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OBSERVATIONS ON SOME TASMANIAN FISHES: PART XXIII

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(with six tables and three text-figures)

ABSTRACT

CARCHARHINIDAE. *Carcharhinus greyi greyi*, second recorded specimen from Tasmania (first recorded as *C. brachyurus*); head in plan, mouth parabolic curves, orthogonal polynomials fitted; girth of head an exponential function of length from snout tip; notes on dentition, coloration; key to Tasmanian carcharhinids.
SPHYRNIDAE. *Sphyrna zygaena*, second recorded Tasmanian example, female, compared with first, male; logarithmic lengths to seven morphological landmarks yield a linear graph when plotted on logarithms of seven natural numbers (similar formulations in other sharks).
SYNGNATHIDAE. *Syngnathus phillipi*, study of two samples (meristic and morphometric data, variation within and between samples, supposed sexual dimorphism, pouch, coloration, depth range): *Syngnathus caretta* (apparently known only from type-specimens) reported from Tasmania; current knowledge of species extended: *Ichthyocampus runa* noted as a Tasmanian species: *Syngnathus poecilolaemus*, metrical data.
LAMPRIDAE. *Lampris regius*, new and old local records.
SCORPIDAE. *Scorpis aequipinnis*, morphometry and coloration in a juvenile sample; comparison with adult material, yielding data on regional relative growth.
LEPTOSCOPIDAE. *Crapatalus arenarius*, new subspecies described and figured.
TRIPTERYGIIDAE. General review of Tasmanian representatives, with key; *Tripterygium clarkei* (later placed in *Gillias* and *Norfolkia*) here referred to *Helcogramma*: specimen noted in R.M. Johnston's memoranda, identified as *T. clarkei* by Whitley, now described as a new species: *Gillias macleayana*, new material, table of dimensions: two new species of *Forsterygion* (New Zealand genus new to Australia) described and figured: *Brachynectes fasciatus* retained in that genus; size classes.
ECHENEIDAE. *Remora remora*, observations on two Tasmanian examples (host, Luth); outline of disc fitted with second degree polynomial; lengths of transverse ridges of disc an exponential function of their serial numbers; unusual white markings in one specimen.
SYNANCEJIDAE. *Glyptauchen insidiator mirandus*, habits; first detailed account of the subspecies; length-number patterns of spines and rays; taxonomic status discussed.

INTRODUCTION

This paper follows the general plan of others in the series. Linear measurements are given, 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. Standard deviation is regularly calculated with n degrees of freedom; derived statistics being computed from the value thus obtained. Registration numbers are those of the Queen Victoria Museum, Launceston. Certain other conventions are noted in earlier contributions.

Family CARCHARHINIDAE

In the five main Australian lists covering the elasmobranchs as a whole — the descriptive catalogue of Macleay (1882), the Check-list (McCulloch 1929), the Fishes of Australia, Part 1 (Whitley 1940), the Handbook (Munro 1956), the name-list of Whitley (1964) — this group has a varied history in respect of *(a)* name, appearing as

Carchariidae (Macleay) — this term of Regan's now used by most authors to denote a distinct family — Galeidae (McCulloch, Whitley 1940), Carcharhinidae (Munro); (*b*) scope of family, Macleay (only) including Sphyrnidae, Munro separating off Triakidae, Whitley separating off Triakidae and Galeorhinidae; (*c*) number of genera and species, the totals recognized being, in chronological order of sources cited, 5 and 11, 20 and 11, 24 and 13, 28 and 8, and (familial limits not specified) 38 or 41 and 19 or 20.

No species is accredited to Tasmania in any of these lists. However, a description, accompanied by a figure (lateral aspect, ventral surface of head, teeth) of a male carcharhinid, total length 2835 mm, length to origin of lower caudal lobe 2137, caught in the Tamar River, northern Tasmania, in 1897 and preserved as a mounted specimen in the collection of the Queen Victoria Museum (Reg. No. 962y) was given in Part V of these Observations (1942). The shark was there provisionally determined as *Carcharhinus brachyurus* (Günther, 1870) with *Galeolamna greyi* Owen, 1853 as a queried synonym: it was noted, however, there was reason to suspect that Günther's type specimens may not have been conspecific, and it was remarked, not without justification, 'the systematics of this genus are in a parlous state.'

Günther's species appears in Macleay's catalogue, the locality cited being Port Jackson, but is dropped from the other Australian lists here considered; it is now commonly treated as endemic to New Zealand (Whitley 1940, 1968; Garrick and Schultz 1963).

Owen's species was translated into recent literature by Whitley, who examined the type material (upper and lower jaws, from South Australia) in the Museum of the Royal College of Surgeons, and later (1940) identified as *Galeolamna greyi* the cocktail shark listed for South Australia by Waite (1923, p.27 and fig.) as *Carcharhinus brachyurus* (Günther, 1870), at the same time providing outline sketches of upper and lower teeth of the type specimen. As the outcome of further investigations in the field in Western Australia, he came to recognize three subspecies, the nominate subspecies, *G. greyi greyi* (from South Australia to Bunbury), *G. g. mckaili* (Swan river), *G. g. cauta* (Shark's Bay to Point Cloates): the last-named is among the forms investigated in the testing of a shark repellant by Whitley and Payne (1947). Illustrations of the first of these appear both in Whitley (1945, fig. 1) and in Whitley (1940, fig. 95, after Waite; fig. 88, no. 4), of the second in 1940 (fig. 303; fig. 88, no. 4; both as *G. greyi*), while the third is here first illustrated (fig. 2) — all three subspecies were subsequently given full specific rank (Whitley 1964), this elevation in status being admitted in the Handbook only in the case of *C. mckaili* ('bays and rivers, W.A.').

The identification of the South Australian whaler shark, or cocktail shark, as *Carcharhinus greyi greyi* is adopted in the Handbook, and is accepted by Scott *et al.* (1974), who note that in South Australia it is 'very common', being 'often seen by spearfishermen in comparatively shallow water'. This too is evidently an important, if not the prime, species of bronze whaler shark noted by Hancock (1976) as accounting for nearly one-third of the total commercial shark catch in Western Australia. The Tamar river specimen is thus now to be referred to Owen's, not, as in the first report of it in Part V, to Günther's species; and the recognition by Munro (1956) and by Scott *et al.* of an eastern subspecies is here conveniently followed.

Carcharhinus greyi greyi is distinguishable from another member of the genus, *C. macrurus* (Ramsay and Ogilby, 1888), doubtfully recorded (Munro, Scott *et al.*) from South Australia, by its having anal origin slightly in advance of, instead of below, second dorsal origin, and by minor differences in dentition.

It may be remarked the Handbook gives the length of *C. g. greyi* as '4½ feet or more', while Scott *et al.* have 'to about 3 m'.

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KEY TO CARCHARHINIDAE RECORDED FROM TASMANIA

1. Spiracle present (minute) slit-like. Precaudal pits absent. Caudal with secondary (posterior) lobe of upper lobe wide (giving 'double-tailed' appearance), its greatest width, measured normal to main axis of fin, > ½ (subequal to) oblique length of lower lobe. Anal origin well behind second dorsal origin..... *Galeorhinus australis*

   Spiracle absent. Precaudal pits present. Caudal with secondary (posterior) lobe of upper lobe small or moderate in width, its greatest width, measured normal to main axis of fin, < ½ (about 1/3) oblique length of lower lobe. Anal origin about below or in advance of second dorsal origin..... 2

2. First dorsal origin in advance of middle of length to caudal base; nearer to pectoral origin than to ventral origin. Longitudinal interval between first dorsal origin and ventral origin > interval between ventral origin and anal origin (extending about to, or beyond, anal termination). Pectoral not falciform, subtriangular, its greatest width ≥ ½ its length; the latter < length to origin of fin. Snout moderately rounded. Greyish above, lighter below ..... *Carcharhinus greyi greyi*

   First dorsal origin behind middle of length to caudal base; further from pectoral origin than from ventral origin. Longitudinal interval between first dorsal origin and ventral origin subequal to interval between ventral origin and anal origin. Pectoral strongly falciform, its greatest width < ½ its length; the latter ≥ length to origin of fin. Snout pointed. Brilliant blue above, white below.. *Prionace glauca*

Specific names adopted above are those used in the Handbook (Munro 1956). Whitley in 1940 listed the first as *Notogaleus australis* (Macleay, 1881) and in 1964 as *N. rhinophanes* (Péron, 1807) — genus *Notogaleus* Whitley, 1931; the second as *Galeolamna greyi* Owen, 1883 — genus *Galeolamna* Owen, 1883; the third in 1940 and 1964 as *Carcharhinus mackiei* (Phillipps, 1935), and later in 1968 as *Prionace mackiei*.

Genus *CARCHARHINUS* Blainville, 1816

Carcharhinus Blainville, 1816, *Bull. Soc. Philom.*, p.12. Type-species, *Carcharias melanopterus* Quoy and Gaimard, 1824. [Opinion 723, BZN, 22 (1), 1965: 184. Check-list (McCulloch 1929) gives logotype *Squalus commersonii* Blainville].
Carcharias Cuvier, 1816, RÈGNE ANIM., 1, p. 125. Type-species, *Squalus carcharias* Cuvier, 1816.
Galeolamna Owen, 1853, DESCR. CAT. OSTEOL. MUS. ROY. COLL. SURG., 1, p. 96. Type-species, *G. greyi* Owen, 1853.

Carcharhinus greyi greyi (Owen, 1853)

Galeolamna greyi Owen, 1853, DESCR. CAT. OSTEOL. MUS. ROY. COLL. SURG., 1, p. 96. Type locality: South Australia. (based on upper and lower jaws)
Carcharhinus brachyurus: Waite, 1923, FISH. S. AUST., p. 27, unnumbered fig. *Id.* Scott, 1942, *Pap. Proc. R. Soc. Tasm.* (1941), p.5, pl. 7. Not *Carcharias brachyurus*

Günther, 1870 (New Zealand only). Not *Carcharias brachyurus* Waite, 1906. Not *Carcharhinus brachyurus* McCulloch, 1919 (= *C. spenceri* Ogilby, 1910, *fide* Whitley, 1943, p. 119).

Galeolamna greyi: Whitley, 1932, *Rec. Aust. Mus.*, 18 (6), p. 324. *Id.* Whitley, 1940, FISH. AUST., 1, p. 100, fig. 95, fig. 88, no. 5: not *G. greyi, ibid* ., p.273, fig. 303 (= *G. mckaili* Whitley, 1945).

Galeolamna greyi greyi Whitley, 1945, *Aust. Zool.*, 11 (1), p.1, fig. 1.

Carcharhinus greyi greyi Munro, 1956, HANDBK FISH. AUST., 2, p. 9, fig. 59. *Id.* Scott, Glover and Southcott, 1974, MAR. FRESHW. FISH S. AUST., p. 36, 2 figs (fig. of animal = *C. brachyurus*: Waite, 1923).

Tasmanian occurrence. The first formal record, in 1942, for Tasmania based on a specimen caught in the Tamar river in 1897 has been noted above. An example stated to be 2.5 m in length and to weigh 160 kg was netted by Mr R. Wright, Launceston, at Greens Beach, northern Tasmania, on 23 January 1976. A report in the Launceston *Examiner* of 24 January (specimen misidentified as a white pointer) was accompanied by photographs of the dorsal aspect and of the mouth. The shark was buried but was exhumed on 25 January by Mr R.H. Green, Curator of Zoology, Queen Victoria Museum, who idendified it as a bronze whaler, and secured the caudal fin and most of the head for the Museum's collections (Reg. No. 1975/5/55). Though seldom coming under scientific observation, *Carcharhinus greyi greyi* is probably by no means uncommon in our waters. The writer has on various occasions received reports of its occurrence here; though it has not been practicable to confirm these, some of them, from fishermen with the South Australian catalogue of Scott (1962) or of Scott *et al.* (1974) available for reference, seem likely to be reliable. As noted above, the subspecies is abundant in South Australia and southern Western Australia.

Head, general. The head as preserved has been cut somewhat short, not including a gill-slit but embracing some gill tissue. Total length 320, length to front, back of mouth 160, 260, of nostril 81, 91, of eye 164, 197. Width of mouth 200; direct distance from nostril to mouth 88.5; from nostril to tip of snout 122.5; internarial 138. Interorbital 235. Nostril slightly oblique; its transverse length 30; anterior border of narial flap crenulate; cavity above tragus 17 (transversely) by 7.5.

Widths of whole head and of preoral head at tenths of anteroposterior lengths from tip of snout and width of mouth cleft at tenths of its fore-and-aft extension are noted in separate sections below. Maximum width of lower jaw 60. Depth at front, back of nostril 59, 67, front, back of mouth 130, 130; maximum depth (about 300 behind snout tip) 157.

Dorsal and ventral surfaces closely approaching each other externad, rendering the profile briefly rounded, tolerably sharp, ridge-like. Eye set right on profile, orbit extending on to lower surface. Abundant small, fairly closely set, irregularly disposed pores covering most of ventral surface, somewhat less numerous on mandible; a well defined arc of about 15-20 closely bordering either side of front of mouth, each pore set in the middle of a light-colored circle, the diameters of the circles sub-equal to their interspaces.

Head in plan. Snout 'long and pointed', 'bluntly rounded', 'moderately rounded','more broadly rounded than in preceding species' — such specifications conventionally appearing in specific diagnoses (the present examples are successive entries in the Handbook) clearly have some value; equally clearly their significance would be considerably enhanced by some measure of quantification. The following analysis of the form of the head, viewed in plan, is offered as an initial contribution to such specification. As preserved the present specimen does not include a gill slit; however, it does include some gill tissue, and with total length, 320, twice length to front of mouth, it can be regarded as being tolerably close to complete to level of first gill slit.

A tracing of the outline has been made, the anteroposterior axis marked off in

deciles, and widths measured at these levels. To introduce a measure of generalization the widths are given as proportional not as absolute dimensions, being expressed as a percentage of a convenient morphological unit. In view of the indeterminate nature of the dimension 'length of head', consequent upon the arbitrary level of severance, the unit here selected is width at level of front of mouth. In general, however, for the purpose of interspecific comparison widths would be more satisfactorily expressed as percentages of total length of head (to first or to last gill slit), thus making allowance for individual differences in mere size, without involving possible specific variation in form.

Orthogonal polynomials of the second and third degree have been fitted in accordance with the method perfected by Fisher (1932). With N = percentile number, counting caudad, W = width of head as percentage of width at front of mouth, the second degree equation is $W = 99.36 + 9.0242\ (N - 5.5) - 0.66295\ (N^2 - 11N + 22)$, *i.e.*, $W = 35.14 + 16.317\ N - 0.66295\ N^2$. Predicted values of W (actual values in parentheses) are 50.8 (46.6), 65.1 (66.9), 78.1 (82.2), 89.8 (92.5), 100.2 (100.0), 109.2 (105.9), 117.0 (114.5), 123.2 (122.0), 128.3 (128.8), 135.5 (133.9). The third degree equation, with the additional term $0.14015\ (N^3 - 16.5\ N^2 + 76.10\ N - 85.80)$, is $W = 23.11 + 26.986\ N - 2.9758\ N^2 + 0.14015\ N^3$; predicted values of W being 47.3, 66.3, 81.1, 93.0, 101.2, 108.2, 115.1, 120.3, 125.3, 135.5.

The reduction in sum of squares due to fitting the regression is a significant one at each stage, the ratio of the remainder, $S\ (Y - \tilde{Y})$ to the mean square for error yielding successively F = 178.62, 23.11, 14.48, (d.f. = 1 and 8, 7, 6). For the equation in N^2 the percentage of deviations of $\tilde{W}$ from W ranges from 0.2 to 9.0, mean 2.80; for the equation in N^3 from 0.2 to 2.7, mean 1.43. The formal significance of the third degree equation is highly satisfactory; the equating of the remaining sum of squares, 8.1364, to Sy^2, 7019.5, with $1\text{-}R^2$ yielding R = 0.99942.

The coefficient of N^2 in the second degree polynomial provides a direct measure of the pointedness of the curve; and hence in equations derived from strictly comparable data permits a quantitative comparison of the feature in two species.

For pragmatic taxonomic purposes a formulation leading to a straight line graph is in some respects more convenient than one involving a curvilinear graph, providing a more immediate visual estimation of parameters. An exponential treatment in the general form of $W = a \log N + b$, or $N = 10^{\frac{w-b}{a}}$ is discussed below (it has been considered expedient to work in common, rather than in natural, logarithms). The chief disadvantage of the procedure with the present data lies in the fact that the graph presents a point of inflexion.

Plotting the 10 relative widths successively caudad on the integral numbers 1-10 along a logarithmic abscissa is found to yield very good approximations to two straight lines, the first (A) covering logs 1-6, the second (B), with a markedly steeper gradient, logs 7-10. Here, as in the preoral and the mouth curve graphs discussed later, the point of inflexion, as visually assessed, occurs at, or significantly close to, a plotted point, i.e., it effectively has as abscissal value a natural-number logarithm. This pair of coördinates can thus formally be treated as belonging to the first segment (the convention here adopted) or the second or to both (the last-mentioned procedure, by its provision of an additional degree of freedom, yielding increased statistical formal significance to each of the two graphs).

With N and W as before, the equation for the best-fitting straight line for (A) is $W = 77.49 \log N + 45.60$; t = 37.255***. Decile widths as calculated are 45.6, 68.9, 82.6, 92.1, 99.8, 105.9. For (B) the equation is $W = 126.74 \log N + 74.47$; t = 51.219***: decile values are 114.6, 121.9, 128.4, 134.2.

For (A) the percentage deviation of predicted from measured values is 0.03-3.0, $\bar{x}$ 1.27; for (B) 0.08-0.3, $\bar{x}$ 0.19, the noticeably greater mean of (A) deriving largely from the contributions (2.1, 3.0) made by the first two entries. A composite character of (A) is thus suggested (in the traced outline of the head a decrease in rate of curvature is apparent near the level of the nostrils, at about the middle of the preoral length.) When deciles of preoral width are plotted on the integral logarithms 1-10, the graph is seen to run, with significant rectilinearity, from log 1 to log 3 (Aa) and to continue, with steeper slope, from log 4 to log 10 (Ab).

With w = relative width, n = preoral decile number, the regression equation for (Aa) is w = 63.09 log n + 27.60 ; t = 373.739***: measured (calculated) decile percentages are 27.5 (27.6), 46.6 (46.6), 57.6 (57.7). For (Ab) w = 83.05 log n + 17.49 ; t = 64.090***; deciles 66.9 (67.5), 75.8 (75.5), 82.2 (82.1), 88.1 (87.5), 92.8 (92.5), 96.6 (96.7), 100.0 (100.5). Percentage deviations of $\tilde{w}$ from w are for (Aa) 0.02-0.2, $\bar{x}$ 0.11, for (Ab) 0.1-0.8, $\bar{x}$ 0.47.

Four equations have been set out above, (A) = {N = 1-6} , (B) = {N = 7-10} , (Aa) = {n = 1-3} , (Ab) = {n = 4-10} . However, in the present specimen {N = 5} is located (adventitiously, as result of abitrary level of severance) at level of front of mouth. We can therefore calculate the postoral portion of the combined (A) and (B) graphs as B_1 {N = 6-10} , the equation (naturally closely similar to that for (B) = {N = 7-10}) being W_1 = 127.40 log N + 6.85 ; t = 104.178: predicted values of W_1 106.0, 114.5, 121.9, 128.4, 134.5, the percentage deviation of these from actual values (given above) being 0.06-0.4, $\bar{x}$ 1.20. Thus in this particular example the form of the head in plan is completely specifiable from the available data, on the basis of the present ad hoc mode of specification, by three equations only, (Aa), (Ab), (B_1), representing three exponential arcs, the first accounting for approximately the anterior one-fourth, the last for the posterior one-third of the length.

It is of interest to note that the goodness of fit obtained in this ad hoc procedure is well above that afforded by the third degree polynomial, the percentage deviation of predicted from actual values being in the former 0.02-0.8, $\bar{x}$ 0.31, in the latter 0.2-2.7, $\bar{x}$ 1.43 — however, the present method has of course the disadvantage of treating the overall curve as three component curves.

Mouth. The anterior border of the crescentic mouth lies behind tip of snout by 1.60 its anteroposterior extension, the latter being just half the chord at the angle of the mouth, or 1.13 direct distance from mouth to nostril. A small, rather widely divergent labial groove is present, its length (12.5 mm) 0.06 width of mouth, equal to direct distance from its tip to mouth cleft.

The curvature of the mouth cleft in sharks varies markedly between, but is in general tolerably uniform within, families; the length of the gape ranging from less than one-third of its width in scyliorhinids to more than twice as much in sphyrnids, the feature doubtless being correlated with feeding habits. In the present specimen the length-width ratio is 0.50; judging from published figures it ranges among carcharhinids from near that value to rather more than 0.6.

The mouth cleft has been examined by the methods employed in the analysis of the curve of head in plan, widths being measured at tenths of the anteroposterior length, and being generalized by being expressed as percentages of chord of mouth at angle.

The N^2 equation is W = 71.60 + 7.5151 N − 0.53220 (N^2 - 11N + 22), i.e. W = 18.56 + 13.369 N − 0.53220 N^2. Predicted values (actual in parentheses) are 31.5 (30.5), 43.2 (44.0), 53.9 (53.0), 63.5 (65.5), 72.1 (72.5), 79.6 (79.0), 86.1 (85.5), 90.5 (90.5), 95.8 (95.5), 99.0 (100.0). The third degree equation, with the additional term 0.36425 (N^3 − 16.5 N^2 +76.10 N − 85.80),is W = 15.43 + 16.14 N − 1.1331 N^2 + 0.036425 N^3; predicted values of W being 30.5, 43.5, 55.8, 64.2, 72.4, 79.4, 85.4, 90.7, 100.0. Note that the equation in N^3 passes through the first and the last two points

of the series.

As with the equations for head in plan, the reduction in sum of squares due to fitting is significant at all stages, with F, as before, 23.60, 195.61, 178.82. For the equation in N^2 the percentage deviations of $\widehat{W}$ from W range from 0.0 to 3.0, mean 0.72. At the conclusion of the fitting of the third degree term the multiple correlation coefficient R has the highly satisfactory value of 0.99986.

For the ad hoc procedure involving an exponential formulation and yielding a rectilinear graph with one point of inflexion the equation for (A) = {N = 1-3} is W = 46.91 log N + 30.73 ; t = 28.491*; decile chords as calculated 30.3, 44.5, 52.5. For (B) = {N = 4-10} W = 87.43 log N + 11.86 ; t = 53.047***; deciles 64.5, 73.0, 79.9, 85.7, 90.8, 95.1, 99.3.

The variation of predicted from measured value in (A) is 0.6-1.0, $\bar{x}$ 0.83%; in (B) 0.3-1.5, $\bar{x}$ 0.72% — values seen not to differ greatly from those for the polynomials.

Comparison of head and mouth curves. Even the most casual observer, it would seem, could not fail to be struck by the visually pleasing relationship between the curve of the mouth and that of the head as a whole: and since the appearance of *On Growth and Form* (Thompson 1942) biologists have learnt to expect that many instances of natural aesthetic elegance are susceptible of precise mathematical specification. In the present case it has been shown both curves represent, to a good approximation, a parabola.

In the formulations already given the curve of the head has been calculated from decile widths expressed as percentages of width of head at level of front of mouth, while the corresponding morphological unit for specification of the mouth curve has been maximum width of mouth. To make possible a direct comparison of the parabolas for head and mouth, that for the latter is here calculated with deciles expressed as percentages of head width at front of mouth, the equation being W = 13.48 + 12.451 N − 0.55341 N^2; that for head W = 35.14 + 16.317 N - 0.66295 N^2. The numerically smaller negative value of the coefficient of the second-degree term in the equation for the mouth is indicative of the relevant curve being shallower than the curve of the head.

An interesting ad hoc comparison of the two curves, presented in the convenient form of a straight line graph (with a point of inflexion) is obtained by plotting successive cumulated deciles of head width. With all dimensions in mm the equation for deciles 1-3 is cum M = 0.5510 cum H + 0.73 ; t = 192.534***: for deciles 4-10 cum M = 0.6293 cum H — 4.45 ; t = 503.809***. Values predicted by these equations (measured values in parentheses): 61.3 (61), 148.1 (149), 255.2 (255), 383.9 (386), 532.6 (531), 689.9 (689), 859.8 (860), 1041.1 (1041), 1229.4 (1232), 1431.2 (1432).

Head, girth. The shape of the head (and of the body in advance of dorsal origin) viewed laterally is of taxonomic significance, especially the degree of gibbosity of the dorsal profile above and behind the gill slits. In the present specimen the overall anteroposterior convexity of the dorsal surface is slight or moderate: however, at 270 behind snout tip there occurs a low median swelling about 60 long and about 100 wide.

The girth of the head of the present specimen at 10 equal intervals, concluding at the furthest level back at which satisfactory measurement is feasible (300 mm from snout tip), has been determined.

It has been found the relation between girth, G, and decile number N (1, most anterior) is, to a significant approximation, of the form $G = bN^k$. Expressed in the convenient form log G = k log N + b, yielding a straight line graph, the equation (G in mm) is log G = 0.5166 log N + 2.3764 ; t = 18.187***. The 10 girths (with

predicted values in parentheses) are 231 (238), 348 (340), 420 (420), 502 (487), 551 (546), 600 (600), 645 (650), 696 (697), 793 (740), 761 (782).

Head, pores. Most of ventral surface liberally sprinkled with minute pores, in general from 1-2 to 3-4 mm apart; least numerous behind level of eyes and along internal border of lower jaw. A regular series of about a score of rather more conspicuous pores, each in middle of lighter colored spot, about 3 in diameter, bordering upper lip; about 30 scattered irregularly adjacent to these.

