10-15 cc of liquid makes its appearance, subsequently increasing slowly to almost twice this amount.

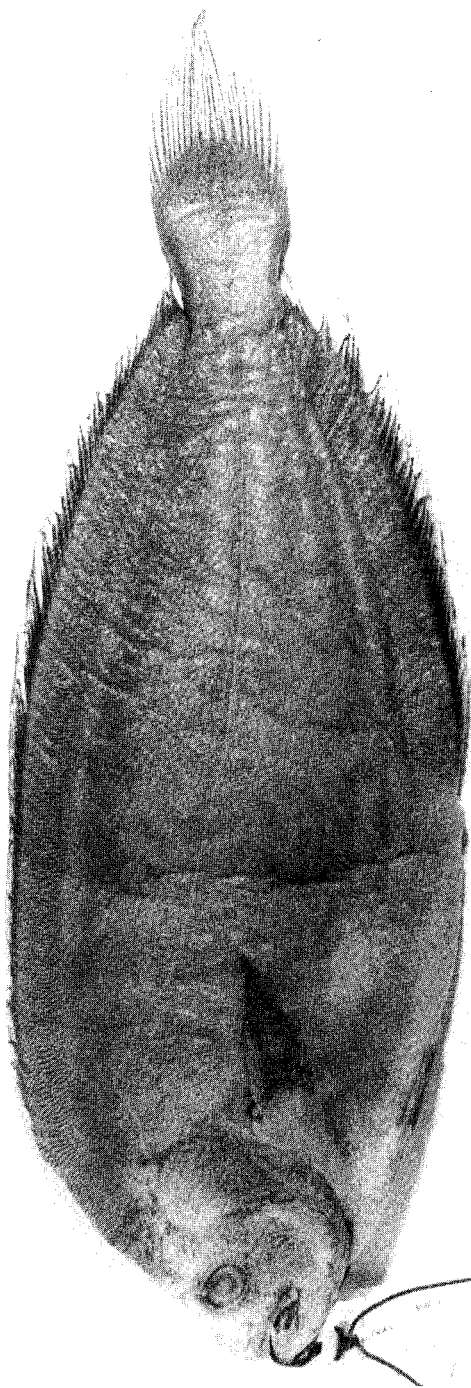
Head spongy, most noticeably so on occiput; smallish, its total length 4.62 in *Ls*; rather compressed; in side view more or less rounded, its length little more than its height; snout wide, blunt, moderately convex above, decreasingly so backward to become nearly flat between eyes. Some disperse pores: the only regularly disposed observed are 3 pairs, one behind the other, on lower surface of mandible, first, smallest, just behind tip of jaw, last, longest, near level of middle of gape, distance apart about an

FIG. 3.- *Schedophilus huttoni* (Waite, 1910). A specimen 231 mm in standard length, 281 mm + in total length (caudal distally imperfect), collected by Mr S. Garcia in the Little Piper River, north coast, Tasmania, 7 April 1974; Queen Victoria Museum Reg. No. 1974/5/118. Photo, J.G. Simmons.

eye diameter. Eye small, 5.6 in head, shortest distance from dorsal profile subequal to shortest distance from mouth cleft, 1.7 in interorbital space as measured between uppermost points on eyes, or 1.2 in more or less hard region between eyes; 1.6 snout, which is 3.6 in head; a continuous series of about 50 short bars, upper surface convex, radiating outward from orbit; no specific ocular adipose tissue.

Actual cleft of mouth nearly horizontal, descending very slightly backward, but general course of upper lip more obviously oblique, as maxilla, after becoming visible above first one-third of cleft, turns downward, its greatest direct distance from orbit about one and two-thirds its least. Maxilla reaching to level of front of pupil; its truncate end a little wider than rounded anterior end of premaxilla. Premaxilla not protrusible, tapering evenly backward; its anterior process, exposed on right side of head, at a slightly obtuse angle, slightly bowed forward, its length one-third that of main bone. Lower jaw barely in advance of upper, its width increasing backward to become somewhat more than that of upper jaw.

Teeth in lower jaw in a single series of 80-90 on each side, those in front minute, slender, more or less acute, the first 30 occupying only some 3 mm, or about one-fifth of tooth-line; teeth behind these gradually and evenly increasing slightly in height, but becoming noticeably wider, with width at base about a quarter height, the tips almost all becoming less acute, some distinctly rounded; all somewhat compressed, last 10-12 more widely spaced; in hind third of left jaw half a dozen stouter bilobed teeth, in right jaw several teeth, occupying a normal position in the



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series, only about one-third height of those flanking them; edentulous interspace at symphysis short, equal to that occupied by half a dozen teeth. In upper jaw edentulous space at symphysis about twice that in lower jaw; anterior half of toothed portion of jaw occupied by 25 (left)-30 (right) teeth more or less similar to those in lower jaw, but rather more slender and much more widely spaced; behind these a diastema subequal to toothless symphyseal space, followed by 8 (left), 9 (right) extremely slender inwardly and forwardly curving, regularly tapering, very acute teeth, subequal in length to those earlier in jaw, very widely spaced, interval between them exceeding their height. Palatines, vomer, basibranchials edentulous. A large palatal frenum, mostly minutely papillose, large, extending forward to within less than a pupil diameter of symphysis, broadly rounded in front.

Gill opening extensive; branchial membranes extending well forward to become continuous over isthmus at level of halfway between snout tip and eye. Gills 4, a slit behind last; gill filaments slender, suddenly tapering distally, longest subequal to an eye diameter. Gill rakers long, curved, subcylindrical, tapering only slightly throughout most of their length, briefly rounding off bluntly distally; their briefly expanded bases about one-fourth their length, close together or contiguous, some minutely denticulate in at least proximal half of upper edge; 5 on upper limb of first branchial arch, 10 on lower limb, longest on lower about twice longest on upper, or about two-thirds longest gill filament; on last arch 8, short, upper rounded, separated by about half their height, lower cylindrical with slight brief terminal expansion, all minutely crenulate distally. Pseudobranchiae present, base about an eye diameter, 15-20 slender tapering filaments, longest (median) about half longest on first branchial arch.

The whole dorsum of the head presents much the appearance of a mass of wax that has been melted and has cooled and solidified irregularly, forming depressions, grooves and openings differing on the two sides of the median line: in the circumstances the true situation in respect of the nostrils, regarding which there is some current confusion, remains uncertain. In the subjoined account approximate measurements are given in mm. On the left side there are in succession backwards: (a) behind upper lip by 2, starting 6 from median line a transverse trough  $3\frac{1}{2}$  by 2; (b) overlapping outer end of (a) an irregular flap with a subtriangular depression, apex towards eye; (c) adjoining a minutely mammillate ridge  $3 \times 1.5$ , running fore-and-aft, an irregular sub-quadrangular depression, 5 by 8, reaching to within 6 of eye, its outer edge forming the boundary of (a), its lateral borders slightly elevated, its posterior border, which runs out and somewhat back, forming an overhanging shelf; (d) 17.5 (direct measurement) behind upper lip, 3 from median line (hence in virtually the same position as (c) on left side) a conical depression, the anterior apex shallow, deepening to rectilinear posterior border, which forms a shelf, beneath which the depression continues back for a distance subequal to half its uncovered length, its posterior boundary, completing a long ellipse, discernible through translucent overhanging shelf; (e) at 28 from upper lip (vertically above middle of eye) two depressions, each about 2 in diameter, the anterior slightly transversely elliptical, the posterior, separated by a narrow oblique septum, a little closer to, about 4 from, middle line; (f) starting about 3 behind (e), a little closer to median line an irregular trough 5 long. On right side in succession backward: (g) in a position similar to that of (a), separated from it by a yellowish bar, a subtriangular depression of comparable size, apex directed outward; (h) external of (g), but (in contrast to situation on left side) quite separate from it, at a little more than two-thirds length of snout, two-thirds of an eye diameter from eye, about one-third this from toothline, in about the same position as (b), a small pocket, into the roofed end of which a seeker enters for rather more than a millimetre; (i) a depression more or less matching (c), but with its posterior margin continued somewhat further back, and not forming so distinct a shelf, and having in the middle of its anterior portion a small lingulate process, partly excavate below, not present in (c); (j) about half as far from hind end of (h)

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as from level of front of (d), a shallow depression with posterior shelf, the whole much like (d), but a trifle longer and narrower; (k) on almost same transverse level as (d), starting less than half length of (c) behind level of front border of that depression, a depression similar in form and size, but lacking the posterior shelf: no small depressions matching those of (e) on left are traceable on right, but about twice as far from midline here, swinging externad posteriorly, is an irregular groove, tolerably deep at its hind end, beginning shortly behind (h) and curving outward and backward for about 15, thus ending well behind level of eye.

Operculum very flexible, papyritious; border with small delicate spiniform processes, their number and disposition differing on the two sides of the fish. On left side at upper angle a broad-based bluntly pointed membranous flap, from which project backward and upward 7 delicate pointed processes, the upper 4 each set in a sheet of very delicate hyaline apparently gelatinous membrane, the others, the longest, in a single triangular membranous matrix; halfway between this flap and upper insertion of operculum, a second, smaller flap with two small processes of a similar type; in upper half of hind border, below the group of 7, several minute colorless hair-like processes; near lower angle, where soft membranous suboperculum first becomes visible, a group of 5 small spinelike processes, embedded as before, followed below by half a dozen more, minute, spaced along lower border, the most anterior behind level of eye by less than eye diameter. On right side with spiniform processes as follows: at position of upper flap 5, lowest longest; at flap at upper angle 3 extremely slender, all in same triangular membrane; below these, 7, shorter, much stouter, not, or barely, projecting beyond the continuous membrane; about at level of bottom of pectoral base 9 small or very small, more or less equally spaced, the 3 lower pointed backward above interoperculum; below these one pair, with indications of probable existence of others. Preoperculum thin, flexible but less so than operculum. On its border on right side, just above angle, about level with bottom of pectoral base, 4 soft, slender, subcylindrical processes, acutely pointed, uppermost directed back and slightly down, about 4 times as long as lowermost, directed almost vertically down: on left side only 2 found, both directed back and decidedly up, subequal, total length, of which nearly half is enclosed in surrounding tissue, about half an eye diameter. Preopercular border broadly rounded, noticeably bowed back.

Dorsal fin originating shortly behind preopercular border, at two-thirds length of head without snout, in advance of pectoral origin by rather less than an eye diameter, terminating in advance of origin of upper caudal ridge containing minor rays by two-thirds depth of caudal peduncle, or in advance of hypural joint by twice this distance; laid back reaching about two-thirds along caudal ridge, slightly short of level of hypural joint; base fleshy, its length, between parallels, 1.38 in *Ls* or 1.92 anal base between parallels. Total radial elements 59, the first 4 classifiable as spines, but nature of immediately succeeding elements doubtful, probably rays; gradually increasing in height to near middle, thereafter decreasing tolerably evenly; 1st spine 1.4 in 2nd or 10.2 in head, 1.8 in 3rd without filament or 2.4 in third with filament, this last 4.2 in head; ray at middle of series 2.0, last ray but one 4.0, last 5.3 in head. Rays simple, slender, regularly tapering hyaline rods, unbranched, lacking any obvious signs of septa, sheathed in pigmented membrane bearing scales for most of its height; terminating in a fine filament extending well beyond end of primary hyaline axis. Anal originating at 0.52 of *Ls*, under about 35th dorsal element, terminating behind dorsal by 0.2 eye; laid back reaching about halfway along lower caudal ridge; base fleshy, its length, between parallels, 1.75 head. Total radial elements 39, similar to those of dorsal and similarly scaled; 1st, 2nd, 3rd spinous; these three without filaments 18.5, 7.1, 5.0 or with filaments 10.0, 5.6, 3.7 in head; ray at middle of series 2.2, last ray but one 3.5, last 4.4 in head. Pectoral pointed, with 10 simple rays; inserted well behind dorsal origin; length to origin of uppermost ray 4.67, to middle of base 4.28 in *Ls*; length from base of uppermost ray direct to furthest tip of fin 6.60 in *Ls* or 1.43 in head; lower 2 or 3 very short, longest (7th) ray 1.61