Head, color. Save for a subelliptical isabelline patch about 50 long, 45 wide, beginning 105 behind snout tip, dorsal surface almost uniform slate grey. Ventral surface mostly off-white, in places approaching ivory; somewhat dusky strip narrowly bordering upper jaw, width 10 at angle increasing to 25 just behind level of tip of lower jaw, in advance of this spreading out to form a semielliptical patch about 60 long, 100 wide; some duskiness (differing in extent and disposition on two sides) round about nostrils; from level of nostril backwards dark grey of dorsal surface extending briefly on to ventral surface, strip increasing to width of 10-12 at level of eyes, behind this progressively decreasing slightly.

Dentition. Teeth in upper jaw 16 and a small symphysial on each side; in anterior part of jaw disposed alternately in outer and inner rows, latter the even numbers, counting outwards; inner tooth set closely against two outer flanking it, from one-tenth to one-eighth of its base hidden by their bases. General form very similar to that of teeth of type as sketched by Whitley (1940, fig. 88, no. 4); subtriangular; border directed towards angle of mouth somewhat sinuate, the larger upper portion convex; other border slightly concave in upper half, curve below more rapid; both borders delicately serrate almost to tip; some stronger serrations on base. Between first main tooth on either side 2 small symphysial teeth; on level of inner series. Vertical height of 10 teeth from second on right, through two symphysial to sixth on left 9.0, 7.1, 4.9, 5.0, 6.5, 7.3, 10.4, 13.0, 15.4, 12.5 (measured from midpoint of exposed, slightly upwardly convex base), size thereafter continually decreasing; bases (visible) 8.6, 7.4, 5.5, 6.6, 8.8, 10.0, 11.1, 12.7, 14.0, 13.1; distance between tips 9.0, 5.7, 6.0, 8.6, 7.9, 9.0, 12.1, 10.3, 11.7. Median teeth nearly erect, others sloping progressively further outwards.

Teeth in lower jaw 16 (plus small symphysial tooth), on each side, not alternate, first three on either side, and symphysial, with a similar tooth directly behind it; smaller than those of upper jaw, decreasing in size from third, outermost 1-2 high; in general more symmetrical than upper teeth, laterally progressively approaching conical; microscopically serrate. Symphysial tooth with a very slightly larger tooth immediately behind it, with base contiguous with bases of inner pair of first teeth. Vertical height of 9 teeth from second on right, through symphysial, to sixth on left 7.0, 6.0, 2.2, 5.0, 6.9, 9.1, 9.9, 9.0, 7.1; bases (visible) 12.5, 8.5, 2.0, 8.1, 12.2, 9.1, 9.9, 9.0, 7.1; distance (dividers) between tips 10.7, 9.9, 5.2, 10.9, 10.9, 11.1, 11.0, 10.9. Anterior teeth leaning outward at about 40^{o}, outer becoming increasingly nearer upright.

Caudal fin. The general form of the caudal is tolerably constant in Australian representatives of *Carcharhinus* – upper lobe subtriangular, superior border moderately convex, length about twice lower lobe, subequal to (usually somewhat exceeding) head; terminal secondary lobe rather small, its length 2-4 in length of rest of lobe.

Some dimensions (mm) of Greens Beach specimen. Length (direct, not following curve) of upper border 655; of other borders, in succession, 160, 65, 350, 160, 305. Depth (in parentheses, first, diameter of elevated strip over vertebral column, secondly, distance of strip from superior border) at origin 92 (60, 32), at upper end of hind border of lower lobe 190 (55, 73), at notch 58 (36, 16), at greatest depth of second lobe 109 (33, 24). Vertebral column ends 65 in advance of tip, 36 below superior

border, 20 above inferior. Borders, in succession as before, moderately convex with rate of curvature increasing caudad; slightly concave, especially in lower one-third; sigmoid; moderately convex, strongly crenulate; slightly concave, regularly crenulate; rather strongly convex.

Upper caudal lobe originating, 23 behind level of origin of lower lobe, as ridge arising from shortly behind middle of subtriangular depression, 25 long, 40 wide, depth 5, at middle of transverse anterior border, depth progressively decreasing backward. At base of lower caudal lobe a transverse bursa, 23 wide, 5 deep, the anterior wall a fleshy subvertical flap, readily apposable to hind wall closing whole pocket.

Above vertebral column virtually uniform dark grey, elsewhere in general lighter, ivory or flesh-colored. Borders, in succession as before, dark grey; a trifle lighter than light ground color; same; in posterior two-fifths marginally lighter for about 1 mm, rest with about 1 of white distally, followed by about 2 of near-black, followed by 2-3 obscurely dark or darkish; similar to anterior part of last border, but more obscurely marked, increasingly so towards tip of lobe; light, concolorous with remainder of lobe.

Family SPHYRNIDAE

As the outcome of a survey by the writer (1973) of Sphyrnidae reported in Australian waters, in all seven species, it was concluded that those satisfactorily recorded comprise *Sphyrna lewini* (Griffith and Smith, 1834), *S. zygaena* (Linné, 1758), *S. mokarran* (Rüppell, 1835) – with *S. ligo* Fraser-Brunner, 1950 as a probable synonym – with the inclusion of *S. blochii* (Cuvier, 1816) in doubt.

The Australian history of *S. zygaena*, an example of which is noted below, is a curious one, traced in detail in the paper cited. In summary: earlier writers not unnaturally recorded hammerheads under the familiar name of the European *S. zygaena* (or, as in Johnston's first Tasmanian catalogue (1883), as the synonymic *S. malleus* Valenciennes, 1822); as the description of *S. lewini* (type locality, 'South coast of New Holland') became more widely known there developed a tendency more or less automatically to report all Australian captures as this species, *S. zygaena* appearing with decreasing frequency in the local literature, and by 1934 (a hundred years after the description of *S. lewini*) virtually disappearing from it. With the publication in 1967 of Gilbert's revision of the hammerheads of the world the systematics of the family were first placed on a satisfactory basis. A hammerhead caught in George Bay, east coast, in 1970 has been shown by the writer (1973) to be *S. zygaena*. While it would appear probable that *S. lewini* occurs in Tasmanian waters, early records of it in local lists – *e.g.*, Lord (1923, 1927), Lord and Scott (1924) – must be regarded as suspect and in need of confirmation.

A key to the Australian species appears in the paper cited. *S. zygaena* and *S. lewini* are most readily distinguished by the outline curve of the anterior part of the head; viewed in plan, this presents in the former an unbroken forwardly convex sweep, while in the latter it includes a median concavity.

Genus *SPHYRNA* Rafinesque, 1810

Cestracion Klein *in* Walbawm. 1792, Type-species, *Squalus zygaena* Linné, 1758, by subsequent designation of Gill, 1861. Name inadmissible by International Commission rules, 1907, 1910.

Sphyrna Rafinesque, 1810, INDICE D'ITTOLOGIA SICILIANA, pp. 46, 60. Type-species, *Squalus zygaena* Linné, 1758, by subsequent designation of Jordan and Gilbert, 1883.

Sphyrna zygaena (Linné, 1758)

Squalus zygaena Linné, 1758, SYST. NAT., ed. 10, p.234. *Ex* Artedi. Type locality: Europe and America.

Sphyrna (Sphyrna) zygaena Scott, 1973, *Rec. Queen Vict. Mus.*, 48, p.3 (Australian synonymy and references).

Material. A young female specimen, 641 mm in total length, collected by Mr N. Blichfenot 30 km north of Bridport, north coast, in 50 m on 12 May 1976 (Q.V.M. Reg. No. 1976/5/149). A young male, 610 mm in total length, collected by Mr E. Gatenby in George Bay, east coast, on 17 April 1970 (Q.V.M. Reg. No. 1970/5/14), providing the first authentic Tasmanian record of this species, has been described and figured by the writer (1973). See also Part XIX (1974a, p.252).

Dimensions. The following set of dimensions, expressed as permillages of total length (between parallels) includes all items reported (1973, table 1) for the George Bay specimen, the values for the latter here being cited (in parentheses) for direct comparison.

Length to first gill slit 176 (162), to fifth 231 (220). Mouth: length to upper lip 65 (61), to angle 112 (109), to mandibular symphysis 70 (66); width of cleft 73 (63), width at labial folds 76 (67). Width, depth of head at: midpoint of scallops 109 (98), 28 (21), tips preocular prominences 256 (233), 37 (36), first gill slit 86 (95), 90 (74), fifth gill slit 89 (74), 92 (85); maximum 287 (259), 94 (85). Eye: length to, parallels, 72 (62), direct from snout tip 153 (138); horizontal diameter 20 (24), vertical 18 (21). Orbit: horizontal diameter 22 (26), vertical 19 (22). Interorbital 271 (248). Nostril: length to, parallels 53 (49), direct from snout tip 120 (106); distance from eye 16 (16), from orbit 12 (15). Internarial 212 (190). Inner narial groove: length (chord) 65 (56); distance from anterior end direct to snout tip (profile) 62 (54); distance between anterior ends of grooves 103 (101). Length of second (largest) gill slit 21 (22), of fifth 17 (17).

First dorsal: length to origin 288 (266); base 85 (90); length of anterior border 148 (139), of distal 108 (82), of lower border of lobe 31 (26); vertical height 109 (103). Interdorsal 257 (248). Second dorsal: length to origin 628 (603); base 31 (30); length of anterior border 37 (31), of distal (41),48 (41), of lower border of lobe 41 (44); vertical height 23 (16). Anal: length to origin 593 (577); base 38 (43); length of anterior border 54 (44), of distal 37 (38), of upper border of lobe 41 (37); vertical height 27 (21). Pectoral: length to origin 218 (213); [this measurement is to level of origin of anterior border; length to girdle, felt immediately below surface, 209, (203)]; base 58 (49); length of anterior border 120 (113), of distal 89 (75), of posterior 34 (38); total length 125 (125); maximum width normal to longitudinal axis 75 (69: in table 1 (1973), in error, 110). Interpectoral: at anterior end of base 69 (62), at posterior end 30 (30). Pelvic: length to origin 477 (457); base 36 (40); length of anterior border 37 (41), of distal 51 (44), of posterior, total 34 (35), free 25 (20); total length 76 (69); maximum width normal to longitudinal axis 38 (39). Interpelvic: at anterior end of base 39 (30), at posterior end 25 (15).

Upper lobe of caudal: length to origin (at precaudal pit) 727 (711); base ('precaudal pit to junction with lower lobe' = to junction of hinder border of subtriangular lower lobe with anterior end of linear section of inferior border) 89 (81); length of anterior border 287 (289), of posterior below notch 193 (193); terminal lobe, anterior border 24 (20), posterior 48 (40); width at notch 24 (21). Lower lobe of caudal: length to origin 718 (692); base (slightly oblique) 72 (67); length of anterior border 114 (107), of posterior 64 (55). Length to end of vertebral column 988 (982). Length to vent (middle) 518 (474). Depth (width) at: first dorsal origin 101 (95), 80 (72), pelvic origin 86 (79), 72 (56), anal origin 59 (57), 41 (41); caudal peduncle (minimum) 41 (39), 34 (30); maximum (body) 109 (97), 78 (74).

It will be seen the relative dimensions recorded are in general in tolerably close agreement; there being no clear indication of sex differentiation.

Metrical characters of key. Specifications of *S. zygaena* and *S. lewini* in the key to Australian species include three metrical items. *(i)* Inner narial groove extending in *S. zygaena* $\geq \frac{1}{2}$, in *S. lewini* $< \frac{1}{2}$ (*ca* 0.4-0.45), distance from anterior end of groove direct to snout tip: in both the earlier (male) and present (female) specimen the value is 0.51. *(ii)* Distance from naris to orbit in *S. zygaena* $<$ (*ca* $\frac{1}{2}$), in *S. lewini ca*, diameter of eye: in the male this is 0.71, in the female 0.63. *(iii)* Lobe of second dorsal extending in *S. zygaena* $< 2/3$, in *S. lewini* $> 2/3$ (*ca* 3/4-4/5) distance from fin base to precaudal pit: in the male the extension is 0.56, in the female 0.60.

Coloration. The overall coloration, slaty grey above, lighter, whitish or approaching whitish below, is similar to, but somewhat lighter than, that of the juvenile male, other references to which are here made in parentheses. Strip of white encroaching from ventral surface on to dark grey along anterior border of head about 2 mm (about 1 mm) wide, expanding on preocular prominences into ovoid whitish patches (not developed). Anterior borders of dorsals narrowly margined (as in male) with darker. Anal mostly whitish or faintly dusky, concolorous with ventral surface of body, deeply dusky round junction of anterior and distal borders, pure white along lower border of lobe (transverse dark markings in male lacking). The curious dark markings on the side behind pelvic origin, in the form of splashes and downwardly and forwardly oblique dark bars described and figured in the male occur also in the present specimen, all here being bars. On the left side, where they are somewhat better developed, they comprise, in sequence caudad, three short, above pelvic base; two fairly close set, about 30 by 2-3 mm, about 20 by 2, first partly above pelvic base; one short midway between dorsal and ventral profiles, above anal base; two dark and conspicuous, about 40 by 3, about 35 by 5-8, extending over two-thirds of height above lobe of anal; three, narrow, short, closely set in hind half of caudal peduncle.

Mouth. As noted above the curvature of the mouth is more shallow in carcharinids than in sphyrnids; the length/width ratio, 0.50 in our example of *Carcharhinus greyi* here being 0.65. An equation has been calculated for the curve obtained by placing a card in the mouth and tracing the outline of the lower jaw; 10 measurements of width then being taken at equal intervals. With N = decile number, counting caudad, $W = 10.92 + 5.127\ N - 0.1539\ N^2$; actual values of W (calculated in parentheses) 15.0 (15.9), 21.5 (20.6), 24.5 (24.9), 30.0 (28.9), 33.0 (32.7), 35.5 (36.1), 38.5 (39.1), 41.5 (42.0), 44.5 (44.4), 47.0 (47.6). To permit of direct comparison with specimens of other sizes the parabola has been recalculated with Wm = width as percentage of maximum width of curve: $Wm = 27.17 + 10.20\ N - 0.3337\ N^2$.

Location of certain morphological landmarks. It is found 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. With L = length, mm, to one of the seven-member set { back of mouth, pectoral origin, first dorsal origin, pelvic origin, anal origin, caudal origin (taken as origin of upper lobe), total length }, N = relevant natural number of set { 2, 3, 4, 5, 6, 7, 8, 10 }, the equation of the best straight line for the present specimen is $\log L = 1.3313 \log N + 1.4668$; $t = 54.523$; measured (predicted) values of L 72 (74), 134 (127), 183.5 (185), 306 (318), 390 (391), 461 (466), 641 (628). For the specimen reported in 1973 the corresponding equation (with L as thousandths of total length, not mm) is $\log L = 1.3466 \log N + 1.6322$; $t = 40.105$; measured (predicted) values of L 109 (109), 203 (187), 260 (278), 457 (479), 577 (589), 711 (705), 1000 (952). In both cases length to pectoral origin is measured to felt-for girdle just below the integument; the value previously reported for the male (1973, table 1) is length to origin of (external) anterior border of fin. In this shark anal origin and second dorsal origin are located quite close to one another: in the formulation length to the former point has been arbitrarily adopted.

Similar results involving some or all of the morphological landmarks here noted (together with length to second dorsal origin, length to base of lower caudal lobe) plotted at relevant intervals have been encountered in a number of other species, the first point, length to back of mouth, being variously located in different families on log 1, log 2 or log 3. With the slope of the graph decided by the plotting of log length to back of mouth on the appropriate abscissa (ascertained, formally, by trial and error, in practice generally obvious from inspection of relative length of preoral head), followed by the plotting of log total length on either log 9 or log 10 (by trial and error), the precision with which the selected ordinate dimensions when plotted at integral abscissal values approximate the predetermined straight line is indeed striking.

Perforations in body wall. The specimen has two perforations extending from the external surface through the body wall to the coelome, one immediately behind the base of each pectoral. Both are very neatly outlined externally, that on left side ovoid, 7 by 5.5 mm, that on right side somewhat pyriform, 9 by 6, divided near middle of its length by a narrow oblique superficial bar of integument. It is not evident whether these represent pre or post mortem injury.

Family SYNGNATHIDAE

Only seven species are credited to Tasmania in the Check-list (McCulloch 1929), four additional species having been included earlier in the local list of Lord (1927). In a paper by the writer (1968) containing a first record for this State of *Syngnathus poecilolaemus* Peters, 1869, twenty Tasmanian species were enumerated — however, entry XVII, *Hippocampus novaehollandiae* Steindachner, 1866, is to be regarded as a junior synonym of XIX, *H. whitei* Bleeker, 1885. A twentieth species, *Ichthyocampus cristatus* McCulloch & Waite, 1918, was noted in Part XVII (1970, p.35).

Two additional species, *Syngnathus caretta* Klünzinger 1879, and *Ichthyocampus runa* (Whitley, 1931), are here noted, and some general observations are made on *Syngnathus phillipi* Lucas, 1891 and *Syngnathus poecilolaemus* Peters, 1869.

Genus *SYNGNATHUS* Linné, 1758

Syngnathus Linné, 1758, SYST. NAT., ed. 10, p.336. *Ex* Artedi, ICHTH., 1738, gen. 1, p.1. Type-species *S. acus* Linné.

Syngnathus caretta Klünzinger, 1879

Syngnathus caretta Klünzinger, 1879, *Sitzb. Akad. Wiss. Wien*, 80 (1), p.419 (p.95 of reprint). Type locality: Port Phillip Victoria.
Syngnathus caretta: Macleay, 1884, *Proc. Linn. Soc. N.S.W.*, 9, p.60. *Id.* Lucas, 1890, *Proc. R. Soc. Vict.* (n.s.), p.38.
Leptonotus caretta: McCulloch, 1929, *Aust. Mus. Mem.*, 5 (1), p.85. *Id.* Whitley, 1941, *Aust. Zool.*, 10 (1), p.16, fig. 12. *Id.* Munro, 1958, HANDBK AUST. FISH., 21, p.85, fig. 587.
Pugnaso caretta : Whitley and Allan, 1958, THE SEAHORSE AND ITS RELATIVES, p.8. *Id.* Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), p.37.

History of species. This is one of our lesser known pipefishes, most of the available information about it being derived from Klünzinger's original account, of which Macleay gave an English version in the supplement to the Catalogue (1884), and from some notes by Whitley (1941, p.16) on, and a sketch (fig. 12) of, the holotype, a female, examined by him in the Wurttembergische Naturaliensammlung, Stuttgart in 1937: some additional data is included in the diagnosis in the Handbook (Munro, 1958), which reproduces Whitley's sketch. It may be noted that in his census of fishes recorded from Victorian waters Lucas (1890, p.38) listed this species in parentheses, his

convention for records based on a single specimen or regarded as doubtful in respect of locality, in which latter category he placed all Klünzinger's material reported (1872) as coming from Hobson's Bay or Port Phillip.

Generic status. Klünzinger referred his fish to *Syngnathus* Linné, 1758, in which course he was followed by Macleay and Lucas. However, since the appearance of the Check-list (McCulloch 1929) it has generally been placed by Australian authors in *Leptonotus* Kaup, 1853; with Whitley and Allan (1958) and Whitley in his name-list (1964) including it in *Pugnaso* Whitley, 1948.

Leptonotus differs from *Syngnathus* primarily in exhibiting marked sexual dimorphism, the female having the dorsal profile of the trunk conspicuously elevated, and the median ventral trunk ridge acute, features well marked in the two other species admitted in the Check-list, *L. semifasciatus* Günther, 1870, and *L. costatus* Waite and Hale, 1918, the latter, which differs from the type-species *S. blainvillianus* Eydoux and Gervais, 1837 (formally included in the Check-list, 'Australia (Kaup)'; but the entry has not been confirmed, and the species has been dropped from the more recent name-list of Whitley) in possessing a ridge on the opercle anteriorly, is accommodated by Whitley (1951) in his subgenus *Kaupus*. Whitley noted in the female holotype he examined at Stuttgart 'a median carina along belly', but made no mention of, nor does his figure show, any elevation of the dorsal trunk profile. In our material a ventral trunk ridge is invariably present and usually prominent: the dorsal profile is significantly rectilinear, though it is probable at least some examples are females. It is concluded there is no good reason for transferring this species, described in *Syngnathus*, to *Leptonotus*.

The type-species of *Pugnaso*, *Syngnathus curtirostris* Castelnau, 1872, is devoid of any opercular ridge, a feature constituting part of the generic diagnosis. The subsequent attribution (Whitley and Allan 1958; Whitley 1964) to this originally monotypic genus of the present species with its well marked, though short, keel is hence inappropriate. [The opercular ridge – its absence, its degree of development when present – has long been a vexed item, leading at times to marked differences in taxonomic practice. Thus McCulloch (1921), following contemporary Australian practice, employed the occurrence of a full, and of a partial anterior, ridge in a key separating *Corythoichthys* Kaup, 1853 and *Syngnathus;* and in the Check-list referred to the former genus a group of species that the Handbook, following current Australian practice, assigns to the latter. Again, *Stigmatopora nigra* Kaup, 1853 and *Stigmatopora argus* (Richardson, 1840) have been separated (Waite and Hale 1921; Scott *et al.* 1974) by the criterion that the keel, regularly present in the former, is lacking in adults of the latter; but see Part IV (1960) where an example of *S. argus* 280.5 mm long is noted as having a well defined keel extending across the whole operculum]. While the other differentiae given for distinction between *Pugnaso* and the type-species of *Syngnathus*, *S. acus* Linné, 1758, are valid for that species, they do not provide any acceptable basis for distinguishing *S. curtirostris* generically from a number of other species that the Handbook refers to *Syngnathus*. The present species is thus not compatible with *Pugnaso* as originally defined, and it is felt there are no good grounds for its transfer from *Syngnathus* to that genus.

It should, however, be noted that in meristic characters, length and form of snout, location and extend of dorsal fin, and in some individuals color pattern *S. caretta* comes closer to *S. curtirostris* than to any other Australian species; being separable from it chiefly by its opercular keel, its ventral trunk carina and, where these are developed, by the supernumerary trunk and/or tail ridges.

Tasmanian material. The present observations are based on 8 specimens: *(a), (b), Ls* 63.7, 64.6, Kelso, Tamar estuary, north coast, 5-6 February 1961, low tide among *Zostera* sp., Q.V.M. Reg. No. 1972/5/206; *(h) Ls* 100.9, Greens Beach, north coast, 5 September 1965, Q.V.M. Reg. No. 1972/5/527; *(d), (e), (f), Ls* 74.9, 75.0, 80.2, Greens

Beach, 17 October, 1965, Q.V.M. Reg. No. 1972/5/555; *(c) Ls* 66.0, 24 March 1976, 1.6 km north of Greens Beach, Q.V.M. Reg. No. 1976/5/132; *(g) Ls* 83.5, 1 km north of Greens Beach, 7 April 1976, Q.V.M. Reg. No. 1976/5/107: all collected by Mr R.H. Green.

Other examples examined: *(i), (j), (k) Ls* 60.6, 64.4, 67.1, same history as *(a), (b)*, Q.V.M. Reg. No. 1972/5/206; *(l)-(s) Ls* 20.1-32.0, $\bar{x}$ 26.1 ± 1.56, same history as *(a), (b)*, Q.V.M. Reg. No. 1972/5/716.

Associated species. Pipefishes taken in association with our material of *Syngnathus caretta* comprise *S. phillipi* Lucas, 1891, *S. curtirostris* Castelnau, 1872, *Lissocampus caudalis* Waite and Hale, 1921, *Urocampus carinirostris* Castelnau, 1872.

Dimensions. Table 1 sets out the principal proportions of specimens *(a)-(h);* arranged in order of increasing total length; the first two lines recording standard length and total length in mm, all other entries being permillages of total length. *S. caretta* is a small species, its length regularly being specified as 10 cm; our largest example has total length 10.3 cm.

TABLE 1

Syngnathus caretta Klünzinger, 1879. Dimensions of 8 specimens from northern Tasmania: standard length and total length in mm, all other dimensions as permillages of total length.

Dimension	*(a)*	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*	*(g)*	*(h)*
Standard length	63.7	64.6	66.0	74.9	75.0	80.2	83.5	100.9
Total length	65.0	66.0	67.2	76.7	77.0	81.9	84.5	102.9
Length to dorsal origin	358	333	350	356	351	349	341	360
Length of dorsal base	65	61	57	72	69	71	50	68
Length to vent	369	364	372	365	361	354	360	389
Length of pectoral	18	-	-	20	22	17	12	15
Head	111	105	104	102	104	100	96	97
Snout	38	41	36	40	39	34	36	31
Eye	20	19	21	20	22	20	15	19
Interorbital at middle of orbit	18	20	19	14	25	15	15	16
Interorbital at front of supraorbital ridges	11	9	10	10	14	8	11	12
Depth of snout, minimum	15	14	13	14	16	13	11	14
Depth at hind border of orbit	31	27	29	30	29	27	24	29
Depth at opercular border	36	31	31	35	22	35	31	36
Depth at vent	29	24	24	29	30	26	24	30
Depth of trunk, maximum	39	29	31	33	38	31	33	37
Width of snout, minimum	8	8	9	11	9	11	11	11
Width at hind border of orbit	31	30	30	27	26	27	24	27
Width at opercular border	26	25	27	25	23	22	22	24
Width at vent	29	17	18	35	26	24	21	29
Width of trunk, maximum	31	28	28	34	27	32	24	29

Meristic characters. Annuli 18 + 43 (2 specimens), 44, 45 (2), 46 (2), 47. Subdorsal 0.5, 0.9 (2), 1.0 (2), 1.1, 1.5, 1.8 + 4.1, 4.3 (4), 4.4, 4.5 (2). P.8/8, 9/9 (2), 10/10 (3); damaged in 2 fish. A. 3 (5), 4 (1); not detected in 2 fish. C.9.