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in head; as preserved, whole base and proximal one-fourth of fin covered with small scales, upwards of 20 on a median ray, beyond this membrane largely missing, but indications of the probable extension of scales beyond middle of length. Pelvic with 1 spine 5 simple rays; originating at 0.20 of  $L_s$ , about below 3rd dorsal radial, in advance of origin of uppermost pectoral ray by 0.3 eye; lengths of spine, without, with, filament, of longest ray (4th from spine) 8.3, 5.0, 2.3 in head; membrane enveloping rays very delicate, when handled tending to become drawn out into long hair-like extensions; fin reaching 0.35 of distance towards vent, its length 2.1 in head; proximal one-fourth of right and left inner margins attached by two folds of membrane to two parallel ridges, a groove between them; scales wholly covering basal one-third of fin, probably originally extending further. Caudal imperfect, length as preserved equal to head; 20 main rays, about 5 minor rays largely buried in the thick integument of each of the dorsal and ventral basal caudal ridges originating about an eye diameter in advance of level of hypural joint; 16 rays branched, most deeply divided, presenting a somewhat unusual appearance, the central ones divaricating about an eye diameter from their origin, separating briefly and then running subparallel as stout moieties, each of these, beyond the basal one-third of the fin, having the appearance of being a complete ray; a conspicuous opaque semicircular area at base of rays wholly covered with scales, upwards of a score in the median line; beyond this minute scales extending along at least half free length of ray but being wholly absent from membrane, so that portion of fin behind proximal opaque patch of scales is much lighter and partly transparent.

Scales subcircular, small, diameter of largest (covering most of flank) 1.2 mm; rather deciduous, leaving small tumid ovoid areas, sometimes confluent, usually with several small pigment spots; about 240 between operculum and hypural joint; obliquely down and back from dorsal origin about 30 + about 80, rows here somewhat sinuous; covering whole trunk, tail and (see above) a good part of all fins; somewhat variable in size, a tolerably well-defined band, about a dozen wide, of locally smaller scales beginning just above origin of lateral line, running back more or less parallel to dorsal profile to end of dorsal fin, continuing, more narrowly, on to caudal peduncle covering upper one-sixth of it, fairly even in width throughout, about an eye diameter, or about one and a half times its modal distance from dorsal profile; scales immediately behind head mostly smaller than on rest of trunk; hind portion of isthmus tumid, smooth, scales if present well embedded, but normal scales at and near tip; a narrow midventral smooth unpigmented ridge extending forward from vent for two-thirds length of head apparently naked; in upper anterior part of body scales, here small, extending forward to cease at a line (length combined eye and snout) running forward and upward at an angle of about 45° from origin of lateral line to middorsal line, head immediately in front of this, scaleless, spongy; an ovoid area occupying anterosuperior half of portion of operculum bounded below by a line joining tip of opercular flap to bottom of orbit naked, rest of operculum scaled, this being only squamous region of head.

Vent a longitudinal slit, twice as long as wide, in middle of an ovoid mound flanked by two well-developed flaps, diverging from shortly in front of origin of anal fin and embracing whole papilla except middle part of its anterior border, papilla here strongly tumid, descending in front to constitute beginning of smooth midventral ridge already mentioned; a slit present on each side between papilla and flap appears to include an aperture leading inward. Lateral line with about 220 tubercles, closely apposed, slightly elevated; course somewhat irregular, especially anteriorly, including here small local sinuosities that may differ on the two sides; general course as follows, originating immediately behind upper angle of operculum, rising in a sinuous line, about one-third of a head length, by about an eye diameter, to a distance from dorsal profile subequal to its own length; descending in a segment that is a mirror image of the first to level of upper one-third of depth of trunk here; thereafter continuing more or less in a single sweep (some minor sinuosities, more marked on



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right side), with gradual decrease of rate of curvature, almost straightening out shortly before level of vent, where it is 1.4 times as far from dorsal profile as from ventral; ending at middle of length of caudal peduncle, being here equidistant from dorsal and ventral profiles.

Coloration. Trunk and tail mostly almost uniform slightly purplish dark grey, somewhat lighter on caudal peduncle and for some distance forward mesially from it with decreasing intensity. Only these noticeable discrete markings: (a) an even strip of off-white with small brownish speckling, about an eye diameter in width, on each side forward from vent to pelvic insertion, in advance of this upper border continuing more or less horizontally, but upswing of ventral profile here converting marking to an elongate triangle, apex near lower jaw; (b) along middle of (a) from vent almost to tip of pelvic the off-white apparently naked ridge noted earlier; (c) at base of each anal ray a subrectangular light grey spot, interval between these from about one-half width of spot anteriorly to one-third posteriorly; (d) on ventral surface a short white stroke in advance of base of first anal spine, dividing into two limbs continuing forward to embrace posterior half of pale grey anal eminence; (e) along whole length of tail above anal base an even light grey band, width about half an eye diameter, distance from profile above anal origin subequal to snout length, decreasing at end of fin to half this, the marking just continuing along lower border of caudal peduncle; (f) a somewhat similar, but rather less intense, light band along whole extent of dorsal base, width decreasing regularly from rather more than an eye diameter in front to about half that behind. Head briefly more or less concolorous with body posteriorly, becoming increasingly lighter forward. Squamous portion of operculum rather more purplish than trunk nearby; naked patch at anterosuperior corner off-white, this color extending over most of rest of head, except immediately below eye, which is light, in part faintly bluish, grey, flecked with a few small spots and short irregular lines of midbrown; a small number of obscure brownish smudges on ventral surface of head.