Proportions. The following suite of proportions includes most of those commonly reported by workers on syngnathids. Head in trunk 2.10-2.75, $\bar{x}$ 2.48 ± 0.0649; in *Lt*

9.03-10.43, $\bar{x}$ 9.81 ± 0.155. Head and trunk in tail 1.57-1.78, $\bar{x}$ 1.73 ± 0.0254; in *Lt* 2.69-2.82, $\bar{x}$ 2.76 + 0.0138. Length to dorsal origin in *Lt* 2.75-3.00, $\bar{x}$ 2.85 ± 0.0273. Dorsal base in length to origin of fin 4.93-6.86, $\bar{x}$ 5.55 ± 0.0699; in head 1.41-1.93, $\bar{x}$ 1.62 ± 0.0675. Eye in head 5.00-6.48, $\bar{x}$ 5.43 ± 0.168; in snout 1.64-2.40, $\bar{x}$ 1.93 ± 0.829. Snout in head 2.52-3.13, $\bar{x}$ 2.76 ± 0.977. Interorbital, measured at middle of orbit 0.85-1.33, $\bar{x}$ 1.07 ± 0.0409 in eye, measured between supraorbital ridges at front of orbit 1.39-2.29, $\bar{x}$ 1.89 ± 0.112. Maximum depth of trunk in *Lt* 28.8-39.2, $\bar{x}$ 33.88 ± 1.27; in head 2.63-3.58, $\bar{x}$ 3.12 ± 0.107. Maximum width of trunk in *Lt* 23.7-33.9, $\bar{x}$ 29.03 ± 1.45; in head 3.00-4.05, $\bar{x}$ 3.55 ± 0.199.

Head, trunk, tail. As might be expected, relative (*e.g.*, *Tlt*) values of such primary elements of length of fish as head, trunk, tail are tolerably constant, ranges being 96-111, 257-268, 628-642, with coefficients of variation 4.3 ± 1.1, 1.3 ± 0.3, 0.7 ± 0.2 (contrast, for instance, eye, with V = 11.7 ± 3.0). The noticeable larger V for head is attributable, not to greater random variation than that exhibited by other regions, but, as is suggested by inspection of table 1, to the existence of significant (negative) correlation of length of head with length of fish: r = − 0.807 (z = 1.197); t = 3.346*.

Mean values of lengths of head, trunk, tail for the present sample yielded a significantly straight line when plotted against logs 1, 2, 10, respectively. With lengths as *Tlt*, L = 534.68 log N + 102.50, giving predicted values as follows (measured values in parentheses) 102.5 (102.3), 263.5 (261.4), 637.2 (636.5) ; t = 346.36***. For absolute dimensions, mm, the equation is L = 41.92 log N + 7.79; predicted (measured) values 7.79 (7.89) 20.40 (20.26), 49.71 (49.75) ; t = 170.29. It would appear that the differential growth of head relative to overall size is more or less balanced out in the mean head length, the *Ls* distribution of the sample being tolerably symmetrical, with skewness, calculated by the mean-median formula, + 0.0991, and with 6 items lying within $\bar{x} \pm s$.

It is of interest to note that in the sample of 9 males and 15 females of *S. curtirostris* discussed below the mean lengths of head, trunk, tail are also linear on logs 1, 2, 10, though not with the extremely close fit found for *S. caretta*. With mean lengths of the three regions as *Tls* (*Tlt* in *S. caretta*) the regression equation is L = 493.66 log N + 118.86 yielding calculated (measured) values 267.5 (259.3), 276.5 (259.3), 612.6 (615.0) ; t = 34.95***. No significant correlation subsists between any of the three regions and *Ls*. Skewness, though not excessive, is markedly greater than in the smaller *S. caretta* sample, being +0.371: 19 entries lie within one standard deviation on either side of the mean (*cf.* 16, normal curve).

Cristae of trunk and tail. The system of body ridges in *S. caretta* is a quite unusual one, including some ridges not or rarely found in other species and presenting a remarkable diversity both of pattern and ridge structure. The facultative (in our material constant) presence of a median lateral caudal ridge is reported both in the original description and in Whitley's notes on the type, but is not mentioned in the Handbook diagnosis. There appears to be no published reference to the dorsal and ventral caudal ridges, or to any supernumerary lateral trunk ridges present in some individuals (where present inconstant in number and relative location; contrast the two regularly occurring and normally disposed lateral trunk ridges of *Urocampus carinirostris* Castelnau, 1872).

Ridges are here denoted by a two-letter symbol thus: first letter either T = trunk or C = caudal; second letter one of these, S = superior (*i.e.*, superolateral), I = inferior (inferolateral), D = dorsal (here and normally median), V = ventral (here and normally median), L = lateral (if single normally median). This system in general follows that employed in the Handbook (Munro 1958), except that, to render L available for lateral, U and L for upper and lower are here replaced by S and I. Both systems are simpler than that using 3 or 4 letters devised by Herald (1953, p.233,

fig. 36). The convenience afforded by that scheme of having a systematic symbol, LTAR, for the taxonomically important 'lateral tail ridge', the short forward extension below dorsal base of CS, is gained at the formal cost of having two symbols associated with a single crista: in any case, the presence or absence of this segment is implicit in the specification of TS and CS as discontinuous or continuous. Annuli are here denoted by T or S followed directly by an ordinal numeral.

TS from just behind head along superolateral edge of trunk to near dorsal origin, swinging down below fin base, ending on $C2^{nd}$, 3^{rd} (one case 4^{th}). CS forward from caudal fin to shortly behind dorsal base, swinging down below it to end, below TS, on $T18^{th}$ or $C1^{st}$; in two specimens (in one on one side only) continuous or subcontinuous with a supernumerary TL. T1 and C1 continuous; left and right T1 continuing forward to fringe opercular borders, usually meeting mesially. TD from head (just behind, sometimes subcontinuous with, occipital ridge) to dorsal, one specimen from $T6^{th}$ for 3 rings only, one specimen developed only on $T1^{st}$. CD usually traceable from just behind dorsal to about $C20^{th}$ -35^{th}, one case to caudal fin; variable in structure. TV from head, one specimen $T4^{th}$, to vent; moderate to strong. CV from $C1^{st}$, 2^{nd} usually to about $C25^{th}$, sometimes to caudal fin; variable in structure. TL most aberrant, most variable (sometimes marked difference on two sides), one, two, or three ridges; main types of pattern as follows (*i*) single ridge, median, either ending in a short downward turn free on T18, C1 or continuous or subcontinuous with CL or with C1; (*ii*) two ridges, primary, median surmounted by short accessory ridge on $T15^{th}$-17^{th}; (*iii*) three ridges, more or less full length, uppermost continuous with CS, two members meeting in an arc on $C2^{nd}$, both here continuous with C1, or, again, three (lowest on 9 rings only) meeting at one point, here continuous with CL, uppermost virtually continuous with CS. CL continuous or subcontinuous with TL or originating on $C1^{st}$-4^{th}, traceable, continuous or interrupted, for at least 10, usually upward of 20, rings, sometimes to end of tail.

While TS, T1, CS, C1 and, somewhat less consistently, TD, TV are in general normal in structure, being either even ridges or sometimes wholly or partly noded with small bosses at ring junctions, the remaining ridges are surprisingly diverse, presenting strong well separated knobs, short dashes either horizontal and collinear or oblique and parallel, either briefly separated or briefly overlapping, with or withour terminal contact, links more or less completely combining to form a chain, spaced mammillary eminences, sometimes included within a groove; the ridge as a whole being either continuous or interrupted, consisting of one or more of the above-noted elements.

Ridges of head. Rostral ridge barely developed in first one-third of snout, thereafter rising, straight or gently concave, to above nostril, thus forming a subtriangular plate, with base subequal to height of upper jaw there; behind level of nostril lapsing as a very low, sometimes indeterminate, ridge terminating above pupil. Strong supraorbital ridges arising between nostril and margin of rostral ridge, diverging backward to about thrice their initial interspace. Dorsum of head usually with a rather sharp median ridge, extending, continuously or commonly in 2-3 segments, from near level of hind border of orbit almost to, occasionally to, origin of TD. A low ridge from tip of snout to middle of orbit along border of upper jaw. Low ridges continuing just beyond orbit delimiting lower margins of lower jaws; between these a strong median ridge bifurcating beneath the eye, the tips meeting two pronounced rounded prominences, each surmounted by a short subcylindrical process.

Opercular keel distinct, straight or slightly convex upwardly, short 0.2-0.45, modally about 0.3, horizontal extent of operculum here.

Other features. Metrical characters commonly incorporated in species descriptions have been given above. Trunk and tail subquadrangular. Snout tip somewhat turned up. Eye set high, supraorbital ridge constituting part of dorsal profile, distance of orbit from ventral profile little more than diameter of small pupil. Interorbital and dorsum of head behind it for an eye diameter a single plate, flat or slightly concave

transversely. Most of head, including nearly all snout, with striae or vermiculations. Trunk and tail scutes with patterned striae, chiefly lyrate or resembling a mitotic spindle; some specimens with most or all of the dorsal and lateral scutes with a subcircular, oval or rhombic area against anterior border less conspicuously marked. Pectoral rounded or very slightly pointed, its length rather more than twice its base. Caudal rounded or obtusely pointed. Dorsal base not elevated, fin of moderate height. Anal minute.

Coloration. Available information on coloration does not extend beyond that given in the one-sentence note by Whitley, virtually an englishing of the original description: 'Brownish black; on the back ... light tortoiseshell-like transverse blotches or crossbands at different intervals from one another, about twelve in number'. Save for specimens *(a)*, *(b)*, *(e)* the first of which is light brown, the second medium brown with good development of the multi-toned marbling from which the species gains the handbook vernacular name of 'tortoiseshell pipefish', while the third is conspicuously bicolor (head and trunk medium brown, somewhat lighter ventrally, tail pale dull yellow), the overall appearance in the eight-specimen sample here reported on is very dark brown, or black, elements of the pattern being inconspicuous, discernible at times only on examination with a lens.

The present paragraph relates only to *(b)*. *(i) Trunk and tail. Dorsal surface.* Medium brown, with the characteristic tortoiseshell markings in various tones of light and dark fawn, yellow, whitish, silvery, forming blotches or crossbars on $T2^{nd}$-3^{rd}, 4^{th}-5^{th}, part 6^{th}, 10^{th}-11^{th}, 14^{th}-15^{th}, near dorsal origin (indistinct); on tail at 2^{nd}-3^{rd}, 6^{th}-7^{th}, 11^{th}, 17^{th} (flanked on each side by blackish bar), 23^{rd} (complete black bar in front, incomplete behind) 28^{th} (like 23^{rd}), 34^{th} (like 17^{th}). *Lateral surface.* Most of the light areas on dorsal surface extend to at least upper half of lateral surface, that on $T2^{nd}$-3^{rd} (here receiving increment from $T1^{st}$) and that on $T4^{th}$-6^{th} reaching almost to ventral profile, most of those on tail similarly prolonged. Between these light bars brownish, sometimes with reddish stippled and/or vermiculated with lighter. *Ventral surface.* More or less even dark warm brown; on tail briefly invaded by several of the lateral light areas. A small white mark on each TV and each CV; on some anterior trunk rings short dashes, elsewhere small, or minute, well-defined spots. *(ii) Head. Dorsal surface.* Snout even medium brown save for small yellow patch just behind upper jaw, white triangle over front of orbit, reddish band above pupil, several transverse sinuous proconcave whitish arcs above back of orbit, thereafter brownish with ridges glistening, obscure dark spot on occiput. *Lateral surface.* Tolerably even warm brown, rostral crest lighter. *Ventral surface.* Warm median brown, darker on opercles, here narrowly rimmed with black.

Chief variations included the following. *Trunk.* Dorsal surface with two lateral deep yellowish markings, continuous circles, cross bars or colons; tortoiseshell patches noted in *(b)* sometimes pearly, exceptionally one or two yellowish; in *(g)* lower lateral trunk scutes each with dark centre flanked on each side by goldish and surrounding two gold spots; in *(e)* each ventral scute brownish with central aureate area, extending full width in last 2-4 rings, narrowing to extinction anteriorly. *Tail.* In *(e)* dorsal surface yellowish or deep straw with somewhat darker median line; lateral surface sometimes dark brown or blackish, immaculate; ventral surface usually lightest, occasionally with some tortoiseshell marking. *Head.* Tip of snout often white, whitish, or light horn; postorbital dorsum dark brown delicately mottled with lighter tortoiseshell; apart from light snout tip virtually uniform dark brown; several white dots on ventral surface and one small white patch at upper angle of operculum.

Dorsal whitish or pale straw, occasionally faintly reddish anteriorly and/or basally; each ray with several strokes of reddish brown, tip usually whitish. Pectoral whitish or pale yellowish, rays somewhat greyish. Caudal variable: even dark brown, dark brown becoming yellowish towards tip, yellowish becoming darker in distal one-fifth or so. Anal hyaline or whitish.

Syngnathus phillipi Lucas, 1891

Syngnathus phillipi Lucas, 1891, *Proc. R. Soc. Vict.* (n.s.), 3, p.8. Type locality: Port Phillip Heads, Victoria.
Syngnathus phillipi: Waite and Hale,1921, *Rec. S. Aust. Mus.*, 1 (4), p.297, fig. 30. *Id.* Munro, 1958, HANDBK AUST. FISHES, 20, p.83, fig. 575.
Corythoichthys phillipi McCulloch, 1911, *Zool. Res. Endeavour*, 1, (1), p.26, fig. 10; and 1929, *Mem. Aust. Mus.*, 5 (1), p.87.
Parasyngnathus phillipi Whitley and Allan, 1958, THE SEAHORSE AND ITS RELATIVES, p.8. *Id.* Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), p.36.

Tasmanian occurrence. As pointed out in Part IV (1939, p.143), although the Check-list (McCulloch 1929, p.87) gives Victoria and South Australia only, this species was reported by Waite and Hale (1921, p.298) also from Western Australia, while earlier McCulloch (1911, p.26) had noted 4 *Endeavour* specimens from Oyster Bay, east coast, Tasmania. A male example dredged in 16-24 m off Verona, D'Entrecasteaux Channel in 1961 was the subject of some observations in Part XI (1963, p.17).

The species proves to be quite common in this State, having on various occasions been taken in considerable numbers in those areas (lower reaches of Tamar river and northern coast adjacent to the estuary) in which most of the collecting of the Queen Victoria Museum has been carried out, being here the most abundant pipefish after, or along with, *S. curtirostris* Castelnau, 1872 – the latter being the subject of notice in several contributions in this series, namely, Parts VI (1953, p.250), XII (1964, p.85), XIV (1966, p.93).

Material. (*a*) 25 specimens collected by Mr R.H. Green at low tide among *Zostera* sp., at Kelso, estuary of the Tamar, north coast, on 5-6 February 1967 (Q.V.M. Reg. No. 1975/5/716); (*b*) 2 specimens collected by Mr G. James at Dianas Basin, east coast, on 2 September 1972 (Q.V.M. Reg. No. 1972/5/514).

Sex ratio. (*a*) 9 males, 16 females (one female damaged; not considered below); (*b*) 1 male, 1 female.

Meristic characters. Annuli: trunk annuli invariable at 18 in both samples; caudal (*a*), males 43 (2 cases), 44 (5), 45 (1), 46 (1), females 42 (4), 43 (4), 44 (3), 45 (2) 46 (2); (*b*) male 47, female 44. Subdorsal annuli: (*a*) males, trunk 0.4 (1), 0.5 (2), 0.7 (2), 1.0 (3), 1.1 (1), tail 5.0 (1), 5.4 (1), 5.5 (2), 5.6 (1), 5.8 (1), 6.0 (2), 6.1 (1), females, trunk 0.5 (3), 0.7 (1), 0.8 (1), 0.9 (5), 1.0 (3), 1.3 (1), 1.4 (1), tail 5.1 (1), 5.2 (1), 5.5 (1), 5.6 (2), 5.8 (1), 5.9 (4), 6.0 (5); (*b*) male 0.8, 6.3, female 1.0, 5.4. Dorsal rays: (*a*) males 20 (1), 21 (1), 22 (4), 23 (2), 25 (1), females 20 (2), 22 (4), 23 (3), 24 (1), 25 (4), 26 (1); (*b*) male 26, female 23. Pectoral rays: (*a*) males 9 (1), 10 (5), 11 (2), 12 (1), females 9 (1), 10 (10), 11 (3), 12 (1); (*b*) male 9, female 9. Anal rays: (*a*) males 2 (4), 3 (5), females 2 (4), 3 (11); (*b*) male 2, female 2. Caudal rays: (*a*) males 9 (1), 10 (8), females 9 (2), 10 (13); (*b*) male 10, female 10.

Body regions. Measurements of standard length, total length, head, trunk, tail are set out in table 2, *Ls*, *Lt* being in mm, other dimensions as *TLs*: the ratios head in trunk, in tail, eye in snout, snout in head are also recorded.

Variation within sample (*a*). *(i) Absolute size.* Males show some tendency to exceed females in length, fewer than a quarter of the males but more than half the females having *Lt* 100: however, the difference between the means is not formally significant (nor is that of *Ls*). *(ii) Head, trunk tail as TLs.* The relative length of the head is significantly greater in females (t = 2.862*), as also probably is that of trunk (t = 1.977, slightly below P 0.05; *cf.* also greater value of female in Dianas Basin sample), the relative tail being concomitantly shorter (t = 2.654*). *(iii) Proportions.* No significant differences between the sexes if found in any one of the four ratios reported on in table 2.

Variation within Dianas Basin sample. Excess of the male or female value follows the

same pattern as in the larger sample, except in the ratio head in trunk, the larger value here being that of the female.

Variation between samples. The absolute size of the Dianas Basin male lies outside the range of the large sample, but that of the female falls within it: however, the difference between the means of the samples is significant (*Ls*, t = 2.464*; *Lt*, t = 2.568*). Attention was first called to the east coast male by the large value for trunk in tail, which, at 3.01, much exceeds the 2.4 of the Handbook (Munro 1958, p.83) and of the conspectus in Part X (1961,p.59). Comparison with data for the Tamar River sample shows the exceptionally high numerical value of the ratio is contributed to both by a relatively shorter trunk and a relatively higher tail. The tail of the female also is relatively long, its *TLs* value exceeding those of all but one of the 15 females of the other sample. The means of the two samples (sexes pooled) show significant differences, additional to those for *Ls* and *Lt*, in respect of trunk (t = 2.633*). tail (t = 3.288*), trunk in tail (t = 2.146*).

Attention is here drawn to these differences as suggesting the possible occurrence of somatic variation with topographical distribution.

Brood pouch. The extension of the (essentially subcaudal) brood pouch is reported by Lucas as being 'over the first 15-18 tail rings', by Waite and Hale as 0 (1) + 16 (15-18), the latter figures being adopted in the conspectus. In the example noted in Part XI the (empty) pouch folds narrowed to extinction on the sixteenth tail ring.

In the present Tamar series the (gravid) pouch subtends 1 + 15 rings (1 specimen), 1 + 16 (1), 0 + 17 (1), 1 + 17 (1), 0.5 + 18 (3), 1 + 18 (2); in the Dianas Basin male 0 + 17. The pouch proper, *i.e.*, the egg-bearing bursa, is wholly subcaudal, but forward continuations of the roots of the folds may extend on to the last trunk annulus, the extension here being somewhat conventionally assessed as the whole or half the annulus.

Expressed as permillages of standard length, the pouch represents 232-296, $\bar{x}$ 265.2 ± 7.03 (s 21.1 ± 4.97, V 7.9 ± 1.9); or, as permillages of length of tail without caudal fin, 365-503, $\bar{x}$ 426.2 ± 13.48 (s 40.45 ± 9.53, V 9.5 ± 2.3). No correlation of either variate with length of fish obtains. In the Dianas Basin male corresponding values are 272, 399.

No reference to the nature of the pouch is to be found in either of the two main treatments of the species (Lucas; Waite and Hale), or in the note on the 4 *Endeavour* examples from Tasmanian waters (McCulloch 1911, p.26, fig. 10) the first notice apparently being that in Part XI (1963). In the specimen there described and illustrated (fig. 5) the pouch, which was empty, and which either had not reached or (perhaps more probably) had regressed from its full development, consisted of two simple folds, devoid of supporting plates, narrowly separated anteriorly by the interposition of the minute anal fin, becoming progressively widely divergent posteriorly to end on the sixteenth caudal annulus almost the full width of the tail apart, the hinder portion being adnate to the general caudal surface.

All nine males of (*a*) bear a well developed pouch. In two individuals the ova show no significant signs of development (both have one full sized opaque pale yellow infertile ovum); in three an early embryo is apparent in most ova as a slender whitish or pale yellowish band extending from less than half around the sphere to more than a complete encirclement of it; in three the eyed stage has been reached, the embryo in the most advanced set constituting about half the total bulk, and several embryos showing the onset of pigmentation: in the remaining example the pouch is empty, apparently in a fairly early phase of regression.

As already reported (1963, p.17) the integumentary folds are devoid of supporting

plates. In the void specimen, they are in contact mesially throughout most of their length, but in the gravid individuals they are disparted in varying degrees by their contents, the position of the ova being clearly indicated externally by two series each of about a dozen rounded bulges. Each bulge exhibits about a dozen fine transverse ridges (these persist in the individual with the collapsed pouch). The overall color of the folds is usually much like that of the tail in general, but may be either somewhat lighter or somewhat darker. Irregular wavy lighter lines, confined to part of an annulus or extending over several annuli, cover most of the fold, up to a dozen often occurring side by side.

In one of the two fish with undeveloped ova the whole egg mass worked free during the course of examination. Bright orange, broadly fusiform, somewhat flattened dorsoventrally, length 22.5 (length of pouch, without terminal roots 26.3, with roots 29.8), greatest width 5.5, greatest depth 4. The 36 ova in two layers; outer in two tolerably regular rows, on right side (of fish) 12, on left 10, first on left beginning behind first on right, last on left ending partly in advance of last on right; at front and back an azygous ovum, front one more closely approaching right series, hind one more nearly part of left; an inner layer of 12 below middle of outer layer, first two, last two uniserial, rest in four side-by-side pairs. Most subspherical, modal diameter about 2 mm, some considerably compressed anteroposteriorly. Largely enveloped in a whitish ovarian membrane, which forms a pronounced fold between the two linear series of outer layer.

Floor (dorsal surface) of pouch pale orange, lightly and patchily peppered with reddish brown. Divided into 23 compartments, in two rather irregular rows, variable in size, area of largest nearly double that of smallest, and in shape, mostly more or less quadrilateral or rounded. On left fold 11 irregular and often imperfectly constituted compartments, on right some extensions from floor of septal walls forming incomplete cells: both folds lined with glistening pale grey membrane. Septa on floor erect, tolerably stout but flexible, height at middle of pouch about 1.3; hyaline, with minute greyish or dark brownish punctulation.

Pouch folds in single male of (*b*) narrower than in (*a*); free margins widely separated, near middle by more than one-third total width of tail here. No distinct signs of septa on floor or on walls; both with what appear to be remnants of a whitish covering or partial covering, possibly of a cereous nature, more nearly continuous on folds, mostly scattered on floor, which exhibits typical lyrate pattern of striae of general external caudal surface, not here traceable in any specimens of (*a*).

Conspectus values. In the conspectus of Tasmanian syngnathids in Part X (1961), which gives (in addition to maximum length and two qualitative features) known meristic and morphometric values for eight characters, the entries for this species were based primarily on Waite & Hale's review of the South Australian lophobranchiates (1921, p.297), which cites also (in parentheses) some counts from the original description, and from which the diagnoses of the Handbook is directly derived. With the addition of some calculations based on measurements of four type-specimens and of a Tasmanian example noted in Part XI (1963, p.17), three single-value entries in the conspectus were extended to become ranges. With incorporation of the present data, counts and ratios now stand as follows (new ranges in parentheses). Annuli 18-20 + 40-48; subdorsal annuli 0-1 + 5-6 (0-1.4 + 5.0-6.1); brood pouch annuli 0-1 + 15-18. Dorsal 22-28 (20-28). Eye in snout 3.1-3.4 (2.63-3.68); snout in head 1.7-2.0 (1.7-2.58); head in trunk 1.8-2.4 (1.69-2.42); trunk in tail 2.32-2.9 (2.1 -2.9).

For three fin counts not recorded in the conspectus our ranges (values of Waite & Hale in parentheses) are A. 2-3 (2-3), P. 9-12 (10-12), C. 9-10 (10).

Supposed sexual dimophism. With the type material before him (no holotype or paratypes specified: some dimensions for 2 males 2 females tabulated), Lucas stated 'In the males

there is a marked tetrahedral prominence on the ventral surface of the head, just behind the level of the eyes, formed at the point of union of the median ventral ridge of the snout, a transverse ridge along the origin of the operculum on either side, and the median ventral ridge of the head, continuous with that of the trunk behind. This projection is quite wanting in the females'.

This feature received no notice from Waite and Hale (1921); nor was it observed in the Tasmanian male reported on in Part XI, the suggestion there being advanced that it is 'perhaps merely the inter-ramal triangle of the normal jaw structure adventitiously swung down (as so often happens), but, by coincidence in this case, only in male examples'. Examination of the present material supports this view. In (*a*) a marked prominence is found, about equally developed, in one male and one female, while a minute subcircular median prominence occurs at the relevant location in two males and three females: in (*b*) the male is here smooth, the female presents a triad of low rounded elevations.

Coloration. Comparison of our material with accounts of coloration provided by Lucas and by Waite and Hale shows agreement for all specimens in the following respects — sides and back brown, males darker than females, ventral trunk ridge black. However, consideration clause by clause of the earlier descriptions discloses a number of cases of partial agreement or of disagreement as follows.

'Narrow, whitish, vertical bands near front border of several of the lateral plates' (Lucas): whitish bars in 3 males 5 females, lighter but not whitish in 1 male 2 females, barely recognizable or represented by a few spots in 7 females, not present in 5 males. 'In some of the males, white spots instead of bands' (L): 2 with bands and spots. 'Under surface lighter' (L): barely so (especially in trunk) in 5 males. 'In some of the females, rows of black spots across operculum, and on under surface of snout' (L.); females with 'underside with a row of dark brown dots on each side, extending from anterior portion of snout to the termination of the opercular ridge' (W. & H.): some spots, medium brown to dark brown not black, on some or all of three regions, snout, chin, operculum, on whole snout of 7, on about half in 5, on one-third in 1, not on snout 2. 'Upper surface of head, operculum, and snout with irregularly white lines, bands, or patches, more or less conforming to the ridges' (L.); males with 'head and snout brown above with white mottlings' (W. & H.): a few irregular white lines, or spots (chiefly on, or near, operculum; usually annulated with brown), or small patches in 5 males 7 females, no white markings, ridges on dorsum of head brown (light-dark), in 4 males 8 females.

Males (W. & H.). 'Opercular ridge with five dots along its length, decreasing in size backwards': 5 dots in 5 (in 1 last 2 confluent), 4 in 1, 2 rows of 5-6 in 2, 8 very small in 1; general, but not invariable, decrease in size backwards. 'Chin opalescent with white markings': opalescent in 8, with white markings in 3 (1 with 1 white mark, 2 with 2). 'Back with about sixteen pairs of irregular, whitish spots between the nape and the end of the tail': about 12 pairs in 1, vague indications of possible spots in 2, no spots in 5; 1 has several dark spots on dorsum of trunk. 'Upper half of each lateral body scute with a brown bar': more or less distinct bars in 7, general local darkening in 2. 'Anterior part of lower lateral ridge with a row of seven white spots decreasing in size backwards': 0 in 2, 4 in 1, 5 in 1, 7 in 3 (very faint in 1), 8 in 1, 9 in 1. Lucas makes no mention of the brood pouch, described by Waite & Hale as 'whitish streaked with brown'. Notes on the 9 Kelso males yield: olivaceous, light olivaceous, light olivaceous with some darker areas and with some dark grey, brownish olivaceous, brownish olivaceous with some greenish, olivaceous partly somewhat dusky, partly somewhat greenish brown partly dark slate, pale brownish and deep fawn. Regularly marked with undulating lines that are variably whitish, greyish, dusky, or brownish, sometimes showing some difference on different folds. 'Subcaudal scutes light brown with a dark brown spot on each side of the anterior edges': 2 with some mesial darkening, obscurely delimited, no spots, 3 almost

uniform with lateral dark spots (or short lines); 2 with mesial darkening and spots, 1 with main area flanked by spots with 2-3 series of short midbrown longitudinal wavy lines; in general, lateral ridge between dark spots or lines lighter than ground colour, approaching white; markings usually more prominent in anterior part of tail. (In females, which are very variable, anteriorly each scute may present a mainly longitudinal mesial region, or one or two (side by side) darker rounded (in 1 later subtriangular) regions; posteriorly, these may break up into smaller units or may fade out; additional markings, usually longitudinal, may develop posteriorly (in 1 faint dark cross bars); as in males dark spots or lines, usually with whitish interspaces, lie along lateral borders). 'Caudal dusky': chiefly light brown in 1, medium brown in 2, dark brown in 2, dusky in 2, some rays brown remainder whitish in 2; in 3 distal and one or both lateral borders from quite narrowly to quite widely (especially terminally) whitish or (1) yellowish. (In females light brown in 4, medium brown in 3, dark brown in 2, faintly dusky in 3, dusky in 1, whitish proximally then deep amber, with 2 rays whitish, in 1; 3 tipped whitish, 7 yellowish).

Dorsal and lateral surfaces of tail, not described by Lucas or by Waite & Hale. Dorsal: uniform brownish, immaculate in 5 males, 8 females, some indefinite mesial darkening in 1 male, 4 females; a short series of small brown spots at middle of borders of anterior scutes in 1 male, in part faintly olivaceous in 1 male, indications of oblique crossing lines anteriorly in 1 male, narrow dark medial line in 1 female, several anterior annuli with a white spot in 1 female, short whitish strokes anteriorly in 1 female: in both sexes dark spots along junction of dorsal and lateral surfaces may encroach somewhat on former. Lateral: uniformly light brownish in 1 male 1 female; in 7 males 8 females some diffuse central darkening in each scute in anterior half or two-thirds of tail, markings usually breaking up or fading out posteriorly (becoming longitudinally ovate in 1 male, forming almost full bars in 1 male, being followed in 1 male by a dusky goldish spot at middle of each annulus junction, in 1 female darker subcircular areas joined by longitudinal stripe); in 1 female median darkening in linear form; in 2 females 2-3 light wavy lines in each annulus; in 1 male a hemispherical dark marking rising from almost full width of ventral border mostly to half, in parts to two-thirds, height of scute; in 3 females annuli marked off, for from two-thirds to whole height, by subvertical or proconcave silvery bars, each tending to break up posteriorly into 1-3 spots; in both sexes normally with alternate light and dark sections along ridges.

The two Dianas Basin specimens exhibit two noteworthy features, the presence in the female on most annuli of the ventral surface of a short light median line, 5 conspicuously whitish, and on the dorsal surface of each annulus in the anterior half of the trunk a dark brown spot or streak on the lateral ridge, later forming a more or less continuous line, much better developed on right than on left side.

A constant feature of the colour pattern, present in all specimens of both our series, that has not hitherto been the subject of the published comment is the presence at the beginning of the dorsal base — surrounding, and commonly involving the base itself and briefly extending on to the first ray — of a small pigmented area, its diameter rather less than one-third of width of fish here, regularly darker than back in general, ranging from fairly dark to very dark brown, occasionally black.

The most noteworthy points arising from the above analysis include absence in most specimens of series of paired white spots on back between nape and tail reported by Waite and Hale (not noted by Lucas); relatively few white markings on head (contrast both accounts) and the general replacement of these on cephalic ridges by brown lines (contrast Lucas); difference in colour of caudal; together with a more or less marked measure of inconstancy of some other characters previously reported. It is not possible, on available data, to determine to what extent these differences may be attributed to possible variation with locality, mode of preservation or other factors.

Depth. Herald (1953) has drawn attention to the fact that the pipefishes taken in the Marshall and Marianas Islands in Operation Crossroads in 1946 seem to be clearly divisible into intertidal and deepwater forms, with the demarcation of the two habitats at 10-15 feet (3-5m). Some notice of the very meagre information on the depth at which our syngnathids occur appears in Parts X (1961, p.61) and XI (1963, p.19).

The position regarding the present species is problematical. On the one hand it has been dredged – in 9-13 fm (16-24 m) (Scott 1963), no depth stated (Lucas 1891, Waite and Hale (18), McCulloch 1911: on the same page as McCulloch's account of the *Endeavour*'s Oyster Bay specimens of this species one of the five localities cited for *Centriscops humerosus* Richardson, 1846 is 'Oyster Bay, Tasmania, 40-60 fathoms', [73-110 m]). On the other hand, it has been collected in shallow water – the Kelso fish were obtained at low tide. Scott *et al.* (1974) state that in South Australia the species is 'quite common in shallow weedy areas in our Gulfs', and while the depth at which the Dianas Basin specimens were taken is not recorded it was probably inconsiderable.

Breeding season. A summary of the available information on the breeding season or seasons among Tasmanian pipefishes has been given in Part XVIII (1970, p.123), where the entry for *Syngnathus phillipi* reads 'pouch present, perhaps not fully developed [more likely in regression?] 23 July (Part XI 1963, p.17, fig. 5), ovigerous November, January, February, (unpublished).' As noted above, of the 9 Kelso males, taken on 5-6 February, 1 has an empty pouch (probably recently discharged), 2 bear undeveloped ova, 3 early embryos, 3 eyed embryos; while the Dianas Basin male, taken on 2 September, has an empty pouch. The period over which a pouch is present in this species in Tasmania thus extends over at least 11 months, the known ovigerous season being the four months November-February.

Maximum length. The total length attained by *S. phillipi* represents about the median value for Australian species of *Syngnathus*, values accepted by the Handbook (Munro 1958), which range from 80 to 270 mm, being greater in 8, less in 7, species. Reported maximum lengths include 107 mm (Lucas), 130 mm (Waite and Hale), 140 mm (Munro), 140 mm, (Whitley and Allen 1958), 140 mm (Scott *et al.*), 126.5 mm (present material).

Genus *ICHTHYOCAMPUS* Kaup, 1853

Ichthyocampus Kaup, 1853, *Arch. Naturges.*, 19, p.231. Type-species, *Syngnathus carce* Hamilton-Buchanan.

Ichthyocampus runa (Whitley, 1931)

Festucalyx (Campichthys) runa Whitley, 1931, *Aust. Zool.*, 6 (4), p. 313). New name for *Ichthyocampus filum*: McCulloch, 1909, *Rec. Aust. Mus.*, 7 (4), p.318, pl. 90, fig. 1, Sydney specimen; not *I. filum* Günther, 1870 (type locality, Bay of Islands, New Zealand, designated by Whitley, 1931).
Larvicampus runa Whitley, 1948, *Rec. Aust. Mus.*, 22 (1), p. 75.
Lissocampus affinis Scott, Glover and Southcott, 1974, MAR. AND FRESHW. FISH. S. AUST., p. 126, fig. on p. 126. Not *Lissocampus affinis* Whitley, 1944.

Remarks. A pipefish collected at Greens Beach, northern Tasmania, by Mr R.H. Green on 18 February, 1976 (Q.V.M. Reg. No. 1976/5/134) was determined by the writer as conspecific with the fish listed and figured by Scott *et al.* (1974) as *Lissocampus affinis* Whitley, 1944; that identification, however, being doubted. In answer to my inquiry, Mr C.J.M. Glover, Curator of Fishes, South Australian Museum, has been good enough to supply, *in litt.*, the information that since the publication of the South Australian catalogue it has been realized a misidentification had occurred, and the specimen figured had already been forwarded to Mr C.E. Dawson, Senior Ichthyologist, Gulf Coast Research Laboratory, Ocean Springs, Mississippi, U.S.A. The Queen Victoria Museum

TABLE 2

Syngnathus phillipi Lucas, 1891. Dimensions (standard length, total length, mm; other dimensions, permillages of standard length) and proportions of a sample of 9 males 15 females from Kelso and Low Head, Tamar River, north coast, and a sample of 1 male 1 female from Dianas Basin, east coast, Tasmania.

Feature	Tamar River					Dianas Basin
	Sex	Range	$\bar{x}$	s	V	
Standard	Male	96.0-110.0	102.1 ± 1.72	5.16 ± 1.22	5.1 ± 1.2	124.0
length	Female	88.5-112.0	98.5 ± 1.49	5.79 ± 1.06	5.9 ± 1.1	101.4
	Pooled	88.5-112.0	99.8 ± 1.29	6.30 ± 0.909	6.5 ± 0.9	
Total	Male	97.9-112.0	104.5 ± 1.74	5.22 ± 1.23	5.0 ± 1.2	126.5
Length	Female	90.7-114.4	100.8 ± 1.49	5.78 ± 1.06	5.7 ± 1.1	103.4
	Pooled	90.7-114.4	102.2 ± 1.20	5.87 ± 0.847	5.7 ± 0.8	
Head	Male	105-133	119.1 ± 3.33	10.0 ± 2.36	8.4 ± 2.0	119
	Female	120-147	127.9 ± 2.21	8.54 ± 1.56	6.7 ± 1.2	123
	Pooled	105-147	124.6 ± 1.73	8.46 ± 1.22	6.8 ± 1.0	
Trunk	Male	240-278	253.0 ± 3.41	10.2 ± 2.41	4.0 ± 1.0	219
	Female	234-279	263.7 ± 4.21	14.7 ± 2.68	5.6 ± 1.0	246
	Pooled	234-279	259.7 ± 2.75	13.5 ± 1.95	5.2 ± 0.8	
Tail	Male	590-646	624.9 ± 4.93	14.8 ± 3.49	2.4 ± 0.6	661
	Female	591-640	608.7 ± 3.20	12.4 ± 2.26	2.0 ± 0.4	631
	Pooled	590-646	614.8 ± 3.14	15.4 ± 2.23	2.5 ± 0.4	
Head in	Male	1.84-2.42	2.09 ± 0.0554	0.166 ± 0.0392	8.0 ± 1.9	1.84
trunk	Female	1.69-2.30	2.06 ± 0.0405	0.157 ± 0.0286	7.6 ± 1.4	1.99
	Pooled	1.69-2.42	2.07 ± 0.0331	0.162 ± 0.0234	7.8 ± 1.1	
Trunk in	Male	1.12-2.66	2.47 ± 0.0488	0.146 ± 0.0347	5.9 ± 1.4	3.01
tail	Female	2.11-2.86	2.42 ± 0.0625	0.242 ± 0.0441	10.0± 1.8	2.57
	Pooled	2.11-2.86	2.44 ± 0.0430	0.212 ± 0.0307	8.7 ± 1.3	
Eye in	Male	2.63-3.68	3.20 ± 0.119	0.356 ± 0.0839	11.1± 1.7	3.62
snout	Female	2.68-3.50	3.13 ± 0.0647	0.251 ± 0.0458	8.0 ± 1.5	3.30
	Pooled	2.63-3.68	3.16 ± 0.0605	0.296 ± 0.0428	9.4 ± 1.4	
Snout in	Male	1.87-2.58	2.17 ± 0.0667	0.200 ± 0.0472	9.2 ± 2.2	2.06
head	Female	1.93-2.36	2.12 ± 0.0302	0.117 ± 0.0214	5.5 ± 1.0	2.05
	Pooled	1.87-2.58	2.14 ± 0.0311	0.152 ± 0.0220	7.1 ± 1.0	

was also at this time in communication with Mr Dawson, at present engaged in a revisionary study of *Lissocampus* and allied genera, and the specimen noted above and with two others were forwarded to him for examination. Mr Dawson has identified these as the species currently known as *Ichthyocampus runa* Whitley, 1931, and has courteously agreed to a report of the Tasmanian occurrence of this species (a Tasmanian example of which from Wineglass Bay (Thouin Bay), east coast, has already been examined by him) being incorporated in the present contribution, which, drafted while Mr Dawson's paper is in the late MS stage, is expected to postdate it in publication.*

It may be noted in passing, that in the typed list of errata and emendations in the South Australian catalogue of Scott *et al.*, circulated in April 1976, the inclusion of a record for Tasmania of *Lissocampus affinis* Whitley, 1944 is an error, being a slip for *L. caudalis* Waite and Hale, 1921, reported from this State in Part X (1961, fig. 3) and Part XVIII (1971, p. 125).

* Added in press. C.E. Dawson. *Proc. Biol. Soc. Wash.*, 89 (53), 599-620. 1977.

Material. Three specimens collected by Mr R.H. Green in the Queen Victoria Museum's collection: (*a*) *Ls* 34.0, *Lt* 34.9, Greens Beach, north coast, 24 April 1976, Reg. No. 1976/5/142; (*b*) *Ls* 69.0, *Lt* 70.5, 3 km north of Greens Beach, 24 March 1976, Reg. No. 1976/5/93; (*c*) *Ls* 81.1, *Lt* 83.0, 2 km north of Greens Beach, 18 February 1976, Reg. No. 1976/3/131.

Meristic characters. Annuli 13 + 45-48. Subdorsal annuli 1 + 2. D. 12. P.6. A.6.

Proportions. Head in total length 10.9, 12.8, 13.6. Snout 3.0, 2.9, 2.9 in head. Eye 6.4, 6.5, 6.8 in head, 2.1, 2.2, 2.3 in snout. Head 2.13, 2.91, 2.56 in trunk. Precaudal length 2.49, 2.91, 2.82 in tail. Trunk 3.66, 4.18, 3.93 in tail. Dorsal base 3.2, 2.8, 2.7 in head. Depth of body 31.7, 35.3, 26.8 in *Lt*, 2.9, 2.8, 2.0 in head. Depth of head 24.4, 33.6, 24.4, in *Lt*, 2.3, 2.6, 1.8 in head.

Coloration. When examined shortly after capture (*c*) was a virtually uniform bright sulphur yellow, with small but conspicuous markings as follows (all unless otherwise specified lively red-brown, deepest on head): on middle side of trunk immediately behind head a whitish spot annulated with reddish, followed by 7-8 pairs (sides differing) of spots, one near upper one near lower border, the first 5-6 pairs marking out the first 5-6 annuli, the next well separated; on ventral surface of trunk a median line of short strokes and an arc embracing front of vent; on ventral surface of tail in each annulus a spot close to either border; other surfaces of trunk, tail immaculate; on lateral surface of head a subvertical, slightly proconcave bar about bisecting operculum, two spokes from eye to ventral profile, first, at 7 o'clock (left side viewed), divaricating and expanding somewhat below, second, at 4 o'clock, extending about to operculum, a small spot near lower end of snout; on ventral surface two pairs of spots, a median hyphen between them, a deep arc joining the ends of the hinder spoke from eye, a brief continuation of the opercular marking; on dorsal surface a faint proconcave arc between posterior borders of eyes. After preservation, ground colour whitish, markings much as before, dorsal colorless, caudal very pale brownish, pectoral (minute) whitish.

Chief variations exhibited by (*b*): trunk and tail markings, though similar, somewhat less pronounced; lateral surface of head with anterior spoke a simple line, posterior spoke more curved, briefly interrupted near lower end; an additional spoke, very short, up and back from 1 o'clock; opercular bar reduced to a short stroke, no spot at end of snout but one at middle of lower border; on ventral surface two spots and a posterior transverse arc on snout, a transverse arc right across postorbital head, a short oblique stroke on branchiostegal border; on dorsal surface a spot at hind angle of orbit, median spot on occiput, spot at middle of operculum; dorsal light brownish, caudal with obscure spots and short longitudinal strokes of reddish brown. Specimen (*a*) differs from (*b*) and (*c*) mainly in possessing a distinct dark bar across ventral surface of snout, continuing halfway up lateral surface, and in having proximal one-third of caudal dark brownish.

Tentacle. 'There is a small tubercle over the eye, and another on the occiput, besides several minute ones scattered over the upper part of the head' (McCulloch 1909, p. 319). A small subcylindrical supraorbital tentacle was present in one specimen; no other appendages were observed.

Syngnathus poecilolaemus Peters, 1869

Syngnathus poecilolaemus Peters 1869, *Monatsb. Akad. Wiss.*, Berlin (1868), p. 458.
Type locality: Adelaide, South Australia (Schomburgk).
Corythoichthys poecilolaemus McCulloch, 1929, *Mem. Aust. Mus.*, 5 (1), p.87.

Proportions. Though Waite and Hale in their review of South Australian lophobranchiates (1921) observed they had 13 males and 11 females before them, they gave the conventional

body ratios for one individual only: these single variates have since become adopted, without amplification, in general works such as the Handbook (Munro 1958) and the South Australian catalogue of Scott *et al.* (1974). In a paper on the first Tasmanian example, *Ls* 185.0, *Lt.* 188.5, from Kelso, north coast (Scott 1968) values of these ratios were recorded. In a note added after the paper's completion mention was made of a second individual, collected between Flinders Island and Clark Island: apart from standard length 122.5 and total length 129.8 no dimensions were published.

The principal body ratios for the Bass Strait example, together with those for the Kelso example (in parentheses Waite and Hale's values where available) follow. Head in trunk 1.5, 1.7 (1.4), in total length 6.3, 7.0 (7.4); trunk in tail 2.4, 2.6 (2.4); snout in head 1.8, 1.7 (1.75); eye in snout 5.3, 5.3 (4.5), in head 9.6, 9.0 (8.0); interorbital 1.3, 1.5 in eye. Length to pectoral origin 6.18, 7.03, to dorsal origin 2.57, 2.73, to dorsal termination 2.12, 2.22, to vent 2.47, 2.62 in *Lt.* Longest pectoral ray 6.9, 6.6, longest dorsal ray 4.7, 5.1 in head. Greatest width 1.2, 1.2 in greatest depth.

Annuli 20 + 45; subdorsal from 0.9 of penultimate trunk to 0.7 of 6th caudal (7.7 annuli). D. 27. P.13. A. 3. C.?8.

Family LAMPRIDAE

Genus *LAMPRIS* Retzius, 1799

Lampris Retzius, 1799, *K. Vet. Akad. Nya.*, Stockholm, 20, p.97. Type-species, *Zeus guttatus* Brunnich = *Zeus regius* Bonnaterre (*fide* Jordan, GEN. FISH.).

Lampris regius (Bonnaterre, 1788)

Zeus regius Bonnaterre, 1788, *Tabl. Encycl. Meth., Ichth.*, p.72. Type locality: Torbay, England (Pennant, BRIT. ZOOL.).
Zeus luna Gmelin, 1789, SYST. NAT. (Linné), ed. 13, 1, p.1225. Type locality: 'In mari Normanniam' (Duhamel).

Tasmanian records. As noted in Part IX (1960, p.90), Australian records of the opah, moonfish or mariposa are few, a survey by Whitley (1950) listing 5 [Western Australia 1, Victoria 2, Tasmania 2): there are, however, 10 entries for New Zealand in the period 1882-1950. Later Whitley (1962, p.62) added New South Wales to the Australian distribution and the species has now been reported from South Australia (Scott *et al.* 1974). It is clear this beautiful pelagic fish (the sole representative of its family) though widely distributed is rare (or, at any rate, rarely encountered) in the southern hemisphere; Smith (1950, p.141) noted only two records in Southern Africa and Munro (1955) did not include it in his Ceylon catalogue.

Three Tasmanian examples have so far been noticed in the literature: (*a*) near Port Arthur, south-eastern Tasmania (first Australian example), December 1895, 1.07 m to caudal base, 1.09 m to middle of caudal, weight 54.4 kg; (*b*) Storm Bay between Bruny Island and Tasman Peninsula, 1936; (*c*) Bridport, north coast, August 1943, *Ls* 1001 mm, *Lt* 1056, weight approximately 45 kg. Some details of these occurrences (with in the case of (*c*) meristic and morphometric data and notes on coloration) have been given in Part IX (1960). For (*a*) see also Morton (1897), Lord and Scott (1924), Whitley (1929). For (*b*) Whitley (1950) notes approximate length, and cited *The Advocate* 1/12/36. By courtesy of Mr D.J. Cherry, the present editor, a photocopy of the report has been made available from the newspaper's files. This notes the fish 'was recently found floating on the surface of the water in Storm Bay by a Hobart fisherman. It was apparently sick and was easily got on board'. It was about four feet [1.2 m] long and nearly as deep, while its width was a little more than a foot.

Attention is here called to three further reports: (*d*) Robbins Island, off the north coast; first seen by Smithton pilot Mr H.G. Vincent on one of his regular island-hopping flights; stated to be 1.3 m long, approximately 1 m deep, 380 cm 'across the back'; saucer-like eyes 100 mm in diameter; a photograph in *The Advocate* of 13 January 1976 provides a good picture of the fish and makes possible a satisfactory specific determination. The newspaper account included reports by Smithton naturalist Mr B.H. Wragge of two other examples: (*e*) Perkins Island, off the north coast, picked up on the beach about ten years ago; (*f*) Seven Mile Beach, about five years ago.

Variation. A comparison of *(i) The Advocate* photograph of (*d*), *(ii)* a photograph of (*a*) made available from R.M. Johnston's ichthyological memoranda by Whitley (1929, pl. 2, fig. 2) and illustrations provided by *(iii)* Günther (1880 , fig. 203), *(iv)* Kershaw (1913, pl.6), a Victorian example, total length 1.09 m [Kershaw noted this fish as affording the first Australian record, having overlooked the 1895 Tasmanian specimen]; *(v)* Munro (1957, fig. 447), *(vi)* Scott *et al.* (1974, fig. on p.97), a South Australian example 1.8 m long stranded near Kingston in 1963 reveals some noticeable differences, particularly in the shape and degree of development of some of the fins.

In *(i)*, *(ii)*, *(iii)*, *(v)*, the pectoral is slender – least so in *(iii)* – falciform, subequal in length to head; in *(iv)* similar in shape, but only about two-thirds head; in *(vi)* short, subequal to snout, very different in form, almost as broad as long, inferior border apparently about two-thirds (instead of from about one-fourth to one-third) superior border. The pelvic is in general subequal in length to pectoral, and equal to, or somewhat less than, width of outspread caudal; characteristically narrow falcate – most noticeably so in *(i)*, *(iii)* – but broader, but distally obtuse in *(vi)*, somewhat blunt distally in *(ii)*, but possibly imperfect here. The caudal is commonly lunate – most pronouncedly so in *(i)*, *(iii)*, tips of lobes extending behind median rays by a distance subequal to length of latter – but is only slightly excavate in *(iv)*: in *(iv)*, *(v)*, (*vi*) posterior caudal border shows some indication of being sinuate. The position of insertion of pelvic is not satisfactorily determinable in *(i)* in others, except in *(vi)* in which it is under, or barely in advance of, dorsal origin, it is located under elevated anterior portion of that fin.