Fins in general darker than body. Dorsal with each ray bicolor, in front, where anterior border of ray is exposed, hyaline, hind half or two-thirds covered with a sheath (largely squamous) very dark brown, in places approaching black basally; free filamentous tips mostly greyish brown; fin damaged, many elements partly or wholly stripped of membrane hyaline, remnants of membrane brownish or greyish. Anal similar to dorsal. Pectoral base light greyish olivaceous, rather lighter than trunk below it, each scale indicated by a dark brownish fleck; rays largely stripped, then greyish, faintly bluish; membrane where intact dark brownish; proximal one-third of fin scaled, dark brown, also indications of former presence of more distal scales. Pelvics like pectorals, with similar strongly scaled basal area of dark brown. Caudal with fully scaled proximal semicircle concolorous with most of trunk, darker than caudal peduncle; rays partly naked, partly covered with mostly scaled membrane similar to, but overall distinctly lighter than, rays of dorsal and anal.

Some aspects of body form.

(a). Postcephalic ventral profile.- Between the end of the head and the beginning of the caudal peduncle the ventral profile presents a single, aesthetically satisfying, sweep. Ten measurements of the height of the curve above a line joining end of lower jaw and beginning of caudal peduncle have been taken at equal intervals. With  $Y$  = this height, mm, and  $X$  = decile number of measurement, counting caudad, the curve is well fitted by the polynomial  $\bar{Y} = 2.15 + 8.365X - 0.5348X^2 - 0.02266X^3$ , measured (in parentheses estimated) values 10.0(9.9), 16.9(16.6), 21.1(21.8), 25.6(25.6), 27.9(27.3), 29.0(28.2), 26.5(26.7), 22.9(23.2), 17.4(17.6), 9.9(9.7);  $R$  0.9921.

The following four relations are all of the form  $Y = bX^k$ , where  $X$  = dimension,  $N$  = a natural number, the exponential formulation yielding a linear graph with loglog plotting.

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(b). Relative length of head, trunk, tail.- Let  $L$  = 'length to' in the set {end of head, end of trunk, end of tail at hypural joint} and  $N = \{1, 2, 3\}$ , then the equation of the rectified relation is  $\log L = 1.3738 \log N + 1.6860$ ;  $t = 14.754^*$ ; measured (predicted) values of  $L$ , mm, 50(49), 116(126), 231(220).

(c). Some fin origins and terminations.- Let  $L$  = 'length to' in the set {dorsal origin, anal origin, dorsal termination, anal termination, caudal origin at hypural joint} and  $N = \{1, 4, 8, 8, 9\}$  (levels of dorsal and anal terminations virtually the same, both plotted on 8), then  $\log L = 0.7654 \log N + 1.6275$ ;  $t = 11.52^{**}$ ; measured (predicted) values, mm, 42(42), 121(123), 208.5(208.3), 210(208.3), 231(228).

(d). Lengths of dorsal spines.- With  $L$  = length of spine,  $N$  = its serial number, counting caudad,  $\{1, 2, 3, 4\}$ ,  $\log L = 0.5739 \log N + 0.6851$ ;  $t = 22.224^{**}$ ; measured (predicted) lengths, mm, 4.9(4.8), 7.1(7.2), 8.9(9.1), 12.0(12.1).

(e). Lengths of anal spines.- With  $L$  = length,  $N$  = serial number,  $\log L = 1.3550 \log N + 0.4296$ ;  $t = 74.491^{**}$ ; measured (predicted) lengths, mm, 2.7(2.7), 6.8(6.9), 12.0(12.1).

**Distribution.** Haedrich (1967) gives the distribution of *Schedophilus huttoni* as 'Seas of New Zealand, eastern Australia and Tasmania', while Trunov (1969) lists as known range prior to publication of his paper as 'New Zealand, Tasmania and South Australia'. There have, however, hitherto been no records for Tasmania. It may be surmised Haedrich's inclusion of Tasmania derives from his treating *Tubbia tasmanica* Whitley, 1943 (holotype taken off eastern Tasmania at  $42^{\circ}42'$  S, by  $148^{\circ}34'$  E; a second specimen obtained 'in Tasmanian waters') as a probable synonym of Waite's species, a position later abandoned in the unpublished manuscript key to Stromateoid fishes by Haedrich & Horn (19 2), in which Whitley's species is keyed in *Ichthyos*: the present writer is inclined to agree with Whitley (1943a) that *Tubbia* is valid. Trunov's 'South Australia' may be a recent example of a confusion, not infrequent in the last century, between the regional 'southern Australia' and the precise 'State of South Australia'. If *Coroplopus dicologlossops* Smith, 1966; from off the Cape of Good Hope is a synonym of Waite's New Zealand species (this identity is here perhaps for the first time expressly proposed), the range of the latter is considerably extended: in any case a distribution along an arc of some four degrees off the west coast of southern Africa has been established by Trunov, who reports 24 specimens taken in this region by no fewer than six vessels.

**Discussion.**

(a). Generic status of holotype and Tasmanian specimen. Waite (1910) described his species in *Centrolophus* Lacépède, 1802 — keying it off from *C. britannicus* Günther, 1860, *C. niger* (Gmelin, 1758), *C. maoricus* Ogilby, 1893 — and continued this generic attribution (1912), being followed in this both by Australian authors (e.g., Phillipps 1927, Whitley 1968) and by overseas writers (e.g., Smith 1966). It has recently been placed (Haedrich 1966, Haedrich & Horn 1972, Trunov 1969) in *Schedophilus* Cocco, 1839. Features distinguishing *Schedophilus* from *Centrolophus* in the generic diagnoses as given by Haedrich include: (a) head broad, deep (small: the contrast as presented is not between comparable characters; the position is that while in *Schedophilus* the head may be smaller (shorter) than in *Centrolophus*, it is relatively deeper, its depth typically exceeding its length); (b) body deep, maximum depth usually  $> 0.35$  LS (usually  $< 0.30$ ); (c) dorsal origin usually before, in very large specimens over, pectoral origin (usually well behind, but in very small specimens over); (d) small spines present (not) on preopercular margin. Comparison with holotype [original description, photograph made available by Smith (1966)]: (a) from figure, apparently longer than high; (b) '4.8 in [0.21 of] the length' (from figure, apparently standard length); (c) dorsal above root of pectoral (specimen large, length 766 mm); (d) no information. The

general weight of the specification thus favours *Schedophilus*. Our specimen seems to be satisfactorily referable to this genus. Two specific characters of *S. huttoni* set it clearly outside *Centrolophus* — dorsal with  $> 50$  ( $< 45$ ), anal with  $\geq 35$  ( $< 30$ ) total radial elements.

(b). Generic and specific status of *Coroplopus dicologlossops* Smith, 1966.— Smith's species, for which he established *Coroplopus*, is known only from the holotype, *Ls* 770, *Lt* 880 mm, from deepish water off the Cape of Good Hope. 'Related most closely to *Centrolophus* Lacépède, 1803, and to the pelagic *Schedophilus* Cocco, 1829 [= 1839], but distinguished from all others in the family by the peculiar nasal opening, apparently single, in a crater-like depression on the side of the snout.' (Smith placed his genus in the Stromateidae; which, with *Centrolophus* and *Schedophilus* cited as the most nearly related genera, is untenable; further, the teeth are of the centrol-ophid, not the stromateoid, type). After having examined the Tasmanian fish and observed how readily subject it is to damage, with resultant formation of quite varied, apparently random depressions in the head (catalogued above), the present writer is strongly disposed to believe no diagnostic significance is safely attachable to the unusual feature on which the new genus is primarily based. Overall dorsal and anal counts (among the most useful differentiae in centrol-ophids) at 60, 36 fall within the range of *Schedophilus huttoni*, with other known features of which the description of the South African specimen are in general in good accord. It is accordingly suggested *Coroplopus dicologlossops* is a synonym of this species. With the collection of numerous examples of *S. huttoni* off the western coast of southern Africa (Trunov 1969) no problem of distribution arises.

(c). Comparison of holotype and Tasmanian specimen.— The present specimen is in satisfactory overall agreement with Waite's account of the holotype. The chief differences involve: (i) relative number of spines and rays in dorsal; (ii) presence or absence of pseudobranchiae; (iii) character of nostrils; (iv) certain differences in proportion.

(i). Waite gives 'D.X, 47'; we find IV, 55. Satisfactory differentiation between spines and rays in this fin is very difficult, and probably the only diagnostically useful count is the total — here 57, 59, cf. a range of 56-60 (Haedrich & Horn) or 56-63 (Trunov).

(ii). In the holotype the nasal region is described thus, 'nostrils confluent, without septum, the orifice with a narrow rod-like bar; the cavity is close to the end of the snout, and is separated from the eye by a space equal to two-thirds of its diameter'. In our specimen the nostrils cannot be satisfactorily identified (see above). The generic specification (Haedrich, p.60) is 'near tip of obtuse snout, anterior nostril rounded, the posterior a slit.' The reported situation in the probably synonymic *Coroplopus dicologlossops* has already been commented on.

(iii). 'No pseudobranchiae'; present in our specimen (see above). Generic character (Haedrich) 'a few rudimentary rakers present under large pseudobranch'. In *Coroplopus dicologlossops* 'pseudobranchiae are present, small, moderately developed, the filaments long and slender'.

(iv). The length of the holotype is given as 776 mm, that of the Sumner specimen, first noted by Hutton (1904) as 783. It is not clear whether *Ls* or *Lt* is recorded; in either event the New Zealand examples are to be regarded as adult or nearly so. (Of 24 examples reported by Trunov, 16 (not individually specified) had total length 495-796, the remainder, 510-835, including 6 more than 700, all save one females with gonads at stage III of maturity.). Our example, *Ls* 231, *Lt* 281+ may be regarded as juvenile. In *Schedophilus*, as in other centrol-ophid genera, there are notable changes in proportion with age, allometric growth leading even to qualitative differences in form, thus, for example, the dorsal fin origin migrates caudad relative to pectoral

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origin with increase in overall size, so that while the origin is in advance of pectoral origin in smaller individuals (in our fish by almost an eye diameter in front of insertion of uppermost pectoral ray) it is over the fin in larger specimens (in holotype 'above the root of the pectoral'). Relative length of pectoral decreases with growth; in the present specimen 0.70, in holotype 'half' head length: similarly for pelvic (in some species fin may reach to vent in young); length here 2.6, in holotype equal to, eye diameter. The shape of the pectoral of the holotype is not noted: Haedrich states that in this genus it is rounded in the young, pointed in the adult, however, it is here pointed. The most obvious difference between the New Zealand and the Tasmanian fish is the general shape, the former having depth in standard length 4.8, the latter 2.6: decrease in relative height with increase in age is a normal characteristic (in Smith's holotype, *Ls* 770, *Lt* 880, the corresponding value is 3.8). Coloration also is an age character, simple patterns — light horizontal stripes in present specimen and in *S. griseolineatus* (Norman, 1937) and occasional vertical bars and mottlings found in the young becoming less conspicuous or being lost in the adult. No markings are noted for Waite's holotype (laconically specified as 'faded'), for Trunov's material, or for Smith's holotype.

(d). Comparison of Tasmanian specimen and Atlantic specimens. The account of Trunov, based on 24 examples from the southeastern Atlantic, is in the main in quite good agreement with other available information on this species. His material provides an upward extension of 3 in the range of dorsal radial elements: no data on pseudobranchiae, or on presence or absence of spinous processes on margin of preoperculum. Scales are noted as 'slightly ctenoid'; in our example cycloid. At 5-6 + 1 + 11-13 the number of gill rakers on the anterior arch exceeds our count of 5 + 10. Maxillary is stated to extend to anterior margin of eye; here, to pupil. The Atlantic fish seems clearly to be conspecific with the Australasian one; however, the possibility of there being subspecific distinction between them is not wholly to be discounted.

## Family OSTRACIONTIDAE

In the first two published Tasmanian lists (Johnston 1883, 1891) and in the contemporary Australian catalogue of Macleay (1882b) the family appears as the old wide group Sclerodermi, in subsequent local lists (Lord 1923, 1927, Lord & Scott 1924) as Ostraciidae. More recent Australian writers have oscillated between Ostraciidae — the form used in the synoptic classifications of Jordan (1923), Berg (1940), Lagler, Bardach & Miller (1962) — and Ostraciantidae, adopted in the provisional general classification of Greenwood *et al.* (1966), and accepted here.