Family SCORPIDAE

The three Tasmanian species of the genus *Scorpis* – *S. georgianus* Valenciennes, 1832, *S. aequipinnis* Richardson, 1848, *S. lineolatus* Kner, 1865 – have been keyed in Part XVII (1970, p. 45); criteria for separating off *Atypichthys strigatus* (Günther, 1860), first reported from this State in Part XX (1974b, p. 180), are given in that paper. Other references to Scorpidae in these Observations are to be found in Part II (1935), Part XVII (1970), Part XXII (1976). Two juvenile examples of *S. aequipinnis* here noted provide some interesting observations on early coloration and on relative growth.

Genus *SCORPIS* Valenciennes, 1832

Scorpis Valenciennes, 1832, *in* Cuvier and Valenciennes, HIST. NAT. POISS., 8, '1831', p. 503. Type species, *Scorpis georgianus* Valenciennes.

Scorpis aequippinnis Richardson, 1848

Scorpis aequipinnis Richardson, 1848, ZOOL. VOY. EREBUS AND TERROR, FISH, p. 121. Type locality: King George's Sound, Western Australia.

Material. Thirteen specimens, here listed in order of ascending magnitude of standard length; registration numbers are those of the Queen Victoria Museum Launceston. (*a*) *Ls* 40.0, 2 km north of Greens Beach, north coast, 18 April 1976, R.H. Green, Reg. No. 1976/5/125; (*b*) 44.0, same history as (*a*); (*c*) 112.0, Shear Reef, Low Head, north coast, 27 January 1973, R.L. Askeland, 1973/5/57; (*d*) 120, Bicheno, east coast, 21 April 1973, Scuba Club, 1974/5/79; (*e*) 133, 3 km east of Wynyard, north-west coast, 7 January 1973,

Scuba Club, 1973/5/16; (*f*) 152, same history as (*d*); (*g*) 155, Albatross Island, Bass Strait, 21 January 1973, D. Milledge, 1973/5/39; (*h*) 162, same history as (*d*); (*i*) 165, same history as (*g*); (*j*) 196, Coles Bay, east coast, 7 April, 1973,—, 1973/5/89; (*k*) 230, Bicheno, east coast, 21 April 1973, Scuba Club, 1974/5/74; (*l*) 231, Stanley, north-west coast, November 1974, M. Hardstaff, 1975/5/5; (*m*) 238, same history as (*k*).

Dimensions of juveniles. Dimensions of (*a*) and (*b*) are given as permillages of standard length; smaller individual first. Total length 1313, 1316. Length to origin, termination of first dorsal 358, 389, 575, 666; of second dorsal 600, 682, 865, 909; of anal 505, 591, 868, 910. Length to pectoral, at front of base 250, 273, at origin of longest ray 290, 295; longest (3^{rd}, 3^{rd}) ray 260, 252. Length to ventral 363, 432; length of longest (4^{th}, 4^{th}) ray 160, 166. Length to vent 498, 545. Head 313, 341. Snout 675, 795. Eye 120, 114. Interorbital 105, 107. Anal spines 75, 61; 90, 80; 103, 91. (Lengths of spines, L, are specifiable in terms of serial number of spine (N) by the formula $L = bN^k$, the parameters, with absolute length in mm, being k 0.3596, 0.2820, b 2.7075, 2.9901; t = 30.33*, 18.18*). Longest (5^{th}, 6^{th}) dorsal spine 110, 107. Longest (3^{rd}, 3^{rd}) dorsal ray 165, 159. Longest (2^{nd}, 2^{nd}) anal ray 155, 159. Depth at front of eyes 200, 211, back of eyes 353, 352, operculum 498, 432, vent 482, 523; maximum depth 498, 534; depth of caudal peduncle 115, 114.

Relative growth. A comparison of relative (*TLs*) dimensions of the two juveniles, (*a*), (*b*), *Ls* 40.0, 44.0, with those of two adults, (*g*), (*l*), *Ls* 196, 231, showed in a number of cases a noticeable disparity between the two groups. To determine whether these differences held good with a larger adult and subadult sample measurements were made of the additional individuals specified above. Clear evidence of differential relative growth was found in ten dimensions, the juvenile and non-juvenile sets being disjoint in four of these. In each of the next ten paragraphs the first line gives (in this sequence and style) the following data, all entries as permillages of standard length; (*a*), (*b*); range for (*c*)-(*l*), mean for (*c*)-(*l*) with standard error; correlation r (z) of dimension and *Ls*; t, followed by one, two, three asterisks, denoting significance at P 0.05, 0.01, 0.001, respectively. Coefficients of variation, V, and medians recorded are all those of the sample (*c*)-(*l*).

(i) Head. 313, 341; 261-297, 278.9 ± 3.32; — 0.571 (0.649); 2.31*. The non-juvenile sample for head exhibits a good measure of constancy (V 4.0), and is tolerably symmetrical, with median 278.

(ii) Eye. 120, 114; 60-80, 69.1 ± 2.15; — 0.914 (1.551); 8.04***. A negative correlation for eye (*TLs*) and *Ls* is frequently encountered. Distribution of (*c*)-(*l*) is negatively skew (median 72); variability being rather large (V 10.3). The correlation of eye, as permillage of head, with head, absolute, is —0.876 (1.359); t 9.73***.

(iii) Length to ventral origin. 363 432; 273-340, 310.4 ± 6.13; — 0.660(0.792); 2.91*. V 6.6, median 311.

(iv) Depth at back of eyes. 353, 352; 247-353, 302.9 ± 8.35; —0.642 (0.762); 3.18**. V 9.1, median 303. Of five other depth measurements — at front of eyes, operculum, vent, caudal peduncle, maximum — all showed a negative, but not formally significant, value of r. There is very marked individual variation within each set of dimensions. Specimen (*a*) contributes some four-fifths, nine-tenths of total positive $dxdY$ for depth of vent, maximum depth, respectively, while (*b*) provides seven-tenths for opercular depth. A general tendency to a negative correlation of depth with length is further evidenced by the fact that, with specimens of the subadult-adult sample arranged in ascending order of magnitude of *Ls*, in all cases, except at front of eyes, the mean value for the first half of the series exceeds that for the second half.

(v) Longest pectoral ray. 260, 252; 174-227, 193.8 ± 4.76; — 0.814 (1.138); 4.64***. V 8.1, median 188. In most of our material the pectoral is longer than as

shown in the figure in Scott *et al.* (1974, p.250), reaching in each of the two juveniles to the second anal ray, and among the others to anal origin (1 specimen), vent (5), short of vent by distance equal to (2), half (3) interval between vent and anal origin.

(vi) Longest ventral ray. 160, 166; 130-172, 146.5 ± 3.73; −0.739 (0.949); 3.64**. *V* 8.4, median 142. The longest ray is regularly the fourth (second from spine). In all our examples the ventral is decidedly longer than depicted in the figure just mentioned, reaching in (*a*), (*b*), to vent, first anal spine, respectively. and among the others to anal origin (1), vent (6), short of vent by distance equal to total (2), to half (2) interval between vent and anal origin.

(vii) Ventral spine. 75, 70; 59-92, 71.6 ± 3.43; −0.566 (0.641); 2.28*. *V.* 15.9, median 67.

(viii) First anal spine. Data for 9 specimens only, spine imperfect in (*d*), (*g*), (*i*), (*k*). 75, 57; 24-58, 45.4 ± 5.45; −0.833 (1.195); 4.99** (d.f. 7). *V.* 31.7, median 50.

(ix) Second anal spine. 90, 80; 42-86, 64.0 ± 5.08; −0.813 (1.137); 4.64***. *V* 19.3, median 65.

(x) Third anal spine. 103, 91; 60-96, 77.2 ± 3.57; −0.831 (1.192); 4.96***. *V* 15.3, median 76.

It is to be noted the coefficients of variation for the anal spines and the ventral spine are large (the only cases reaching double figures). However, the distribution as measured by the number of entries (7; with d.f. 7; 8, 7) within one standard deviation on either side of the mean is normal or virtually so.

Among other measurements made, positive correlations not significant at P 0.05 were found for longest dorsal ray (0.170), longest anal ray (0.274): in both cases, however, adult mean noticeably exceeds juvenile mean, though with adults arranged in ascending order of magnitude of *Ls* the mean of the first five specimens is greater than that of the last five; individual variation is great, the adult range for dorsal rays being 157-250, for anal rays 171-259. Non-significant negative correlations characterize length to dorsal origin (−0.180), length to anal origin (−0.139), length to pectoral origin (−0.486), length of longest dorsal spine (−0.492), interorbital (−0.366): in all cases the juvenile mean exceeds the adult (barely so in length to dorsal), and with specimens in order as before the first mean exceeds the second in length to dorsal origin, length to pectoral origin. Dimensions in which both the relative value of young and adult and the relative value of first and second halves of the adult sample (each 5 individuals) show the same sense of correlation as that of the whole sample quite probably would be found, on investigation of a more extensive series, to exhibit statistically significant correlation with length of fish of the appropriate sign.

Non-metrical juvenile features. The juvenile examples differ from the non-juvenile not only in respect of the metrical features considered above, but also in coloration (treated separately below) and in several points of general appearance.

A striking feature of a sizable example of this species is shortness of the exposed, as compared with the total, length of the dorsal spines. The concealment of the proximal portion is not primary attributable to the presence of a basal sheath of scales, though scales do ascend on to the fin, but is brought about by a thick fleshy covering in the form of an upward extension of the general integument, its distal border effectively constituting part of the overall profile of the body. In the juveniles the whole appearance of the fin is quite different, the spines standing more or less erect, and though provided with a thin squamous sheath, being clearly traceable

throughout their entire length. The spinous dorsal of the young *Scorpis aequippinis* thus has much the same character as that of the mado, *Atypichthys strigatus* (Günther, 1860).

Coloration. While adult and subadult fish, as preserved, are largely uniform brownish black above, lighter below, with the fins, except for, in many individuals, a narrow light hind border to the caudal, more or less concolorous with the body, the small examples exhibit a distinct, more diversified, juvenile pattern.

General colour of trunk and tail olivaceous above lateral line, silvery below; liberally sprinkled with small melanophores, distinctly larger in a band extending about equally on either side of lateral line, its width subequal to distance of lateral line from dorsal profile anteriorly; a conspicuous black spot on body at upper angle of pectoral lobe, just extending on to rays. Head olivaceous, darkest on occiput; an irregular silvery patch below eye. First dorsal olivaceous. Second dorsal largely olivaceous; briefly dusky at distal border anteriorly; behind a line from near middle of distal border to near posterior end of base white. Anal largely olivaceous, narrowly blackish along anterior border; this strip in contact with a blackish pennon extending along anterior half, or more, of outer edge; behind an arc from near tip of pennon to base of fin white. Pectoral pale yellowish green. Ventral, inner one-third very pale yellowish green, rest blackish. Caudal chiefly light olivaceous; a whitish terminal lunule involving about middle half of the falcate posterior border and extending back in its greatest (mesial) extension about one-fourth of way to base; upper and lower borders very sharply delimited by narrow black bands. The color pattern of the caudal bears no similarity to that of the adult, and is both striking and curious — the black flanking strips, markedly different in intensity of colour from the rest of the fin, appear like two diverging black rods standing out, on casual observation, almost as isolated structures with little if anything spread between them.

Family LEPTOSCOPIDAE

Of the two genera recorded from Australia, *Crapatalus* Günther, 1861 and *Leptoscopus* Gill, 1860, each with a single local species, only the former is known to occur in this State, an example of *C. arenarius* McCulloch, 1915 from Greens Beach, north coast, being the subject of some general observations in Part XVIII (1971, p. 139); a second example seen at the same time escaped capture. The species is said not to be common — McCulloch's material comprised only three examples, and Scott *et al.* (1974) stated only three had been recorded from South Australia; however, in recent months upwards of a score have come under the writer's notice. Fish from southern and eastern Tasmania exhibiting some differences from typical *Crapatalus arenarius* as described and figured by McCulloch and as represented by the 1971 northern Tasmanian specimen are here described as a new subspecies.

Genus *CRAPATALUS* Günther, 1861

Crapatalus Günther, 1861, *Ann. Mag. Nat. Hist.*, 3 (7), p. 86. Type-species, *Crapatalus novaezelandiae* Günther.

Crapatalus arenarius McCulloch, 1915

Crapatalus arenarius McCulloch, 1915, *Proc. Linn. Soc. N.S.W.*, 40 (2), p. 269, pl. 37, fig. 1. Type locality: Narrabeen, near Sydney, New South Wales.

Crapatalus arenarius lasti subsp. nov.
(fig. 1)

Type-specimens. Holotype (*e*) standard length 80.2 mm. total length 90.6, 4 paratypes, (*a*) 44.0, 50.3, (*b*) 48.5, 55.5, (*c*) 53.0, 60.4, (*d*) 54.0, 62.6; Blackmans Bay, south-

eastern Tasmania, March 1976, Mr P.R. Last; Queen Victoria Museum Launceston Reg. Nos. holotype 1976/5/200, Q.V.M. Type No. 228; paratypes 1976/5/201 *a-d*, Q.V.M. Type Nos. 229 *a-d*.

Since the description based on the type-specimens was drawn up further examples, all collected by Mr Last, have become available for examination. These extend the ranges for some meristic characters: the values for the new material are shown in square brackets. Additional material: Blackmans Bay, 4 specimens, *Ls* 36.0-79.0, 3 April 1976, 3 specimens, Nine Mile Beach, Swansea, east coast, *Ls* 50.2-72.3, 4 September 1976, 10 specimens, Nine Mile Beach, Swansea, *Ls* 53.0-76.1, 6 November, 1976.

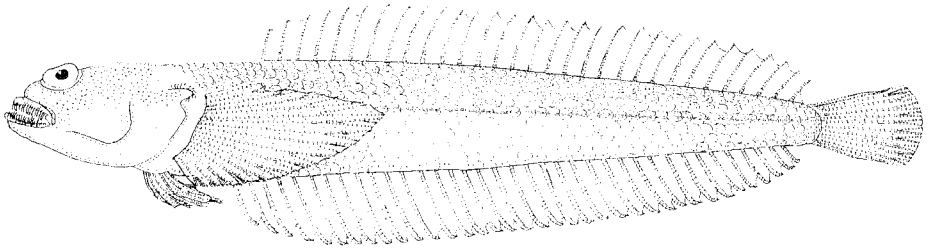

FIG. 1 - *Craptalus arenarius lasti subsp. nov.* Holotype, standard length 80.2 mm, total length 90.6 mm, Blackmans Bay, south-eastern Tasmania; Queen Victoria Museum Reg. No. 1976/5/200, Type No. 228 : x 1½.

Diagnosis. Differs from the nominate species as follows: no exposed spines on breast; anal distinctly higher than (*cf.* equal to or slightly lower than) dorsal; caudal lacking produced ray, the uppermost main ray being equal to, or shorter than, the ray immediately below it.

Description. The definitive datum relates to the holotype, data in parentheses to paratypes in ascending order of standard length; ranges for additional material in square brackets. Basic measurements are set out in table 3.

Br. 6. D.31 (33, 33,33,31) [32-34]. A.37 (35, 35, 36, 40) [34-36]. P.17 (16, 17, 17, 17) [17-21]. V.1,5. C. 2+10+2. L.lat.43 (44, 42, 42, 41) + 1 on caudal in each case: on right side of holotype a second, abnormal tubercle on caudal extending half length of fin, its length thrice that of a normal tubercle [44-47]. L.tr. 5/1/5.

Head 4.2 (3.8, 3.8, 3.9, 4.0) in *Ls*. Maximum depth of body 8.2 (8.5, 6.7, 6.6. 7.8) in *Ls*, 1.9 (2.3, 1.8, 1.7, 2.0) in head; depth at vent 6.7 (7.3, 5.9, 7.6, 8.0) in *Ls*, 1.6 (2.0, 1.5, 1.9, 2.0) in head. Eye 6.8 (6.8, 6.7, 7.1, 6.7) in head, 1.07 (0.59,0.53, 0.79, 1.07) in interorbital, 1.5 (1.4, 1.4, 1.3, 1.1) in snout. Depth of caudal peduncle 1.6 (1.4, 1.6, 1.6, 1.4) eye, 6.8 (4.9, 4.2, 4.4, 4.7) in head. About longest, 7th, dorsal ray 3.3 (3.5, 4.0, 3.5, 3.5) in head, 1.2 (1.2, 1.3, 1.2, 1.2) in 7th anal ray. Longest, 5th-6th, pectoral ray 1.0 (1.2, 1.1, 1.0, 1.0); longest, 4th, ventral ray 1.8 (2.6, 2.2, 2.2, 2.1); ventral spine 4.8 (4.7, 4.7, 4.5, 4.0); caudal fin 1.8 (1.8, 1.8, 1.8, 2.1) in head.

Head depressed, nearly flat above, moderately rounded below. Trunk and tail compressed, latter evenly tapering. Head wholly naked. Body covered with large cycloid scales, extending forward on dorsal surface about halfway between dorsal origin and tip of snout, on lateral surface to pectoral base (itself naked) on ventral surface to, but not on to, ventral fin base; extending back briefly in an arc of 1 laterally, 2-3 mesially on to caudal; subequal except above, and briefly laterally, in advance of dorsal, here smaller. Lateral line sloping down, virtually straight, for a distance subequal to postorbital head, thereafter horizontal; tubules hemicylinders slightly expanded, with some indication of very brief bifurcation, at posterior end, modally

extending across whole scale, crowded anteriorly, first one-fourth of series in about one-sixth of its length. No exposed spines on breast (*cf.* Affinities, below). Urinogenital apertures in an ovoid elevation immediately in advance of anal fin, its wall plicate, crenulate, particularly anteriorly; a minute papilla, fully exserted in paratype (*c*) as a digitiform process, length subequal to width of adjacent anal ray, arising from, or proximally in contact with, a mammilliform elevation.

Lower jaw projecting beyond upper. Mouth at an angle of approximately 40° to horizontal; maxillary extending back to below 0.5 eye (0.4, 0.2, 0.4, 0.7). Both lips with a row of slender, acuminate, inwardly curved cirri, regularly decreasing in size outwards, length of longest about half eye; in lower jaw free, extending whole length of lip, 45 (42, 39, 40, 47); in upper jaw free mesially, either absent or invisible in gelatinous matrix near angle of mouth, countable 28 (28, 33, 26, 30): with mouth closed tips of cirri briefly interlock. A curved line of 15 (12, 14, 8, 14) similar to, but somewhat shorter than, labial cirri fringing upper part of operculum, anterior two-thirds of series directed up, or up and somewhat back, the rest curving markedly to point down, or down and forward; several of the uppermost usually more or less embedded in gelatinous material. Eye superolateral, but wholly visible from above, its least distance from ambitus little less than interorbital; distant from preorbital margin by rather less than its diameter. Interorbital slightly concave (almost flat in several paratypes). Anterior nostril tubular, decreasing in height obliquely forward and outward, set in subcircular concavity about equidistant from orbit and preorbital border. Posterior nostril subcylindrical, somewhat compressed distally, partly externad of anterior, hard against orbit, slightly larger and higher (in some paratypes apparently lower) than anterior. Preopercular margin rounded, entire; in advance of its margin, skirting its whole length and continuing forward into lower jaw the subjacent operculomandibular canal of the lateral line system, giving off a dozen equally spaced radiating tubules, each with one or two (at angle three) pores, four more tubules in mandible: lateral canal also traceable, zigzag to eye, in advance of this in paratypes portions of supraorbital and infraorbital canals apparent, the latter with one or two genal offsets. Operculum without spines, thickened above, thin, more or less membranous below: from shortly below the opercular cirri, through an arc subequal to that they beset, border delicately crenulate.

Teeth in jaws minute, cardiform, depressible; in up to three rows in front, narrowing behind to one; greatest width of band subequal to length of adjoining labial cirri. About twelve-fifteen teeth on anterior half or less of each palatine, some anteriorly in two imperfect rows. A small group of half a dozen cardiform teeth on each side of vomer, separated by an interval wider than one series. Visible surfaces of pharyngeal bones covered with villiform teeth.

Dorsal originating about above middle of pectoral, above 4th (4th-5th) anal ray, behind head by 0.34, (0.28, 0.26, 0.27, 0.32) head, attached by membrane to caudal peduncle almost at level of hypural joint, base (ray-ray) 1.54 (1.60, 1.53, 1.59, 1.57) in *Ls*; composed wholly of simple rays slightly flattened and expanded distally, tips free, increasing in length to about 7th, showing scarcely any diminution through first half of fin, thereafter slowly decreasing. Anal similar to dorsal, originating about below anterior one-third of pectoral, attached by membrane barely beyond (at or virtually at) level of hypural joint, base (ray-ray) 1.46 (1.47, 1.49, 1.48, 1.47) in *Ls*; composed wholly of simple rays similar to, but longer than, those of dorsal, 7th anal ray 1.2 (1.3, 1.3, 1.2, 1.2) 7th dorsal ray. Pectoral large, total length 1.3 (1.1, 1.2, 1.2, 1.1) head; longest, 7th (6th-7th) ray 0.95 (0.80, 0.95, 0.96, 0.87) head, rays above this becoming somewhat abruptly shorter, those below decreasing evenly; first (uppermost) ray simple, next five bifurcate for half their length, rest with the upper ramus of the primary dichotomy giving off from near its base a secondary ramus that keeps close to it; rays tips free. Ventral inserted in advance of pectoral, about under preopercular border, extending almost horizontally outward, rather rounded, ray next to spine simple, other rays markedly bifurcate; interval between fins two-thirds

length of fin. Caudal rounded, neither uppermost nor lowermost of main rays (both single) reaching nearly as far back as median rays; no produced ray.

Coloration in formalin. (*a*) *Holotype*. Trunk and tail above lateral line pale greenish, in places with some hints of brown, most of the scales with several large and many small melanophores, most abundant and intense beside dorsal base; below lateral line, including ventral surface, whitish, immaculate save for a row of minute black spots one on each of most scales flanking anal base, and for a few small obscure dark markings elsewhere on lower flank. Head above a line from near angle of mouth to tip of opercular lobe greenish or greenish brown with thickly set dark brown chromatophores, dark bluish transversely elliptical patch on occiput, small cluster of minute brown spots round mandibular symphysis, extending on left side only as narrow strip along lower lip; rest of head pale greenish, immaculate. Dorsal rays in anterior half of fin pale green each with two groups of dark brown chromatophores, in posterior half most punctulated, wholly or in most part, with brownish; membrane hyaline, immaculate. Anal immaculate, rays whitish, membrane hyaline. Pectoral mostly pale greenish, several lower rays purplish brown distally. Ventral whitish proximally, purplish brown in distal half or less. Caudal greenish in proximal one-third, thereafter brown with some hint of purple.

(*b*) *Paratypes*. Dorsal rays show variation as follows: brown or golden brown in anterior two-thirds, lighter behind, some with one or more darker patches; half a dozen more or less equally spaced rays silvery, rest tipped or briefly banded brownish; mostly brownish olivaceous, becoming somewhat lighter behind; first one-fourth rather dark brownish, lighter behind, with, in places, bronze tinge. Anal rays range from white to very pale brownish, tending to become a little deeper distally. Pectoral and ventral vary in extent of purplish area. Caudal with somewhat variable amount of brownish, one specimen tipped very dark brown.

Size. *Crapatalus arenarius* is a small fish, the 'length' of McCulloch's type being noted as 85 mm, *Ls* and *Lt* of the 1971 northern Tasmanian specimens being 75.9, 85.6, and the conventional length given by Scott *et al.* 9 cm. The standard length of the 22 specimens here noted is 36.0-80.2, $\bar{x}$ 59.2 ± 2.61, the total length 41.0-90.6, $\bar{x}$ 67.0 ± 2.97. The *Ls* frequency distribution in 12 length classes 35.5-37.4 ... 77.5-81.4 is 1, 1, 2, 2, 4, 1, 1, 5, 0, 2, 2, 1.

Affinities. *Crapatalus arenarius lasti* is much similar in general facies to the nominate subspecies, the most notable differences being those set out above in the diagnosis.

McCulloch reported and figured 'breast armed with two small spines which project forward': in the 1971 account of the northern Tasmanian specimen attributed to the typical species it was noted the spines were less developed than seemed to be indicated by the figure of tye type; they are, indeed, minute. No exposed spines are present in any of the type-specimens of *C. a. lasti* or in any of the additional examples examined. The relevant region in the holotype differs somewhat from that in the paratypes. In the holotype a subtriangular area, slightly wider than long, extends forward from the ventral bases as a median tumescence, rounded laterally, its top followed, at a lower elevation, by a slender rod, rather more than half an eye diameter in length, apparently bifurcated briefly at its anterior end, and flanked on either side by a sigmoidal fleshy fold originating near ventral base. In the paratypes the pre-fin subtriangular area may resemble that in the holotype, may present an almost flat face, or may include a smaller subtriangular elevation, the apices common; beyond the apex, generally the most elevated point on the whole system, and in most cases somewhat rostriform, the isthmus continues forward more or less in the form of a semipyramid, the sides somewhat concave, the free border slightly or markedly convex dorsad. Partial dissection at the elevated apex of the triangle in a paratype, (*b*), reveals the presence of a single small broad acute spine, previously totally embedded and quite invisible.

The anal, in the nominate subspecies equal to or a little lower than the dorsal, is here distinctly the higher fin; the 7th anal ray, noted by McCulloch as equal to, and being in the 1971 northern Tasmanian fish very slightly less than, the 7th dorsal ray, is here 1.21-1.49, $\bar{x}$ 1.31 ± 0.0456 it: the anal is regularly higher than the dorsal also in the additional material. In *C. a. arenarius* as described and figured by McCulloch the uppermost main caudal ray is produced slightly beyond the general border of the fin, and this is the situation also in the northern Tasmanian fish: in *C. a. lasti* this ray is not produced and may be shorter than the ray immediately below it. In the Tasmanian example of the nominate subspecies length to ventral is 138 *TLs* (no exact data available for types): in the types of the present subspecies the *TLs* value is 159-179, $\bar{x}$ 165.8 ± 4.58; for 17 other examples 165-197, $\bar{x}$ 176.9 ± 1.50.