Three species occur in Tasmania: (i) *Aracana aurita* (Shaw, 1798), (ii) *Aracana ornata* (Gray, 1838), (iii) *Lactoria diaphana* (Bloch & Schneider, 1801); (i) and (ii) being fairly common, while (iii) is known locally from two examples only, the second being here reported. In their general text, p.93 (but not in their initial list of species, p.14) Lord & Scott include also *Aracana spilogaster* (Richardson, 1840) (entered as *A. spilogastra* Gray) and *Aracana flavigaster* (Gray, 1838), entries that appear also in the South Australian catalogue of Waite (1923), and, together with three varieties, in the revision of the genus *Aracana* and its allies by McCulloch & Waite (1915), and in the Australian Check-list (McCulloch 1929); however, it has been shown these are, respectively, the female of *A. aurita* and the female of *A. ornata* (females lack a conspicuous pattern of five blue loops on the caudal fin present in males).

## KEY TO OSTRACIONTIDAE RECORDED FROM TASMANIA

1. Height of carapace  $\leq$  its width. Anal base wholly behind dorsal base (partly under caudal base). Caudal rays simple.....*Lactoria diaphana*
- Height of carapace  $>$  its width. Anal base largely under dorsal base (distance from caudal base subequal to length of anal base). Caudal rays distally multifid.....2

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2. Supraorbital spine above middle of orbit, directed upwards.  
 Distinct hump on snout in male. Male color pattern  
 spots and lines.....*Aracana ornata*  
 Supraorbital spine above hind part of orbit, directed  
 backwards. No hump on snout in male. Male color  
 pattern lines only.....*Aracana aurita*

Genus *LACTORIA* Jordan & Fowler, 1903

*Lactoria* Jordan & Fowler, 1903, *Proc. U.S. Nat. Mus.*, 25, p.278, Type-species,  
*Ostracion cornutus* Linné.

*Lactoria diaphana* (Bloch & Schneider, 1801)

*Ostracion diaphanus* Bloch & Schneider, 1801, SYST. ICHTH., p.501. Habitat unknown.  
*Lactoria diaphana*: Jones, 1955, *Rec. Queen Vict. Mus.*, 3, p.1, pl.1.

Tasmanian history. Though Tasmania lies well outside the normal range of this species — given by McCulloch 1929 as New South Wales (where, it is noted by McCulloch (1927, p.127) as being 'sometimes stranded on our ocean beaches'), South Africa, East Indies, Pacific Ocean, Japan; (Marshall (1964) notes one specimen found on a Queensland beach in 1952) — a specimen from Circular Beach, about 3 km from Bicheno, east coast, has been reported by Miss Heather Jones (Mrs J. Steer). In her paper (1955) she speculated it 'must have been brought down from more northerly waters by the eastern Australian current that brings down the sea snakes of the genera *Hydruis* and *Platurus*, which have only been recorded on the East Coast'. These marine snakes include *Laticauda laticaudata* (Linné, 1758) (see Lord & Scott 1924), *Pelamis platurus* (Linné, 1766) (see Lord 1920, Lord & Scott 1924, Scott 1932), *Hydrophis ornatus* var. *ocellatus* Gray, 1849 (see Scott 1932). It is of interest to note that another member of the order Tetraodontiformes, the Ocean Puffer, *Lagocephalus lagocephalus* (Linné, 1758), appears in the Tasmanian list on the basis of a single individual. In reporting on this specimen, stranded on King Island, Bass Strait, in 1967 Andrews (1970) suggested it 'probably originated in the Southern Indian Ocean and was carried across on the west wind drift current'.

Second specimen. A second local occurrence can be reported, a specimen having been found on a beach at Falmouth, east coast, by Mrs J. Smith on 1 August, 1977 (Q.V.M. Reg. No. 1977/5/35). Like the Circular Beach specimen, the standard length of which was noted as 4.65" (118mm) and the total length as 3.56" (90mm), the present example is immature, having *Ls* 63mm, *Lt* 76mm. Günther (1870) gives adult size as 8½" (216mm).

Meristic characters. D.9. A.9. P.10. C.14. Fin rays simple. Scales of sides mostly hexagonal, occasionally pentagonal or heptagonal: they do not form directly continuous longitudinal lines, but there are about 12-13 contiguous elements between gill opening and end of carapace, about 17 on ventral surface between mouth and vent; from anterior lateral spine 8-9 to eye, 8-9 to caudal base, 10 to paired dorsal spine almost directly above it, 13 to its fellow lateral spine across ventral surface (spinigerous plate included in all counts); about 13 from tip of snout to, and including, median dorsal spine, about 6 between it and caudal base; 4-6 counted obliquely across median dorsal platform.

Other metrical characters. With minor modifications and additions the measurements and proportions conforms with that adopted by Woods (1966, p.120) in his report on the

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Ostraciontidae collected in 1946 during Operation Crosswords in the Marshall and Marshall Islands.

Depth of body at pectoral origin 1.80 (35mm); depth of body including median dorsal spine and measured at that point 1.52 (41.5), without spine measured at midpoint of its base 1.80 (35); width across dorsal surface, maximum (without spines) 3.50 (18), minimum 5.04 (12.5); head (tip of snout to upper edge of gill opening) 3.41 (18.5); snout to vent 1.18 (53.5): all in standard length. Snout 1.76 (10.5); eye 2.68 (6.9); interorbital (minimum, at middle of anterior orbital border) 1.75 (10.6); least depth of caudal peduncle 1.5 (10), least width 0.61 (30.5); length of pectoral fin 1.21 (15.3); length of caudal fin 1.42 (13); height of dorsal fin 1.55 (11.9); height of anal fin 1.78 (10.4); gill opening, oblique height 6.38 (2.9); postorbital portion of head 14.4 (1.1); dorsal spine (carapace spines all measured direct from tip to middle of nearer longitudinal margin of base of spinigerous plate) 2.85 (6.5); supraorbital spine, left 2.26 (8.2), right 2.15 (8.6); paired dorsal spines, left 3.70 (5.0), right 3.78 (4.9); lateral spines, first, left 4.20 (4.4), right 4.20 (4.4), second, left 4.74 (3.9), right 4.63 (4.0), third, left 2.85 (6.5), right 2.76 (6.7): all in length of head

Other features. Carapace nearly pentagonal in section, comprising, at level of front of eyes, a dorsal segment gently convex upwards, its chord 13 mm, an upper lateral segment, almost linear, sloping length 13, a lower lateral section, almost linear, sloping length 13, a lower lateral section, almost linear, sloping length 27, and a strongly convex ventral section, chord 50. The chord of the dorsal element makes a little more than a right angle with the upper lateral, which is at about  $220^\circ$  to the lower, which is at about  $50^\circ$  to the chord of the ventral surface: if the last named is resolved into an equilateral triangle the angle at the apex is  $130^\circ$ . The areas of the three sections of the frontal elevation are in the ratio 1.00: 1.36: 1.24. Spines: (a) paired supraorbital, (b) median dorsal, (c) paired lateral dorsal, (d) three pairs along ambitus; (a) largest (c) smallest; (b), (c) and anterior pair of (d) virtually collinear transversely; all directed backward except (a), the downward extension of the axis of which meets the gill slit, located about equidistant from dorsal and ventral profiles. Carapace continuous right up to bases of fins. Mouth terminal, small, sub-elliptical. Orbit mostly crenulate, a little nearer to anterior than to superior profile, least distance from latter subequal to orbit. Interorbital strongly concave, two spines in width between bases of spines. Gill opening small, subelliptical, downwardly and forwardly oblique, anterior margin crenate. Dorsal fin somewhat falciform, 3rd ray longest; anal rounded; pectoral somewhat falciform, first ray very short, about 3 in last, which is 4 in longest (4th); caudal bluntly pointed.

The plates exhibit marked variation in size, shape and ornamentation. (i). Size.- A cluster of about a dozen surrounding the vent small or minute (less than half a millimetre); small adjoining the upper half of mouth; on front and sides of head modally about 3 mm long, larger on postorbital dorsum, still larger (up to 6) on ventral surface; on trunk small to moderate on dorsal surface, moderate to large on lateral surface, the largest peripheral. (ii). Shape.- Some of those bordering the vent with sides ill-defined, approaching circular or elliptical; of 129 distinctly polyhedral plates on ventral surface (on each side a dozen — including the spinigerous plates — extend partly on to ventral partly on to lateral surface) those with 3,4,5,6, 7 sides number 1,1,30,88,9, respectively. (iii). Ornamentation.- On each side of upper half of mouth 3, between and behind these 4 (2 medium) tuberculate and/or fluted, the margins more or less strongly ctenoid: on most of front of head with/without 5-8 obscure radiating lines, or groups of lines forming pennons widening outward; with/without a score or more extremely fine striae crossing the common rim of adjoining plates and continuing briefly into each plate; with/without up to a dozen minute scattered elevated points; a number of irregularly disposed slightly elevated lines,

sometimes minutely crenulate, extending across from less than half a plate to several plates: on dorsum most with a minute central knob and with fine parallel striae crossing margin normal to it and extending from less than a quarter to more than half-way towards the centre, these features best developed in region in advance of median dorsal spine: on sides of trunk 3-6 fine ridges running parallel to the sides, thus forming contained figures similar to the plate outline; usually a central knob and often a set of radiating lines extending from it to outer border (commonly at an angle there), with/without fine striae crossing border: on anterior portion of ventral surface generally similar to those on flank, but lacking the contained figures: on anterior portion of ventral surface with small rounded elevations, modally 8-10, encircling the central elevation in an irregular ring about halfway between it and scale margin or nearer latter. Supraorbital spines and median dorsal spine with a base in the form of a truncated pyramid constituted of 8 (left supraorbital 7) panels, surmounted by a stout subconical slightly recurved projection, the spine proper; each basal plate with numerous subvertical striae in upper half, with transverse striae across the plate junctions, also, in the case of the spines with a triangular system of 7-8 alternate light and dusky areas, widest above, extending down from upper border half-way or more towards lower. Lateral dorsal spines more conical, without sharp distinction between base and tip, vertically striate throughout most of length: lateral spines in general similar, last strongly compressed dorsoventrally.

Coloration. As preserved the carapace is translucent below a line from mouth cleft to gill slit, briefly upward to level of orbit, thereafter back to within a couple of millimetres of middorsal line at caudal base, marked in all this region only by 7 short subvertical dusky streaks, longest subequal to an eye diameter, equally spaced along the ambitus between level of gill slit and third lateral spine, extending briefly on to both dorsal and ventral surfaces: above this line wholly dark, blackish, except for upper lip, which is brown, and for some partly whitish plates near snout tip spines whitish or translucent, some duskiess at or near tips. Fins white or colorless, except caudal, which is faintly dusky distally. Viscera, visible through carapace, white or off-white.

Some aspects of form. The shape may be formally designated anseriform but perhaps more fitly, if more colloquially, be spoken of as being that of a toy duck, with the characteristic features of the bird form emphasized almost as if by caricature, the rounded 'hull' presenting an exaggeratedly bold sweep both transversely and fore and aft, and the upper half being in part concave; the overall result being almost more duck-like than the duck. Some metrical specifications are noted below.