The present fish show some differences in coloration from the types of *C. a. arenarius*, fins in which are described as colorless, but here bear some markings. However, markings on the fins were noted for the northern Tasmanian example of the nominate subspecies; and the types of *C. a. lasti* (which exhibit some variation among themselves) do not differ trenchantly in colour pattern from that specimen.

Together with nominate *Crapatalus arenarius* the present subspecies differs from the New Zealand *C. novaezelandiae* Günther, 1861 in the much larger and less numerous scales.

The subspecific name *lasti* is in honor of Mr Peter R. Last, who collected all the specimens here noted, and who has on various occasions kindly made available material for examination.

Family TRIPTERYGIIDAE

The familial or subfamilial status accorded the threefins in the Australian literature has been an unstable one, shuttling (even in the same author) among Blenniidae, *e.g.*, Macleay (1882), McCulloch and Waite (1916, 1918), Waite (1921, 1923), McCulloch (1922), Lord (1923), Lord and Scott (1924), Whitley (1930, 1948); Blenniidae Clininae, Marshall (1964); Blenniidae Tripterygiontinae (Whitley, 1931); Clinidae, *e.g.* Lord (1927), McCulloch (1929), Whitley (1964a,b); and Tripterygiidae, *e.g.* Munro (1962), Scott (1962), Scott *et al.* (1974). The recognition here of a separate family Tripterygiidae follows that of Greenwood *et al.* (1966).

A single Tasmanian representative, *Tripterygium clarkei* Morton, 1888, appears in the Check-list (McCulloch 1929), there being referred to *Gillias*, Evermann and Marsh, 1900. Only three sets of material appear to have been the subject of primary published notice: (*a*) the type specimen (Morton 1888, pp. xlvii, 78); (*b*) a specimen recorded in R.M. Johnston's memoranda, made available by Whitley (1929, p.65), (*c*) 'some twenty specimens of varying age' captured 'among the piers of Hobart in August 1909'. (Hall 1913, p.82). The relevant accounts are discussed below. It is suggested that (*a*) be relegated to another genus, *Helcogramma* McCulloch and Waite, 1918, and that (*b*) be given a new name; (*c*) appears not now satisfactorily determinable.

A single example of a second species, *Tripterygium macleayanum* Lucas, 1891, relegated in the Check-list to *Gillias*, was reported from this State in Part IV (1939, p.151, fig.2), having previously been known only from Victoria. Some observations on four other individuals, together with remarks on taxonomy, appear below.

Tasmanian examples of a third species, *Brachynectes fasciatus* Scott, 1957, have been noted in Part XV (1967, p.216) and Part XVI (1969, p.175): reasons are here advanced for the retention of *Brachynectes* Scott, 1957, recognised by Whitley (1964) in his Australian name-list, but later rejected by its author (Scott *et al.* 1974, p.286) in favour of *Verconectes* Whitley, 1931. Some observations are made on additional

TABLE 3

Crapatalus arenarius lasti subsp. nov. Dimensions of holotype, (*e*), and four paratypes from Blackmans Bay, southern Tasmania. First line absolute measurements, mm, all other entries permillages of standard length.

Dimension	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)
Standard length	44.0	48.5	53.0	56.0	80.2
Total length	1143	1144	1140	1118	1130
Length to origin of dorsal	341	330	323	323	318
Length to termination of dorsal; ray, membrane	966,998	948,984	951,981	959,982	966,999
Length to origin of anal	287	278	274	277	281
Length to termination of anal; ray, membrane	961,1002	969,996	972,1000	966,986	975,1007
Length to vent (middle)	280	270	266	268	274
Length to pectoral origin; base, median rays	209,273	225,268	208,264	195,225	212,254
Length to ventral origin	159	165	151	179	175
Length of 7th dorsal ray	68	65	74	71	71
Length of 7th anal ray	91	82	85	86	87
Length of pectoral; from base, longest (nth) ray	298,214 (6th)	311,248 (6th)	302,244 (6th)	288,220 (7th)	308,226 (7th)
Length of ventral	136	129	123	126	137
Length of longest (nth) ventral ray	102 (4th)	118 (4th)	114 (4th)	124 (4th)	131 (4th)
Length of ventral spine	57	56	57	63	50
Head	266	262	255	252	237
Snout	55	49	58	52	52
Eye; without, with lid	39,47	39,56	36,47	38,46	35,49
Interorbital	23	21	28	40	37
Anterior internarial; between bases, middles of nares	34,45	29,43	28,43	36,52	27,41
Depth, width at front of eyes	91,116	62,103	57,108	71,121	75,135
Depth, width at back of eyes	111,159	103,165	104,187	98,125	116,173
Depth, width at operculum	141,164	165,223	157,208	125,143	134,203
Depth, width at vent	134,134	155,172	144,173	125,121	150,162
Greatest depth, width of head	134,223	165,206	166,208	125,179	140,223
Greatest depth, width of body	141,138	148,175	151,174	129,125	157,187
Depth, width of caudal peduncle	55,11	63,11	58,9	54,13	54,12

material.

Two new species of *Forsterygion* Whitley and Phillipps, 1939, a genus not previously known in Australia, are described and figured.

A key to the Tripterygiidae recorded from Tasmania is subjoined; this supersedes a key in Part XV (1967, p.216). In accordance with paragraph 23 of the General Recommendations of the Code, it follows the formal descriptions of the new species.

Genus *HELCOGRAMMA* McCulloch and Waite, 1918

Helcogramma McCulloch and Waite, 1918, *Rec. S. Aust. Mus.*, 1, (1), p.58. Type-species, *Helcogramma decurrens* McCulloch and Waite.

Helcogramma clarkei (Morton, 1888)

Tripterygium clarkei Morton, 1888, *Pap. Proc. R. Soc. Tasm.* (1887), p.xlvii, *nom. nud.*, p.78. Type locality: Clarke's [now Clarke] Island, Bass Strait.
Tripterygium clarkei: Johnston, 1891, *Pap. Proc. R. Soc. Tasm.* (1890), p.33 (p. 12 of reprint).
?Tripterygium clarkei: Hall, 1913, *Pap. Proc. R. Soc. Tasm.* (1912), p.82.
Gillias clarkei Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p.70. *Id.* Lord and Scott, 1924, SYNOP. VERT. ANIM. TASM., pp.13, 82. *Id.* Lord, 1927, *J. Pan-Pac. Res. Inst.*, 2 (4), p.15. *Id.* McCulloch, 1929, *Mem. Aust. Mus.*, 5, (3), p.347 (Morton's specimen). Not *Gillias clarkei* Whitley, 1929, *Pap. Proc. R. Soc. Tasm.* (1928), p.65 (based on *Tripterygium sp.* R.M. Johnston MS = new species, see below).
Tripterygion clarkei: Scott, 1939, *Pap. Proc. R. Soc. Tasm.* (1928), p.150 (Morton's specimen). *Id.* Schultz, 1960, *U.S. Nat. Mus. Bull.*, 202, p.293.
Tripterygion clarkii [*sic*]: Fowler, 1953, *Trans. R. Soc. N.Z.*, 81 (2), p.264. [In the Contents of vol. 81, part 2, p.156 (unnumbered), as the result of a transposition of author names and pagination data, Fowler's paper is attributed to R.K. Dell, and the pagination, 257-267, is given incorrectly as 221-237.]
Norfolkia clarkii [*sic*] Whitley, 1964, *Rec. Aust. Mus.*, 26 (5), p.193 (Morton's specimen).
Norfolkia clarkei Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), p.54 (Morton's specimen). *Id.* Scott, 1967, *Pap. Proc. R. Soc. Tasm.*, 101, p.216 (not 'R.M. Johnston's specimen', *Tripterygium sp.* = *Gillias clarkei*: Whitley, 1929 = new species, see below).

History and status. Morton referred his single specimen, total length 3 inches [*ca* 75 mm] to *Tripterygion* Risso, 1826 (rendered, as emended by authors, *Tripterygium*), prefacing his account with the generic diagnosis, as given, after Günther, in Macleay's Catalogue (1882, p.26). By Lord (1923, 1927) and by Lord and Scott (1924) it was transferred to *Gillias* Evermann and Marsh, 1900, a course followed in the Check-list (McCulloch 1929). However, *Gillias* has at least part of head scaly, whereas the (short) original description expressly specified 'head scaleless'.

Since the appearance of the texts just cited *Tripterygium clarkei* has been placed in a genus not then established, *Norfolkia* Fowler, 1953. In a key to the Australian species of that genus Whitley (1964a) includes this species; of which he treats *Tripterygium macleayanum*, 1891 as a synonym (however, this identification was shortly after abandoned in the name-list (1964b), in which the species appear separately as No. 1927 and No. 1929). The specification in the diagnosis of Fowler's genus 'Head largely with fine scales and muzzle naked' (type-species, *N. lairdi*, 'Cheek below suborbitals with 6 rows of scales and opercles fully scaled'), while applicable to the Victorian fish described by Lucas is not compatible with the Tasmanian fish described by Morton. In proposing his genus Fowler himself has considered the possibility of relegating to it these two species, together with the third species placed in *Gillias* in the Check-list, *Tripterygion straticeps* Ramsay and Ogilby, 1888 (incorrectly

attributed by Fowler to Ramsay and Macleay). After reviewing accounts of these he observed, 'it appears the generic identity of the three preceding species referred to *Gillias* by McCulloch is questionable. Their inclusion in *Norfolkia* would be equally doubtful till more evidence is forthcoming'. It may be noted in passing that Whitley (1964a) treats *N. lairdi* (a slip in the species reference gives *laird*) as synonymic with *Gillias squamiceps* McCulloch and Waite, 1916 (see comments below, under *Gillias macleayana*).

If the specification by Morton of the lateral line, 'very distinct, terminating in a line with the eighth ray of the third dorsal', is correct and complete, the fish cannot enter *Tripterygion*, but is to be assigned to *Helcogramma* McCulloch & Waite, 1918. Apart from *Lepidoblennius* Steindachner, 1867 (excluded from consideration here by possessing an uninterrupted line extending to caudal base; probably also by having membrane of first dorsal continuous with that of second), this is the only Australian genus diagnosed as having a single lateral line. However, the identification necessarily falls short of being definitive: the lateral line is described in *Helcogramma* as curving down from the shoulder; no indication of its direction in his specimen is given by Morton. It should be noted the concept of *Helcogramma* as formulated by the authors of the genus has undergone revision at the hands of Schultz. In dealing (1960) with material (treated as Clinidae Tripterygiinae) collected in connection with Operation Crossroads 1946 — in line with his earlier revision (1950) in which he recognised five genera only, *Tripterygion*, *Lepidoblennius*, *Notoclinus* (referable to Clininae?), *Helcogramma*, *Forsterygion* — he retains the first of the two criteria of the lateral line on which McCulloch and Waite relied for the separation of *Helcogramma* from *Tripterygion*, 'runs downwards from the shoulder to the middle of the back', but has qualified the second, 'no secondary series of incised scales posteriorly' to admit of a facultative extension beyond the pored (tubuliferous) scales by a collinear series of notched scales (thus providing for the inclusion in *Helcogramma* of several non-Australian species).

Helcogramma clarkei differs from the type-species, *H. decurrens* McCulloch and Waite, 1918 in possessing 16 (*cf.* 13) spines in second dorsal and in having lateral line continued beyond middle of third dorsal (*cf.* end of second dorsal). The New Zealand *Tripterygium medium* Günther, 1861, referred by Whitley (1968, p.80) to *Helcogramma*, has a single lateral line, normally ending beyond second dorsal (Waite (1913) notes in some individuals it continues to base of caudal): it differs trenchantly from *H. clarkei* in having at least 4 (*cf.* 3) spines in first dorsal (quoting Günther's '4-5' Waite (1913, p.7 footnote) observes, 'I have examined a large number of specimens but in none found five spines').

In the course of assessing Morton's account it must be borne in mind that the line of pierced or incised scales constituting in most forms a secondary, posterior lateral line is usually inconspicuous, and if not directly sought for can even be overlooked. With a double lateral line, naked head, second dorsal longer than third (this last feature excluding from consideration *Brachynectes* Scott, 1957 — later abandoned by its author, but maintained in the name-list of Whitley (1964) — also *Notoclinus* Gill, 1893, a representative of which occurs in New Zealand), Morton's fish would be eligible to enter *Tripterygion* Risso, 1826, or, if indeed these be distinct, either of the two remaining genera reported from Australia, namely *Vaucluselle* Whitley, 1931 (the initial diagnosis of which has undergone notable modification with the inclusion in it of *V. acanthops* Whitley, 1964) and *Verconectes* Whitley, 1931 (substitute name for *Trianectes* McCulloch and Waite, 1918, regarded as preoccupied by *Trinectes* Rafinesque: this preoccupation has been denied by Schultz (1960, p.283) and by Mees (1962, p.27); it does not appear to exist under the Code). No character reported by Morton for his specimen unequivocally qualifies it for, or debars it from, any one of these.

While a genus with a second lateral line thus remains a residual possibility, it would appear the appropriate course is to accept, in the absence of any evidence

directly negating it, the published description at its face value. Accordingly, it is suggested Morton's fish should be withdrawn from *Tripterygion*, *Gillias* and *Norfolkia* in which it has successively been placed and should be known as *Helcogramma clarkei* (Morton, 1888).

Genus *TRIPTERYGION* Risso, 1826

Tripterygion Risso, 1826, NAT. HIST. EUR. MERID., 3,p.241. Type-species, *Tripterygion nasus* Risso [= *Blennius tripteronotus* Risso, 1810, *fide* Schultz]. Emended by authors to *Tripterygium*.

Enneapterygius Rüppell, 1865, NEUE WIRBELTH. ABYSSIN. FISCHE, p.2. Type-species *Enneapterygius pusillus* Rüppell.

Enneanectes Jordon and Evermann, 1895 *in* : Jordon, *Proc. Calif. Acad. Sci.*, ser. 2, 5, p.501. Type-species, *Enneanectes carminalis* [not of Jordon and Gilbert = *Gillias sexmaculatus* Fowler, 1941, *fide* Schultz].

Trianectes McCulloch and Waite 1918, *Rec. S. Aust. Mus.*, 1 (1), p.53. Type-species *Trianectes bucephalus* McCulloch and Waite.

Notoclinops Whitley, 1930, *Mem. Qld Mus.*, 10, (1), p.20. Type-species, *Tripterygion segmentatum* McCulloch and Phillipps.

Verconectes Whitley, 1931. *Aust. Zool.*, 6 (4), p.324. Type-species, *Trianectes bucephalus* McCulloch and Waite. Substitute name for *Trianectes* McCulloch & Waite, stated to be (but not) preoccupied by *Trinectes* Rafinesque.

Vauclusella Whitley, 1931, *Aust. Zool.*, 6 (4), p.324. Type-species, *Tripterygion annulatum* Ramsay and Ogilby.

Australian genera. Consideration of the current position in respect of the taxonomy of the Australian tripterygiids occasioned by the present observations on several species has shown it to be in considerable disarray. Several locally proposed genera appear, as diagnosed, to be inadequately distinguished from earlier genera established for extralimital forms; furthermore, the status of some species in respect of these, even as constituted, is problematical. The general state of confusion is added to by several other factors, the most important of these being the existence of conflicting views on the true scope of some of the older genera (thus, are species with the first dorsal descendant to be excluded from *Tripterygion* Risso, as maintained by Waite (1913, p.2) against a widely accepted contrary usage?) and the lack in both some generic and some specific descriptions of data on features now recognized as being taxonomically significant (*e.g.*, number of scales between lateral line and base of (second) dorsal, squamation of breast and of pectoral base, nature of pectoral rays).

It has become evident that, pending the completion of a full-scale review of Australian (indeed, Australasian) forms, no comprehensive solution can be looked for. In the circumstances it is concluded the procedure that best serves to eliminate existing anomalies without at the same time bringing about possible fresh confusion is not at this stage to introduce any new proposals, but simply to subsume locally described genera other than *Brachynectes* Scott, 1957 and *Fosterygion* Whitley and Phillipps, 1939 (for these two genera see below) in either *Tripterygion* or *Gillias*, and to refer local species to one of these. The position thus arrived at, as set out in the above table of synonymy, is broadly that adopted by Schultz (1960), differing from it in retaining *Gillias* and *Brachynectes* (latter not noticed by Schultz; overlooked?) as separate entities.

Tripterygion whitleyi sp. nov.

Tripterygium sp. Johnson MS, *in*: Whitley, 1929, *Pap. Proc. R. Soc. Tasm.* (1928), p.65. Type locality: Leven [= Leven River, north-west coast, Tasmania].

? Tripterygium clarkei: Hall, 1913, *Pap. Proc. R. Soc. Tasm.* (1912), p.82. Not *Tripterygium clarkei* Morton, 1888, *Pap. Proc. R. Soc. Tasm.* (1887), p.78 (p.xlvii, *nom. nud.*).

? Tripterygion clarkei: Schultz, 1960, *U.S. Nat. Mus. Bull.*, 202 p.293. Not *Tripterygion clarkii* [*sic*] Fowler, 1953, *Trans. R. Soc. N.Z.* 81 (2), p.264

Gillias clarkei Whitley, 1929, *Pap. Proc. R. Soc. Tasm.* (1928), p.65 (*ex* Johnston MS). *Id.* McCulloch, 1929, *Aust. Mus. Mem.*, 5 (3), p.347, *partim* (Johnston's specimen). Not *Gillias clarkei* Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p.70; Lord and Scott. 1924, SYNOP. VERT. ANIM. TASM., pp.13, 82; Lord, 1927, *J. Pan-Pac. Res. Inst.* 2 (4), p.15.

Norfolkia clarkii [*sic*] Whitley, 1964, *Rec. Aust. Mus.*, 26 (5), p.193, *partim* (Johnston's specimen).

Norfolkia clarkei Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), p.54, sp. no. 1927, *partim* (Johnston's specimen).

(Norfolkia sp.) 'R.M. Johnston's specimen' Scott, 1967, *Pap. Proc. R. Soc. Tasm.*, 101, p.216 (in key).

History. The half dozen lines about the holotype of *Tripterygium clarkei* Morton in this Society's *Proceedings* for August 1887 included the comment 'Mr. Johnston had a specimen, but of a different species but had not described it'. In R.M. Johnston's memoranda, redacted by Whitley (1929), an entry headed simply *Tripterygium sp.* probably relates to this individual.

Formally citing references to Morton (1888) and Hall (1913), Whitley treated it as conspecific with Morton's specimen, at the same time transferring it to *Gillias*. It should be noted, however, that if this specimen is that mentioned in the 1887 *Proceedings*, Johnston himself regarded it as a distinct species; it is here so described. While the bestowal of a specific name in the absence of type material is a far from satisfactory proceeding, to be undertaken only after careful consideration, the continued lumping together under a single name of two fish clearly not conspecific is still less satisfactory, constituting a more immediate occasion for confusion.

Description. Johnston's memorandum is here transcribed verbatim. 'Blenny. *Tripterygium sp.* B.4. D.21/8; A.2/19; P.13; V.2. Length scarcely 3 3/5 times length of head, which is nearly equal to height of body. Eye large. Snout 1½ times diameter of eye, surmounted by a long tentacle which has three or four branchlets. A bifurcate tentacle at nostril. Interorbital space less than diameter of eye and 1/3 length of head. Dorsal in three divisions. Black spot on interspace between first two spinous rays. Lateral line conspicuous a [long] curvature of [back], descends at point below termination of first dorsal and follows the line along middle of body with more distant pores. Nasal tentacle bifurcate [see above]. Body reddish brown, mottled with darker; lighter below. Leven'. [*i.e.*, Leven river, north-west coast].

The type-specimen is R.M. Johnston's specimen, the subject of the above description published in the *Papers and Proceedings of the Royal Society of Tasmania*, 1929 (1928) (Whitley *ex* Johnston MS).

The second binomen is in honor of the late Gilbert Percy Whitley, an outstanding figure in the history of Australian Ichthyology, and over many years a valued ever-helpful friend of the writer.

Affinities. Nothing in Johnston's account precludes the referral of his fish to *Tripterygion* in which (as *Tripterygium*) he placed it.

The dorsal count is noted as 21/8, *i.e.*, presumably iii, xviii, 8 (the presence of more than three spines in the first dorsal being highly unlikely). Among published accounts of Australian threefins, that of only one other species, *Vauclusella acanthops* Whitley, 1964, here referred to *Tripterygion*, has been found in which the number of second dorsal spines is, as here, twice or more the number of dorsal rays, the dorsal formula being iii/xvi to xvii/8 (for available counts in other species enumerated in

the name-list of Whitley the range of the ratio spines/rays is 0.8-1.5, mean 1.22 ± 0.050; the distribution, interestingly enough, being close to symmetrical, with *sk* = − 0.475, and with 11 − expected in normal distribution 12 − items within one standard deviation on either side of the mean). This Queensland species − the brief original description of which (1964), based on the holotype and five paratypes from Heron Island, has since been amplified and complemented by a figure (1965, fig.12) − agrees with the Tasmanian fish in anal count (which is, indeed, much the same in most species), and, as indicated, closely approaches it in dorsal count.

On the basis of the rather few comparable items recorded, *T. whitleyi* differs from *T. acanthops* as follows: P.13 (*cf.* 15-16); depth nearly equal to (0.7) head, or round about 3 3/5ths in 'length' (4.9 in *Ls*, 3.9 in *Lt*); narial tentacle bifurcate (from figure, apparently simple); supraorbital tentacle with three or four branchlets (from figure, probably simple, lanceolate); lateral line ending at termination (from figure, at about three-quarters) of base of second dorsal; first dorsal with black spot between first two spines (no spot); body reddish brown, mottled with darker (as preserved, plain greyish brown, no dark blotches). *T. acanthops* exhibits three exceptional features: unusually elevated second dorsal (longest spine 1.8 longest spine of first dorsal, 1.5 longest dorsal or anal ray); uppermost pectoral ray produced well beyond branched rays, reaching past level of anal base; three conical spines over each eye. It would seem not unlikely that, if exhibited by his specimen, features so visually striking would have engaged Johnston's attention sufficiently to lead him to record one or more of them even in a brief description: the suggestion remains of course purely speculative.

From *T. clarkei* as here accepted (*i.e.*, as represented by Morton's account of his fish) *T. whitleyi* differs trenchantly thus: D.iii, xviii, 8 (*cf.* iii, xvi, 11); lateral line ending 'below termination of first dorsal', *i.e.*, below end of second dorsal, 'first dorsal' being employed by Johnston as equivalent to spinous dorsal, as is evident from his use in the dorsal formula of two counts only, '21/8' (*cf.* below eighth dorsal ray); two lateral lines (if Morton's account correct, one): minor variations included fewer pectoral rays, deeper body, probable difference in nature of narial tentacle. Attention has been called in Part XV (1967, p.216) to the incompatability of the two accounts.

Identity of Hall's material. Hall (1913) provided some observations on the coloration (recognizing 'two types of colour with intermediate stages of variation in each type') of some twenty specimens of a fish he identified as *Tripterygium clarkei* Morton, (noting that the species had hitherto been recorded only from Clarke Island, and that the type was not available for comparison), observing that 'as with the other blennies they were feeding among the mussels of the piles' of piers in Hobart. He stated 'the twenty-four specimens represented in these notes [other species discussed were *Pictiblennius tasmanianus* (Richardson, 1849), *Clinus perspicillatus* Valenciennes, 1836, *Cristiceps australis* Valenciennes, 1836, *Trachinops caudimaculatus* McCoy, 1890] will be additions to the Tasmanian Museum'. In 1938 the then Director of the Museum, Dr J. Pearson, who kindly made a search at the request of the writer, stated the material could not be traced. While there appears every reason to suppose Hall's material did indeed include a tripterygiid, there seems to be no possibility of reaching a conclusion regarding the reliability of his specific determination.

Genus *GILLIAS* Evermann and Marsh, 1900

Gillias Evermann & Marsh, 1900, *Rept U.S. Fish. Comm.*, 1899, p.357. Type-species, *Gillias jordani* Evermann and Marsh.

Gillias macleayana (Lucas, 1891)

Tripterygium macleayanum Lucas, 1891, *Proc. R. Soc. Vict.* (n.s.), 3 (1890), pp. 9, 12,

pl. 3, fig. 4. Type locality: Port Phillip, Victoria.
Gillias macleayanum McCulloch, 1929, *Aust. Mus. Mem.*, 5 (3), p.348.
Gillias macleayana Scott, 1939, *Pap. Proc. R. Soc. Tasm.* (1938), p. 151, fig. 2.
Tripterygium macleayanum: Fowler, 1953, *Trans. R. Soc. N.Z.*, 81 (2), p.264.
Tripterygium macleayanum: Schultz, 1960, *U.S. Nat. Mus. Bull.*, 202, p.193.
Norfolkia clarkei Whitley, 1964, *Rec. Aust. Mus.*, 26 (5), p.193.
Norfolkia macleayana Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), p.54. *Id.* Scott, 1967, *Pap. Proc. R. Soc. Tasm.*, 101, p.216.

Generic status. As observed in some general remarks on Australian genera above, *Gillias*, sunk by Schultz in *Tripterygion*, is here treated as a valid genus. In terms of this position the present species is excluded from *Tripterygion* by its possession of scales on part of head. There remains the possibility of its belonging to *Norfolkia*, to which it has recently been referred by Whitley (1964a, b) and by the writer (1967).