(i). Ambitus.— The ambitus is almost in the horizontal plane behind the eyes, in advance of which it slopes forward and upward at an angle of about 45°; its greatest height above the ventral surface occurring at the first one-third of the standard length, being slightly less than one-third of its distance, at the same point, from the dorsal profile. With ten measurements of width of fish taken at equal intervals along the anteroposterior axis the outline in plan is satisfactorily defined by a third degree polynomial. Where  $W$  = width, mm,  $N$  = serial number of decile, counting caudad,  $W = 5.59 + 19.853 N - 2.7057 N^2 + 0.09810 N^3$ : actual measurements (estimated in parentheses) are 22 (22.8), 37 (35.2), 43 (43.4), 46.5 (48.0), 50 (48.5), 48 (48.5), 46 (45.6), 41.5 (41.5), 36 (36.6), 31.5 (31.6). A specimen of a *Lactoria*, Ls 37 (Q.V.M. Reg. No. 1977/5/88) found on a beach in Coolangata, Queensland (species undetermined; not *L. cornutus* (Linné, 1758), the only other form noted in the work of Marshall (1964) on the fishes of the Great Barrier Reef and the coastal waters of Queensland) having come into the writer's hands since the above was written, it was thought of interest to ascertain whether or no in it also the ambitus was satisfactorily specifiable by a polynomial. The corresponding equation is  $W = -6.24 + 14.034 N - 1.6975 N^2 + 0.04023 N^3$ : measured (estimated) widths, mm, 6.3 (6.5), 15.3 (14.8),

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21.4 (21.1), 25.0 (25.0), 27.2 (26.4), 25.0 (25.3), 23.1 (21.9), 19.0 (16.6), 9.0 (10.6), 5.4 (7.0) :  $R$  0.9954.

(ii). Dorsal and ventral profiles.- The dorsal profile presents two major segments, rising steeply concave almost to level of hind border of eye, thereafter being gently convex, the chord sloping down and back. The ventral profile is virtually a single even curve, the hind end, however, becoming subvertical in the last few millimetres. With ten equally spaced measurements of depth of curve below a line joining mouth and midpoint of the briefly squared-off terminal section of the carapace (last measurement including this short section), the outline is tolerably well defined by the following equation ( $H$  = depth below chord, mm;  $N$  = decile number, counted caudad, as before)  $H = 6.82 + 6.224 N^2 - 0.6663 N$ ;  $H$  (H) 12.2 (12.4), 16.9 (16.6), 20.0 (19.3), 21.7 (21.1), 22.0 (21.3), 20.4 (20.2), 17.3 (17.7), 13.5 (14.0), 9.3 (8.9), 3.1 (2.4). The addition of an  $N^3$  term results in a slight overall improvement in predicted value:  $H = 5.03 + 7.812 N - 1.0106 N^2 + 0.02087 N^3$ ;  $H$  11.9, 16.7, 19.9, 21.4, 20.0, 17.4, 13.5, 8.7, 3.0. The respective values of  $R$  are 0.9716, 0.9731.

(iii). Lengths to lateral spines.- In this species three pairs of lateral spines are present on the ambitus, the first pair directed at right angles to length of fish, the second and third pointed successively more backward. Their location along the anteroposterior axis is such that the logarithms of the lengths to their insertions,  $\log L$ , fall collinear when plotted against the logarithms of their serial numbers,  $\log N$ , the equation of the best straight line, with  $L$  in mm, being  $\log L = 0.5534 \log N + 1.5388$ ;  $t = 18.772^*$ ;  $L$  ( $\bar{L}$ ) 34.8 (35.6), 49.2 (50.1), 62.6 (62.2). In the Queensland *Lactoria* mentioned above it is found that in a loglog plot lengths to the first three spines occur, as in *L. diaphana*, on logs 1,2,3, with the rearward fourth spine (not present in *L. diaphana*) following on log 7.  $\log L = 0.6191 \log N + 1.0604$ ;  $t = 21.572^{***}$ ;  $L$  ( $\bar{L}$ ), mm, 11.3 (11.5), 18.4 (17.7), 23.7 (22.7), 37.9 (38.3).

(iv). Distances between lateral spines.- A formally similar relation subsists between intervals between tips of spines of a pair,  $I$ , and the ordinal number of the pair, in this case, however, counted cephalad,  $N^1$  (giving, as before, a positive slope). The equation, with measurements in mm, is  $\log I = 0.5582 \log N^1 + 1.4496$ ;  $t = 23.175^*$ ;  $I$  ( $\bar{I}$ ) 28.0 (28.2), 42.1 (41.1), 51.5 (52.0). In view of the general tendency towards variability in the lengths of spines, it might seem preferable to employ as the relevant interval the distance between the spine-bearing plates. With measurements, mm, made between the middle of these plates the equation becomes  $\log I = 0.5249 \log N^1 + 1.4175$ ;  $t = 21.731^*$ ;  $I$  ( $\bar{I}$ ) 26.0 (26.2), 39.2 (37.6), 46.4 (46.5). It may be noted that whereas in *L. diaphana* the distance between the fellows of the three pairs of lateral spines increases caudad, in the Queensland species, while the distance increases from first pair to second, it decreases again from second to third, and from third to fourth (fourth less than first) — the two interval-number graphs each with only one degree of freedom thus being, in the present context, trivial.

(v). Location of spines and fins on dorsal surface.- The general dorsal contour is interrupted by four sizable projections — the supraorbital spines (paired), the mid-dorsal spine (median, azygous), the dorsal fin and the caudal fin (not terminal, being followed by a brief ledge on the carapace, the base wholly dorsal, the rays directed up and back at an angle of about  $45^\circ$ ). In a loglog plot the lengths (from tip of snout, between parallels) to the insertion of these structures treated as ordinal values are found to be collinear when their abscissal values are whole numbers, {1,4,6,10}, the equation, with measurements in mm, being  $\log L = 0.8015 \log N + 1.001$ ;  $t = 166.000^{***}$ ;  $L$  ( $\bar{L}$ ) 10.0 (10.0), 30.5 (30.5), 42.5 (42.2), 63.0 (63.5). In the Queensland fish, which possesses a second median spine, the number set is {1,3,5,7,10}. Equation:  $\log L = 0.5177 \log N + 1.1221$ ;  $t = 78.153^{***}$ ;  $L$  ( $\bar{L}$ ), mm, 13.3 (13.2), 23.2 (23.4), 30.3 (30.5), 36.9 (36.3), 43.4 (43.6).



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