It agrees with *Gillias* and differs from *Norfolkia* as that genus is understood by its describer in the following points: (*a*) nasal tentacle (none), (*b*) fringed supraorbital tentacle ('No supraorbital flap, though right orbit with free skinny point above posteriorly but none on left orbit'), (*c*) pectoral base and fin naked (base scaled, fin scaled proximally), (*d*) upper and lower sections of lateral line (lower not satisfactorily identified in the writer's 1939 paper, present specification based on new material) separated by one row (two rows) of scales. It differs from *Gillias* (as represented, *fide* Schultz, by its type-species, *G. jordani* Evermann & Marsh) and agrees with *Norfolkia* (*e*) in having upper section of lateral line extending to below third, instead of second, dorsal. In the extent to which the head is scaled it occupies an intermediate position, apparently being somewhat more scaled than in *Gillias*, while noticeably less so than in *Norfolkia*. *Norfolkia* has 'upper edge of supraorbital with a row of very minute and somewhat irregular denticles', while *G. jordani* has 'entire supraorbital edge' (Fowler). In the largest of the specimens specified below about two-thirds of the upper rim of the orbit is abundantly denticulated, in two specimens it bears fewer than half a dozen minute tapering processes, the remaining specimen none; all have some processes fringing hind part of orbit. Similar processes ('fringed papillae', Lucas) occur also in all individuals on the dorsum in about the hinder one-third of the interorbital space.

As interpreted by Whitley, *Norfolkia* comprises four species: *Gillias squamiceps* McCulloch and Waite, 1916*(with which Fowler's type-species, *N. lairdi*, is synonymized — a comparison of the descriptions and figures reveals, however, divergences difficult to reconcile), *N. thomasi* Whitley, 1964, *Tripterygion striaticeps* Ramsay and Ogilby, 1888, *Tripterygium clarkei* Morton, 1888 (with which is synonymized *Tripterygium macleayanum* Lucas, 1891; but note presence in latter, absence in former, of head scales): of these species, the first two have D. iv, the other two D. iii. Inclusion of the additional species in *Norfolkia* entails a not insignificant recasting of the genus (note, *e.g.*, negation of items (*a*), (*b*), in the preceding paragraph; termination of superior lateral line in *N. thomasi* below second dorsal). While there is, indeed, a possibility there could be greater compatability between Lucas' species and a revised diagnosis of *Norfolkia* than between it and *Norfolkia* as established by Fowler, in the absence of any such synoptic redefinition it is expedient to treat the genus as it was originally specified.

New material. As already noted, the only Tasmanian example hitherto reported is that of which a description and figure were given in Part IV (1939) — this account, indeed, appears to be the only non-derivative one to appear since the original description. Four additional specimens: (*a*) *Ls* 24.5, *Lt* 30.0, 37.4, (*b*) 31.0, 37.4, (*c*) 46.0, 55.9, (*d*) 48.6, 61.0, collected by Mr R.H. Green, 2 km north of Greens Beach, north coast, 18 April 1976; Q.V.M. Reg. No. 1976/5/129.

Meristic characters. Br.VI. D. III, XIV, 11; III, XIV, 7; III, XIV, 11; III, XIII, 11.

*Attribution to *Norfolkia* accepted by Hoese, 1976, *Rec. Aust. Mus.* 30 (15), p.427.

A. 20, 20, 20, 21. P. 8 branched + 7 simple (left), 8 + 7 (right); 9 + 7, 9 + 7; 7 + 8; 8 + 7; 8 + 8, 9 + 7. V. 2. C. 12 + 4/3 procurrent rays, 14 + 1/2, 14 + 2/3, 12 + 1/1. L. l. 28 (scales with tubercles) + 6 (posterior incised scales), 31 + 8, 29 + 6, 28 + 8; the superior element reaching to below penultimate dorsal ray in (*a*), (*b*), (*c*), antepenultimate in (*d*). Sc. tr. at origin of first dorsal 3/1/11-12, at origin of third dorsal 2/1/5.

In (*b*) the third dorsal, with only 7 rays, though intact throughout, is not wholly normal, short segments of several imperfectly formed radial elements being suspended in the membrane. In (*d*) the third spine of the first dorsal is not fully developed.

Comparison with published counts show variations as follows (present data in parentheses): second dorsal XIV (XIII-XIV), third dorsal 10, 12 (11 ; abnormal 7), anal 22 (20-21), pectoral 15, 12 + 6 (7-9 + 7-8), superior lateral line 25-29 (28-31); scales, transverse, at first dorsal origin 3/1/8 (3/1/11-12) at third dorsal origin 2/1/5 (2/1/5). 'Length' 50 mm, standard length 43.8 (24.5-48.6).

Dimensions. A series of dimensions is set out in table 4, the first entry, standard length, being in millimetres, all other entries being permillages of standard length.

Supplement to 1939 account. Lucas' original account is brief and his figure is an outline one only: a detailed account and an illustration were provided for a Tasmanian specimen in Part IV (1929). The present material affords some interesting additional data.

The figure by Lucas shows the lengths of the spines of the first dorsal decreasing; however, the Tasmanian fish is figured with second spine longest, the text giving lengths of 1st, 2nd, 3rd spines as 32, 35, 29% of head length. Three different patterns are found in three of the present specimens (one fish with 3rd spine imperfect), namely 2nd > 1st > 3rd, 3rd > 1st > 2nd, 3rd > 2nd > 3rd. In all other Australian triptery-giids hitherto described the series is reported either as regularly ascendant or as regularly descendant (slope treated as a generic character by Waite); contrast, however, descriptions below of two species of *Forsterygion*. In the present species the variation is perhaps rendered somewhat less significant by the subequal size of the spines.

Maxilla to below hinder one-third of eye (1939 specimen and Lucas' figure); here to 0.5, 0.5, 0.7, 1.1 eye.

Lucas neither mentions nor figures a second lateral line, and in the 1939 account no such line was clearly recognized, 'a slight mediolateral groove, apparently without perforations, extends forward from caudal base to level of about eighth ray of third dorsal'. A similar groove occurs here (traceable in some individuals further forward), with in it a line of 6-8 notched scales continued cephalad maximally to below middle of rayed dorsal, there separated from superior lateral line by one scale-row.

Jaws equal anteriorly in (*b*), (*c*), lower projecting somewhat in (*a*), (*d*). Pectoral to level of 12th spine of second dorsal in (*b*), (*c*), (*d*), 1st dorsal ray in (*a*); ventral to vent in (*a*), (*d*), just short of it in (*b*), (*c*). Anal papilla bulbous or semiconical, longitudinally plicate, the rounded posterior end with a central aperture ringed by the six or eight mounded ends of the plicae. Angle of operculum notched between two variously developed horns, lower subcontinuous with tip of branchiostegal membrane.

Scales on head small, ctenoid, somewhat more extensive than previously reported, covering preoperculum down to level of lower border of orbit, and on operculum extending across anterior 0.7-0.9 of width in upper half, the posterior bounding arc curving

forward and down to meet preopercular margin well below level of inferior orbital border. Scales on occiput reaching to just behind back, or barely beyond front, of base of supraorbital tentacle. Arising shortly above upper end of preoperculum on each side and running transversely a slightly sinuous, overall proconvex line of about 30 small mounded elevations, basally contiguous, each surmounted by a digitiform process, length of whole structure exceeding half length of head, its distance behind level of eye 3-5 times its distance from dorsal origin. This feature, not previously reported, is perhaps comparable with 'a well-defined series of upraised pores separating the head from the back' found by McCulloch and Waite (1918, p.54) in their *Trianectes bucephalus* from South Australia: its morphological relations are identical with, and it may represent a less developed equivalent of, the curious conspicuous transverse series of cirri found in two genera of Blenniidae Salariinae, *Cirripectes* – represented in Australia by the Queensland *C. filamentosus* (Alleyne and Macleay) – and *Exallias;* it may be speculated that these linear structures are prefigured by the paired nuchal tentacles found in other salariinids, *e.g.*, some species of *Salarias*.

Coloration. In general much as already described (1939, p.154). Chief features worthy of notice: general colour, after short preservation in alcohol, greenish somewhat greyish, subsequently mainly yellowish, fawn or brownish (1939 yellowish grey, in formalin); dark bars on trunk and tail less sharply demarcated laterally, least distinct in (*a*), generally not reaching ventral profile; whole preanal ventral surface of trunk bright orange (anterior half flesh-coloured); large rounded carmine spot on occiput, subsequently barely observable; conspicuous light and dark genal markings disposed as before, but showing variation in relative width; caudal (noted in 1939 as lacking discrete markings, and so in (*d*)] in general conspicuously patterned with 12-15 well defined dark cross bars; in all except (*d*) anal strongly banded, 3 dark bars on each ray; less well developed banding on second and third dorsals, former without any definite dark distal line; first dorsal rays dark.

Genus *FORSTERYGION* Whitley and Phillipps, 1939

Forsterygion Whitley and Phillipps, 1939, *Trans. R. Soc. N.Z.*, 69 (2), p.236.
Type-species, *Blennius varius* Bloch and Schneider, 1801 (= *Tripterygion nigripenne* Valenciennes, 1836. ? = *Tripterygion capito* Jenyns, 1842).

Forsterygion multiradiatum sp. nov.

(fig. 2)

Type-specimens. Holotype, Kangaroo Bay, Bellerive, south-eastern Tasmania, standard length 105 mm, total length (caudal slightly imperfect distally) 120+, taken in fish trap ; 2 fm (3.7 m), 12 August 1975, collector Mr P.R. Last, Queen Victoria Museum, Launceston Reg. No. 1976/5/202, Q.V.M. Type No. 230. One paratype, Bellerive, south-eastern Tasmania, standard length 92, total length 108, August, 1976, collector Mr T. Walker, Q.V.M. Reg. No. 1976/5/203, Q.V.M. Type no. 231: taken with type-specimens of next species. Though its caudal fin is somewhat frayed distally, the larger specimen is otherwise more satisfactorily preserved; furthermore the smaller specimen possesses an anomalous pectoral fin, with one ray more then the left side than on the right.

Meristic characters. Where there is a difference between the holotype and the paratype the specification for the former is here, and throughout the description, cited first. B. 6 D. vii, xxiv, 14; vii, xxiv, 15. A. ii, 29. P. 19 (3 + 9 + 7); left fin 20 (3 + 8 + 9), right 19 (3 + 8 + 8). V.2. C.15, of which 10 (9) are branched. L. lat. tubules 36 left, 35 right; 33 left, 35 right; ending below 3rd, 5th {4th} dorsal ray + pored scales 15 left, 17 right; 19 left, *ca* 16 right. Sc. *ca* 67, *ca* 69. Sc. tr. at second dorsal origin 6 + 1 + 21, on caudal peduncle 2 + 1 + 3. Scales between upper lateral line and dorsal profile at second dorsal origin 7; between upper and lower lateral lines 2.

TABLE 4

Gillias macleayana (Lucas, 1891). Dimensions of 4 examples from 2 km north of Greens Beach, north coast, Tasmania. First line absolute measurements, mm, other lines relative magnitudes, permillages of standard length.

Feature	(*a*)	(*b*)	(*c*)	(*d*)
Standard length	24.5	31.0	46.0	48.6
Total length	1224	1206	1215	1225
Length to origin, termination of first dorsal	245, 302	216,277	217,260	220,265
Length to origin, termination of second dorsal	367,702	339,710	322,637	329,681
Length to origin, termination of third dorsal	735,898	716,936	680,870	712,910
Length to origin, termination of anal	453,898	440,936	478,883	473,922
Length to pectoral, to base, origin of middle ray	241,302	213,287	252,283	247,323
Length of pectoral, from base, origin of middle rays	420,339	400,303	410,309	409,331
Length to ventral	176	177	174	191
Length of ventral, inner ray, outer ray	241,171	206,145	228,174	239,185
Length to vent	429	419	457	449
Head	282	290	319	315
Snout	53	65	67	70
Eye, with rim, without rim	104,86	97,87	91,65	87,73
Interorbital	41	39	30	33
Depth, width at front of eyes	104,94	123,113	104,107	97,121
Depth, width at back of eyes	180,131	161,135	152,152	166,165
Depth, width at opercular border	192,200	190,187	189,174	202,206
Depth, width at vent	200,114	178,103	174,130	189,132
Depth, width, greatest	204,206	194,226	191,215	202,212
Depth, width, of caudal peduncle, least	86,21	97,23	85,17	81,19
First dorsal spines, length of first, last, longest	102,108,98	100,97,106	85,91,98	80,107,-
Second dorsal spines, length of first, last, longest	118,73,161	98,65,129	-,63,111	107,47,150
Third dorsal rays, length of first, last, longest	102,78,196	129,95,174	-,87,176,	123,68,144
Anal rays, length of first, last, longest	69,78,153	66,74,135	65,88,152	43,82,154

Dimensions. A series of dimensions, expressed as permillages of standard length, is included in table 5, which gives also dimensions of a second species described below.

General description. Length of head 3.62, 3.47, greatest depth of head 4.77, 4.84, greatest depth of body 5.25, 4.38 in *Ls*. Depth of caudal peduncle 3.30, 3.34 in head. Eye 4.14, 3.90, snout 3.97, 3.79 in head. Interorbital 2.0, 1.9 in eye. Length to vent 1.55, 1.50 head, 2.33, 2.31 in *Ls*.

Body moderately elongated, compressed, tapering evenly from head to caudal peduncle. Head rather large, pointed anteriorly, subcylindrical posteriorly. Snout broad, blunt, slightly depressed. Eye large, elevated, not quite entering profile. Orbit smooth, not in general noticeably raised above eye, but forming a low keel between 1 and 4 o'clock (left side viewed), continued as a fine ridge to just beyond bottom of eye. Interorbital with on either side a low longitudinal tumescence, flanking a pronounced median trough with sloping sides. Mouth oblique, upper jaw barely

in advance of lower; lips tumid; maxilla extending back to between anterior and posterior nostrils, expanded posteriorly, most backward point near top of hind border, greatest oblique width subequal to direct distance from eye. A well developed palatal frenum. Anterior nostril equidistant (dividers) from border of preorbital and orbit; a low mounded fleshy base from which arises a cone, partly gelatinous in appearance, truncated obliquely forwards and outwards, surmounted on its hinder rim by a briefly stalked broad ovoid hyaline lamella fringed with 6-8 tapering processes. Posterior nostril a subcircular (subelliptical) opening with a slightly raised minutely fimbriated rim; slightly externad of anterior nostril, about its own diameter from orbit at 10 o'clock. A broad supraorbital tentacle, with very brief base and 4-5 long slender processes; set right on orbit at 1 o'clock (left side viewed), about equal in height to nasal tentacle. Gill membrane free from isthmus, broadly united across it; median point of posterior border an eye diameter in advance of pelvic insertion; branchiostegals 6, 6th (lowest) and 5th not closer together than 5th and 4th.

Teeth in the jaws cardiform, in a broad band narrowing rapidly posteriorly; a distinct outer row, teeth minute erect behind, progressively increasing in size and becoming recurved in front; better developed in upper jaw, where there are about 25 on each side. A rather large narrow arc of minute teeth on the vomer, subcontinuous with minute palatine teeth in two or more rows anteriorly becoming uniserial behind.

One small naked area immediately behind, extending somewhat below, hind half of pectoral base; one on ventral surface behind, contiguous with, bases of ventral rays, its width about one-third of whole body width here, its fore and aft extension a little less. Otherwise whole body with rather large scales forward on dorsal and upper lateral surfaces to a line from origin of first dorsal to upper end of branchiostegal membrane or insertion of uppermost pectoral ray, the line of cessation sharp: on lower lateral and ventral surfaces in advance of a line from near pectoral base to vent scales suddenly become small, and continue to decrease in size forward, finally being minute and at the same time become less apparent, more deeply embedded. General body scales rather large, strongly ctenoid, with modally about 30 stout straight acute spinules, traceable far back from scale margin; small scales on lower part of abdomen cycloid. The pectoral base is smooth and has the appearance of being naked; it bears, however, minute cycloid scales. Head wholly naked. An area bounded behind by the sharply delimited anterior border of the body scalation, laterally by a line back from middle of orbit about to level of dorsal origin, above by a line just behind middle of interorbital thickly set with minute elevations tending to be arranged in short transverse series. Rest of head smooth, except for numerous small pores with slightly (barely) elevated rims. These include many irregularly scattered around lower half of orbit and extending upwards and forwards on to the preorbital; about two score near margin of preoperculum; 8-10 on each mandibular ramus; a number on dorsum between nostrils and extending back on to front of interorbital. Upper lateral line following very closely dorsal profile, distance from it at level of vent two-fifths that from ventral profile; 35, 36 (33-35) contiguous elongate tubules, extending to below 3rd, 5th (4th) dorsal ray. Lower lateral line of minutely pored scales traceable with difficulty, total probably 19, just overlapped by upper line.

First dorsal with 7 weak spines, originating above upper angle of operculum; base 3.7 (3.7) in head; spines increasing in length back to penultimate, which is 1.8 (1.8) first, or 3.7 (3.8) in head; last 1.2 (1.2) first; just connected to base of second dorsal by a small forward triangular extension of membrane of latter. Second dorsal with 24 tolerably rigid spines; base 7.9 (7.2) base of first dorsal, 2.4 (1.9) base of third; first spine 1.6 (1.6) in longest (12th, 10th), which is 2.6 (2.8) last, or 2.1 (2.1) in head; connected to third dorsal by low membrane about half height of last spine. The border of the second dorsal is in marked contrast to that of the next species (which attains its greatest height anteriorly and runs backward and downward almost linearly), presenting a moderately convex curve rising evenly to shortly before middle, then dropping somewhat more rapidly but still evenly. A more precise

specification of the curve is the following. Where L = length of spine, N = serial number of spine counted caudad, N^1 = serial number counted cephalad, $L = bN^k$ for spines {1-10} $L = bN^{1(k)}$ for spines {11-24}; the best straight lines for the holotype, expressed in the convenient form of $\log L = k \log N[N^1] + b$, being $\log L = 0.2237 \log N + 0.9384$ ($t = 26.902$***) and $\log L = 0.3609 \log N^1 + 0.7373$ ($t = 72.067$***). Measured (in parentheses, predicted) spine lengths (holotype) are: {1-10} 8.7 (8.7) , 10.0 (10.1), 11.0 (11.1), 11.7 (11.8), 12.8 (12.4), 13.2 (13.0), 13.7 (13.4), 13.9 (13.9), 14.0 (14.2), 14.1 (14.5); {11-24} 13.9 (14.2), 13.7 (13.8), 13.4 (13.4), 12.9 (13.0), 12.6 (12.5), 12.2 (12.1), 11.8 (11.6), 11.0 (11.0), 10.6 (10.4), 9.9 (9.8), 8.9 (9.0), 7.9 (8.1), 7.0 (7.0), 5.5 (5.5), Third dorsal with 14 (15) simple rays: border convex, rising steeply to 3rd ray, which is 1.1 (1.2) first, 2.6 (2.6) last, 2.2 (2.0) in head; no connexion by membrane with caudal peduncle. Anal with 2 spines, first minute about one-fourth second, which is less than half first ray; 29 simple rays, soon attaining modal height, increasing somewhat posteriorly; longest (about 22nd) ray 1.8 (1.7) first, 2.0 (1.8) last, 2.4 (2.5) in head; membrane excavate for up to one-third length of ray; originating below 10th (10th) spine of second dorsal, base 1.1 (1.2) second dorsal base, 2.1 (2.0) in *Ls*; no membranous connexion with peduncle; laid back, reaches nearly to (to) insertion of lowest caudal ray. Pectoral rather large, broadly rounded, reaching when adpressed to below 16th (16th) spine of second dorsal; 19, 19 (19 right, 20 left) rays, comprising, from above 3,3 (3,3) simple, pointed; 9,9 (8,8) branched; 7,7 (8 right, 9 left) unbranched, bluntly pointed, somewhat recurved distally; first 5.9 (6.6), last 2.6 (2.6), longest 1.2 (1.2) in head. Pelvic with 2 simple tapering rays, connected by membrane for about half length of outer, which is 1.4 (1.1) in the inner, the latter 1.4 (1.6) in head. Caudal with 15 rays, 10 (9) branched, fin abraded posteriorly in holotype; in paratype truncate, its length 1.7 in head.

Coloration. *(i). Holotype.* Ground colour of dorsal surface and lateral surface down to midlateral line dark brown, deepening a little anteriorly; below dorsal profile a line of somewhat lighter areas, not very conspicuous, largest, six or eight times smallest, about two-thirds eye diameter, 5-6 below second dorsal, 3 below third; a small pale spot at upper, another at lower, termination of caudal peduncle. Ventral surface very pale brownish, in parts somewhat greyish. Small naked patch behind pectoral deep cream, naked patch behind pelvics very pale orange. Dorsum of head and lateral surface about down to level of lower border of orbit more or less concolorous with trunk. Cheek and opercle brownish olivaceous; branchiostegal membrane, inflated, somewhat lighter. Ventral surface greyish, lower lip darker. Nasal tentacle hyaline, in parts dusky. Ocular tentacle dark brown proximally, the processes mostly greyish.

First dorsal chiefly dark brown, a few small irregular areas lighter. Second dorsal virtually uniform medium brown, the rays lighter; tips of rays conspicuously whitish. Third dorsal much like second, a trifle lighter; extreme tips of some rays greyish. Anal with ground colour similar to that of second dorsal; all or most of the distal one-third or so of the ray projecting beyond membrane, together with a small slip of the well excavated membrane at its outer attachment to the hind border of the end of the ray, conspicuously white or slightly bluish-white. Pectoral membrane pale greyish or hyaline; rays of lower half brownish, a distinct bronze tinge along their interior surface; rays of upper half noticeably lighter; anterior surface of base yellowish grey, covered abundantly with minute red-brown chromatophores; posterior surface deep cream, nitidous, a sprinkling of dark chromatophores near upper border. Pelvic rays dusky greenish proximally, lighter distally; membrane greyish, microscopically punctulated with red-brown. Caudal concolorous with rayed dorsal.

(ii) Paratype. In general much like holotype. Chief differences: darker overall in body and all fins, the first and second dorsals and several lower rays of the pectoral approaching black; mottling on lower half of lateral surface of trunk and tail with darker component less extensive, the brown spotting confined to half or less than half, instead of covering all or most, of the scale; light areas below dorsal profile discernible in hinder half only and there quite obscure.

Discussion. *(i). Generic status.* In proposing *Forsterygion* Whitley and Phillipps nominated a type-species, *Blennius varius* Bloch and Schneider, 1801, *ex* Forster MS (noting its identity with *Tripterygion nigripenne* Valenciennes, 1836), but gave no formal generic diagnosis. Schultz (1960, p. 282) in a key characterizes the genus thus. 'First dorsal fin with V to VII spines, second with about XIX to XXII spines; anal with about II, 25 to 27; pectoral rays about 17 to 19; vertical [subvertical] scale rows about 60 to 65; lateral line, anteriorly, separated from base of second spiny dorsal by 5 or 6 scales; breast scaly; head naked'. From the type-species, *F. varium*, as described and figured by Waite (1913, p. 7, pl. III), this differs notably in specifying 'breast scaly' (Waite 'throat and chest naked') — but see observations above on the inconspicuous nature of the scales in these regions and diversity in the two species here described — and in extending first dorsal, second dorsal, anal and pectoral counts.

The present species fails to meet the criteria set out by Schultz as follows: 2 more second dorsal spines, 2 more anal rays, one more pectoral ray (in one fin of paratype), a few more scales in the lateral series. On comparison with the type-species perhaps the most striking discrepancy is that presented by the profile of the first dorsal fin, which in *F. varium* rises regularly to the last spine (5th or 6th ; figured by Forster, 6th; by Waite, 5th), whereas here it rises only to the penultimate (6th) and then falls — a pattern in which any spine of the first dorsal other than the first or last stands highest being highly unusual among tripterygiids generally (*cf.*, however, observations above on Tasmanian examples of *Gilliias macleayana* and on species described below). Despite these features, to which absolute value could be granted only by the establishment of a new genus, the general agreement in other characters with *Forsterygion* as conventionally accepted appears of sufficient weight to lead to the attribution of the present species to that genus.

(ii). Species affinities. No member of this genus has hitherto been reported from Australia. From what is probably its nearest ally the New Zealand *F. varium*, as that species is described in Waite's revision (1913), the present fish is immediately separable by, among others, the following features: D. vii, xxiv, 14-15 (*cf.* v-vi, xx, 12); nature of first dorsal profile; A. ii, 29 (*cf.* 25). From the second Tasmanian species described below (with the type-specimens of which paratype of the present species was taken) it differs chiefly thus: 4 more spines in second dorsal; profile of that fin well curved, highest towards middle (nearly straight, highest anteriorly), fin bordered (not) with white; total anal radial elements 31 (24-25); no naked strip flanking first dorsal base; upper (lower) portion of posterior border of maxilla reaching farther back; no noticeable light or dark markings on lower part of flank.

As the data in table 5 show, there is marked overall morphometric similarity between the two Tasmanian species of *Forsterygion*. However, in 5 relative (*TLs*) dimensions the mean value for the present is statistically significantly less than that for the other species; mean length to vent 431.0, 462.5, t = 2.681*; length to third dorsal termination 922.0, 969.5, t = 3.272*; length to anal origin 450.0, 484.0, t = 2.764*; length to anal termination 938, 973.8, t = 3.245*; depth of caudal peduncle, 84.0, 95.2 t 3.437*. In view of the absence of any real information on differential growth of these features the significance of these differences remains uncertain. However, it may be noted that in the two cases in which there appears to be some tendency for the ratio to vary with overall size (length to termination of dorsal, to termination of anal) the values for the smaller specimens of the other species are suggestive of a possible positive correlation of ratio with *Ls*, whereas the mean value for the larger fish of the present species is less than that for the smaller fish.

The specific name *multiradiatum* is from *multi*, a combining form of *multus*, many, plus *radiatum*, from *radiatus*, the past participle of *radiare*, to furnish with spokes or rays, from *radiatus*, a ray, signifies many-rayed, the allusion being to the large number of dorsal and anal radial elements, the counts exceeding those of the type-

species and also the upper extremes of the range attributed by Schultz (1960) to *Forsterygion*.

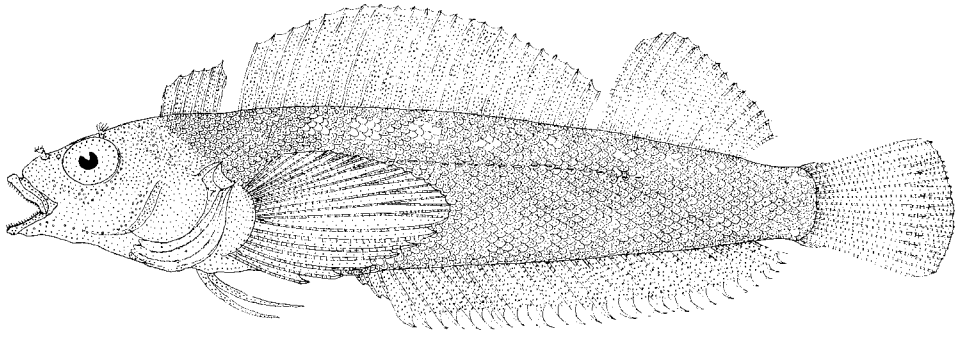

FIG. 2. - *Forsterygion multiradiatum sp. nov.* Holotype, standard length 105 mm, total length (caudal slightly imperfect distally) 120 mm, Kangaroo Bay, Bellerive, south-eastern Tasmania; Queen Victoria Museum Reg. No. 1976/5/202, Type No. 230: x 1.

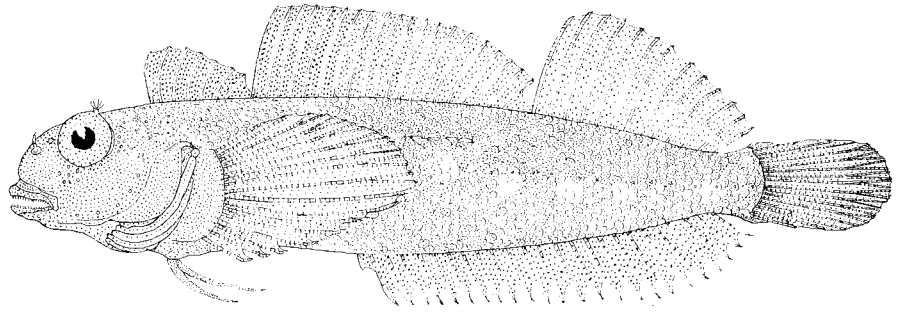

FIG. 3. - *Forsterygion gymnotum sp. nov.* Holotype, standard length 64.5 mm, total length 76.7 mm, Montagu Bay, south-eastern Tasmania; Queen Victoria Museum Reg. No. 1976/5/204, Type No. 232: x 1½.

Forsterygion gymnotum sp. nov.

(fig. 3)

Type-specimens. Holotype, Montague Bay, south-eastern Tasmania, August 1976, standard length 64.5 mm, total length 76.7, collector Mr T. Walker, Queen Victoria Museum, Launceston Reg. No. 1976/5/204, Q.V.M. Type No. 232. Five paratypes, same history as holotype, (*a*) *Ls* 54.1, *Lt* 65.1, (*b*) 55.0, 66.5, (*c*) 62.4, 73.5, (*d*) 64.0, 76.9, (*e*) 67.0, 79.4. One paratype will be offered to each of the following institutions, British Museum of Natural History, London, Australian Museum, Sydney, Tasmanian Museum, Hobart, the remaining two being deposited in the Queen Victoria Museum, Launceston, Reg. Nos. 1976/5/205,206, Q.V.M. Type Nos. 233,234. Taken with paratype of *Forsterygion multiradiatum*.

Meristic characters. Where different values are found in holotype and paratypes the

value for the holotype is here followed, after a semicolon, by the range (in parentheses, mode) of the paratypes. B. 6. D. vii, xx, 14; 13-14 (14). A. i, 24; 23-24 (23). P. 17, 2 + 7 + 8; 17, 2-3 (3) + 5-7 (7) + 8-9 (8). V. 2. C.16, 9 being branched; 15-16 (15), branched 9-10(10). L. lat. tubules left 26, right 25; 22-25 (22); ending below 17th dorsal spine; 17-18th (17th): + pored scales left 15, right 22; *ca* 15-*ca* 28. Sc. *ca* 70; *ca* 66-*ca* 72. Sc. tr. at second dorsal origin 5 + 1 + *ca* 23, on caudal peduncle 3 + 1 + 3. Scales between upper lateral line and dorsal profile at origin of second dorsal 5, at middle of fin base 7; between upper and lower lateral lines 2.

Dimensions. A series of dimensions, with standard length, total length in mm, all other measurements expressed as permillages of standard length, is included in table 5, which also gives corresponding dimensions of the two specimens of the species described above.

General description. From here onwards data for paratypes are given in parentheses. Length of head 3.73 (3.24-3.72, $\bar{x}$ 3.51 ± 0.0579); greatest depth of head 4.92 (4.51-5.00, $\bar{x}$ 4.74 ± 0.0598); greatest depth of body 4.51 (4.23-4.54, $\bar{x}$ 4.46 ± 0.0366) in *Ls*. Depth of caudal peduncle 2.93 (2.70-3.40, $\bar{x}$ 2.99 ± 0.734) in head. Eye 3.84 (3.43-4.05, $\bar{x}$ 3.80 ± 0.0696); snout 3.46 (3.60-4.25, $\bar{x}$ 3.84 ± 0.0882) in head. Length to vent 1.66 (1.55-1.75, $\bar{x}$ 1.63 ± 0.0237) in head, 2.25 (2.07-2.2, $\bar{x}$ 2.15 ± 0.0181) in *Ls*.

It is found that, with means for the six specimens used, tail, trunk head are of such relative anteroposterior extension that the lengths to their posterior boundaries are an exponential function of the first three natural numbers, these lengths thus being collinear and falling on integral values in a log-log plot. With L = length, mm, to hind border of region (tail, trunk, head) and N = 1, 2, 3 the equation is $L = 6.2040\ N^{-1.1567}$; t (d.f.1) = 42.661***; actual (computed) values 61.7 (62.0), 28.3 (27.8), 17.2 (17.7).

General form, features of head, including dentition, similar to those of species described above. Chief differences: eye reaching dorsal profile; orbital keel barely developed; maxilla somewhat less expanded posteriorly, reaching back to eye (*cf.* between posterior nostril and eye), its most backward extension near bottom (top) of its hind border; median point of posterior border of branchiostegal membrane about half (one-tenth to three-fifths) eye diameter in advance of ventral insertion.

Strongly ctenoid scales, similar to those of *F. multiradiatum*, cover whole tail and most of trunk. Along an arc from about middle of pectoral base to near vent they suddenly decrease in size by a factor of the order of 10, and become cycloid: in advance of this line the lower lateral and ventral surfaces present every appearance of being naked. Pectoral base smooth on both surfaces; no scales obtained on manoeuvring with a needle. No predorsal scales on dorsum, the naked area extending back on either side of first dorsal, about one (down to little more than half) eye diameter wide, continuing, rapidly narrowing, beside first four or five spines of second dorsal; immediately adjacent scales very small. Head wholly naked. Upper lateral line similar in structure and course to that of *F. multiradiatum*, but having fewer tubules, 25, 26, (22, 25), *cf.* 33-36, and ending earlier, shortly before end of second dorsal. Full course of lower lateral line of pored scales traceable with difficulty; total number probably 28.

First dorsal with 7 spines (rather more rigid than those of earlier species), originating above upper angle of preoperculum, just connected to second dorsal, its distal border virtually linear, almost parallel to its base, hence sloping somewhat upward and backward relative to general anteroposterior axis of fish (in one paratype, (*d*), profile virtually horizontal); first spine 3.5 (3.0-3.9, $\bar{x}$ 3.5), middle 3.4 (2.6-4.0, $\bar{x}$ 3.3), last 5.2 (3.0-5.5, $\bar{x}$ 4.5) in head; base 2.4 (2.3-2.4 $\bar{x}$ 2.34 ± 0.0246) in head. Second dorsal with 20 spines; border almost linear, sloping down and back; first spine 1.97 (1.7-2.1, $\bar{x}$ 1.91), second, longest (usually longest), 1.92 (1.8-2.2 $\bar{x}$ 1.94), middle 2.08 (1.7-2.4, $\bar{x}$ 2.19), last 4.68 (4.4-5.0, $\bar{x}$ 4.59) in head; base

relative to base of first dorsal tolerably constant, 3.3 (2.9-3.5, $\bar{x}$ 3.15 ± 0.0101); however, relative to base of third dorsal quite variable, 1.3 (1.4-1.9, $\bar{x}$ 1.64 ± 0.0916), there being significant negative correlation of the ratio with standard length (for all 6 specimens, $r = -0.875$ ($z = 1.364$), $t = 3.610$*); connected by membrane to very base of first dorsal ray. Third dorsal with 14 (one paratype 13) simple rays, border rising to second or third ray, thereafter almost linear, sloping down and back, very nearly parallel with second dorsal border; first ray 1.9 (1.8-2.4, $\bar{x}$ 2.13), second 1.7(1.7, -2.3, $\bar{x}$ 1.97), third 1.7 (1.6-2.0, $\bar{x}$ 1.83), middle 2.2 (2.0-2.7, $\bar{x}$ 2.29),last 3.5 (3.5-5.2, $\bar{x}$ 4.46) in head. Anal originating below 10th spine of second dorsal; one short spine, largely embedded (embedded, free) and 24 (23-24) stout simple rays, tips obtuse, usually more or less uncinate; membrane excavate for about one-third or less (about one-fifth to about one-third) of ray length; largely equal in height after first few rays, but rising somewhat towards termination; longest ray, about 20th, 1.3 (1.2-1.4, $\bar{x}$ 1.23) first,1.6 (1.4-1.7, $\bar{x}$ 1.55) last,or 2.3 (2.5-2.8, $\bar{x}$ 2.63) in head; base 1.50 (1.20-1.38, $\bar{x}$ 1.26) second dorsal base, 2.02 (1.95-2.52, $\bar{x}$ 2.16) in *Ls*; no membranous attachment to caudal peduncle. Pectoral rather large, broadly rounded, extending to below 12th (10th-14th) spine of second dorsal, with 17 (17) rays, comprising, from above, 2 right 2 left simple, unbranched, pointed, 7, 7 branched, 8, 8 unbranched, more or less uncinate(2 + 7 + 8 (5 fins), 3 + 6 + 8 (3), 2 + 6 + 9 (1), 3 + 5 + 9 (1)); first (uppermost) 4.4 (3.5-6.0, $\bar{x}$ 4.27), last 3.8 (2.5-3.5, $\bar{x}$ 2.87), longest, 10th (9th-11th, modally 10th), 1.0 (1.0-1.1, $\bar{x}$ 1.07) in head. Ventral with 2 simple rays, connected by membrane for 0.6 (0.5-0.6, $\bar{x}$ 0.58) length of inner ray, which is 1.2 (1.3 -1.4, $\bar{x}$ 1.32) outer, which is 1.5 (1.4-1.6, $\bar{x}$ 1.52) in head. The relative size of the ventral-anal interval, differences in which in a species of *Helcogramma* have been noted (Schultz 1960, p. 300) as representing sexual dimorphism, is here a function of size of fish, the interval, as *TLs*, exhibiting negative correlation with *Ls*, $r = -0.960$ ($z = 1.949$), $t = 6.855$**. Caudal rounded; 16 (15-16) rays, 9 (9-10) branched; length 1.4 (1.3-1.5, $\bar{x}$ 1.42) in head.

Coloration. *(i). Holotype.* General colour of lateral surfaces of trunk and tail medium brown, a little lighter in lower half; about 10 subelliptical (major axis vertical) or subcircular greyish patches (differing somewhat on the two sides) in a line from shortly behind pectoral base to near caudal base, decreasing in size backward, largest a little smaller than eye; on caudal peduncle light colour extending diffusely beyond these patches, which thus become less definite, so that region may be described indifferently as dark mottled with lighter or vice versa; further irregular, mainly longitudinal lighter areas adjacent to much of dorsal profile. Ventral surface more or less concolorous with lower lateral surface, rather lighter in advance of vent. Head in general not noticeably different from trunk, a little more greyish on branchiostegal membrane; ventral surface dark greyish with some dusky touches; lips concolorous with one another and with upper surface of snout. Nasal tentacle hyaline and greyish; supraorbital tentacle grey, briefly darker proximally. First dorsal very dark brown, almost black. Second dorsal much like first anteriorly, a little lighter posteriorly; no white tips to rays. Anal in general about concolorous with second dorsal, but distal one-third or so of rays conspicuously lighter, lacteous. Pectoral membrane greyish, rays medium brown (those of lower half slightly darker), with tinges of bronze; front surface of base concolorous with trunk, back surface pale, glistening. Ventral evenly dark brown approaching black. Caudal overall about concolorous with rayed dorsal; some scattered minute dark chromatophores.

(ii). Paratypes. Ground color much as in holotype, darker in one, somewhat lighter in two, the latter with some hints of greenish below lateral line. Whereas in (*b*) and (*c*), as in the holotype, the general impression produced by the midlateral pattern is that of a row of more or less round light markings separated by darker bars, in (*a*), (*d*) the darker areas are more rounded, the net effect here being rather the reverse one of a row of dark spots (up to a dozen) on a light background; markings scarcely developed in (*e*). Irregular lighter areas generally developed, often obscurely, along bases of dorsal fins, but in smallest individual, (*a*), the general

effect is that of half a dozen dark patches here. Head in general much as in holotype; decidedly lighter in (*a*), which is lightest overall. Lips generally concolorous with each other and, or but slightly lighter than, dorsum of snout. Supraorbital tentacle greyish, brownish; may be tinged with greenish. Vertical fins in general much as in holotype, sometimes a little darker or lighter, but maintaining the same relative intensity *inter se*. In (*a*), in which rayed dorsal is lightest, a brief encroachment on fin membrane of two dark spots near dorsal profile; in (*b*) similar dark patches on fin but no spots on body. Lower half (or less) of pectoral regularly darker than rest. Ventrals either totally dark, approaching black, or with very slight lightening near tip (never conspicuously bicolor as in *F. multiradiatum*).

Discussion. *(i). Generic status.* See remarks on *F. multiradiatum* above. Whereas that species is in agreement with *Forsterygion* as recognized by Schultz in having the ventral surface between the vent and the ventral fins scaled (though very obscurely), in the present species this area is apparently naked, thus being compatible with the account by Waite of the type-species. Our fish seems clearly referable to Whitley and Phillipps' genus.

(ii). Species affinities. *Forsterygion gymnotum* is immediately distinguishable from all described Australasian tripterygiids other than *F. multiradiatum* by the 7 spines of the dorsal; and from that species by the subhorizonal distal border of that fin; other differences between the two Tasmanian species are noted above and in the subjoined key. From the type-species, the New Zealand *F. varium* — the meristic characters of which as reported by Waite (1913) have been extended by McCulloch & Phillipps (1923, p.21) — it differs trechantly in the two features of the first dorsal, and is further separable on a number of minor characters, *e.g.*, interorbital excavate (*cf.* flat), mouth short of (to middle of) eye, ocular tentacle multifid (bifid), nasal tentacle multified (simple), shape of head, coloration. Among New Zealand tripterygiids its nearest cogener is *F. robustum* Clarke, 1879 — if that species is distinct; synonymized by Waite (1913) with *F. varium* (Forster, 1801) — but it appears clearly to be distinct from all New Zealand forms. However, the taxonomic position in respect of the New Zealand fauna is at present a greatly confused one; a revision by Mr J.Moreland, National Museum of New Zealand, is currently in course of preparation.

The specific name *gymnotum* is from the Greek γυμνός, naked, plus νῶτον, back, in allusion to the present of a naked, non-scaled area on the back on either side of the base of the first dorsal fin and the early part of the second dorsal.

Genus *BRACHYNECTES* Scott, 1957

Brachynectes Scott, 1957, *Trans. R. Soc. S. Aust.*, 80, 180. Type-species, *Brachynectes fasciatus* Scott.

Brachynectes fasciatus Scott, 1957

Brachynectes fasciatus Scott [T.D.], 1957, *Trans R. Soc. S. Aust.*, 80, 180, fig. 1. Type locality: Pelican Lagoon, Kangaroo Island, South Australia.
Verconectes fasciatus Scott [T.D.], 1962, MAR. FRESH. WAT. FISH. S. AUST., 255, fig. on page 256. *Id.* Scott, Glover and Southcott, 1974, MAR. FRESHW. FISH. S. AUST., 286, fig. p.286.
Brachynectes fasciatus: Whitley, 1964, *Proc. Linn. Soc. N.S.W.*, 89 (1), 54. *Id.* Scott [E.O.G.], 1967, *Pap. Proc. R. Soc. Tasm.*, 101, 216; 1969, *Aust. Zool.*, 15 (2), 175.

Generic status. As observed above, *Verconectes* Whitley, 1931 — (unneeded) substitute name for *Trianectes* McCulloch and Waite, 1918 — is probably to be regarded as a synonym of *Tripterygion* Risso, 1826. Though shortly after its establishment *Brachynectes* was abandoned by its author, the feature from which it derives its name — second dorsal (X) shorter than third (13) — is incompatible with the traditional concept (Macleay 1882,

TABLE 5

Fosterygion multiradiatum sp. nov., holotype, paratype, *Forsterygion gymnotum sp. nov.*, holotype, five paratypes. Dimensions: first line, standard length, absolute, mm; all other lines as permillages of standard length.

Feature	*F. multiradiatum*		*F. gymnotum*					
	Holotype	Paratype	Holotype	Paratypes				
				(*a*)	(*b*)	(*c*)	(*d*)	(*e*)
Standard length	105.0	92.0	64.5	54.1	55.0	62.4	64.0	67.0
Total length	1143+	1174	1189	1203	1209	1207	1201	1185
Length to first dorsal origin	187	193	171	166	164	159	175	181
Length to first dorsal termination	256	272	281	296	291	272	298	294
Length to second dorsal origin	276	292	327	325	324	296	331	331
Length to second dorsal termination	710	707	659	723	704	697	688	703
Length to third dorsal origin	724	720	704	752	736	745	720	736
Length to third dorsal termination	910	934	953	961	947	987	984	985
Length to anal origin	443	457	465	482	509	495	481	472
Length to anal termination	926	950	961	961	965	987	984	985
Length to vent	429	433	443	460	484	478	459	451
Length to ventral origin	238	245	217	196	236	240	233	224
Length of inner ventral ray	200	185	175	189	191	176	198	172
Length of outer ventral ray	146	162	141	129	149	141	156	133
Length to pectoral, front of base	267	277	257	220	255	239	263	267
Length to pectoral, origin of middle ray	314	322	295	277	293	319	311	291
Length of pectoral, whole fin	257	293	326	355	320	308	297	304
Length of longest pectoral ray	219	229	278	262	271	256	266	258
Head	276	288	268	303	309	272	280	269
Snout	70	76	70	74	73	67	70	72
Eye	67	74	78	87	82	79	78	75
Interorbital	33	38	31	30	35	32	31	33
Depth, width at front of eyes	143, 173	141, 185	138, 194	129, 163	127, 155	96, 204	109, 214	119, 184
Depth, width at back of eyes	167, 210	185, 212	195, 231	181, 222	178, 200	194, 226	178, 241	175, 225
Depth, width at operculum	200, 190	226, 163	202, 186	213, 211	220, 200	208, 210	213, 209	187, 209
Depth, width just behind vent	200, 114	207, 130	216, 141	220, 129	218, 116	208, 119	219, 123	239, 134
Maximum depth, width of head	210, 210	207, 213	203, 239	222, 226	220, 227	212, 240	195, 238	209, 239
Maximum depth, width of body	190, 157	228, 174	222, 198	232 200	236, 185	221, 192	220, 188	222, 151
Minimum depth, width of caudal peduncle	84 , 19	84 , 20	91 , 16	100, 19	91 , 16	101, 16	94 , 16	94 , 16

p.26) of *Tripterygion*, which has the middle dorsal the longest. *Brachynectes* continued to be recognized in the name-list of Whitley (1964), a position with which the writer finds himself in agreement – see earlier discussions on this genus in Part XV (1967) and Part XVI (1969). The two papers by the present writer cited provide some additional general information and note differences exhibited by the Tasmanian examples of *B. fasciatus*, several of which suggest the desirability of some emendation of the original account and figure.

Additional material. Parts XV, XVI give metrical and other data for 7, 1 Tasmanian specimens (XV also 1 South Australian). Scott *et al.* (1974, p.286) report the species only from the type locality, Kangaroo Island. At and near the locality of the Part XI specimens, Greens Beach, north coast, it is rather common. Additional material in the collections of the Queen Victoria Museum comprises: Greens Beach, 1, *Ls* 35.1, *Lt* 42.4, 4 November 1966, Reg. No. 1972/5/350; 14, *Ls* 23.1-32.0, $\bar{x}$ 26.6 ± 0.814, *Lt* 29.2-39.6, $\bar{x}$ 33.6 ± 0.923, 13 January, 1968, 1972/5/431; 1, *Ls* 35.0, *Lt* 43.1, 11 September 1965, 1972/5/507; 1, *Ls* 28.2, *Lt* 33.4, 13 January 1968, 1976/5/28; 16, *Ls* 23.0-35.6, $\bar{x}$ 29.5 ± 1.10, *Lt* 30.3-46.2, $\bar{x}$ 38.1 ± 1.41, 13 January 1968, 1976/5/35: Kelso, Tamar river estuary, north coast, 3, *Ls* 26.3, 27.2, 34.1, *Lt* 34.0, 37.2, 41.5, 13 January 1968, 1976/5/35.

Length classes. With all Tasmanian examples for which data is available (43) pooled the frequency distribution of *Ls* in 14 length classes, 22.5-23.4 ... 35.5-36.4 is 3, 3, 6, 6, 1, 2, 2, 1, 2, 4, 2, 3, 5, 3. The distribution exhibits some indication of being trimodal at 25.5, 31.5, 35.5; these values may represent year classes. None of our examples closely approaches the conventional length given in Scott *et al.*, namely, 57 mm.

KEY TO TRIPTERYGIIDAE RECORDED FROM TASMANIA

1.	First dorsal with 7 spines	2
	First dorsal with 3 spines	3
2.	Margin of first dorsal ascending caudad to 6th spine, which is >1½ (1.8) first. Second dorsal with > 22 (24) spines. Anal with > 28 radial elements (ii, 29). Upper lateral line ending below third dorsal. No naked strip flanking first dorsal	*Forsterygion multiradiatum*
	Margin of first dorsal subhorizontal; 6th spine ≤first. Second dorsal with <22 (20) spines. Anal with < 28 radial elements (i, 23-24). Upper lateral line ending below second dorsal. A naked strip flanking first dorsal .	*Forsterygion gymnotum*
3.	Number of spines of second dorsal (18) > 2 number of dorsal rays (8)	*Tripterygion whitleyi*
	Number of spines of second dorsal (*ca* 10-24) < 2 number of dorsal rays (*ca* 10-14)	4
4.	Head with some scales. Spines of second dorsal 13-14	*Gillias macleayana*
	Head naked. Spines of second dorsal either *ca* 10 or *ca* 16	5
5.	Number of spines of second dorsal (10) < number of dorsal rays (12-13). Two lateral lines. Upper lateral line ending under second dorsal	*Brachynectes fasciatus*
	Number of spines of second dorsal (16) > number of dorsal rays (11). One lateral line [?]. [Upper] lateral line ending under third dorsal	*Helcogramma clarkei*

Family ECHENEIDAE

Of the eight species (representing seven genera) of Echeneidae accepted by Strasburg (1964), following Maul (1956), fewer than recognized by a number of writers, three are recorded in the Australian Check-list (McCulloch 1929), namely *Remora remora* (Linné, 1758), *Remilegia australis* (Bennett, 1840) [as *Remora*], *Echeneis naucrates* Linné, 1758; the list admits only the first as Tasmanian (as did both Johnston's first and second lists; as *Echeneis remora*). However, Lord (1923, p. 70, 1927, p.15) and Lord and Scott (1924, pp. 13, 83) list also *Echeneis naucrates*, but give no specific records of it.

KEY TO ECHENEIDAE REPORTED FROM TASMANIA

Moderately stout, depth 5-8 in *Ls*. Lower jaw not produced in a median flap. Anal base short, < length of disc; rays < 28 (23-25). Dorsal rays <30 (21-27). Disc < 3.5 (2.6-3.1) in *Ls*; laminae 16-20. Pectoral rounded. More or less uniform brownish, greyish or blackish; no dark midlateral band ..... *Remora remora*

Slender, depth 9-14 in *Ls*. Lower jaw produced in a median flap. Anal base long, > length of disc; rays > 28 (30-38). Dorsal rays > 30 (32-41). Disc > 3.5 (3.8-4.3) in *Ls*; laminae 21-28. Pectoral pointed. Dark brown above, paler below; a broad blackish midlateral band from mouth to caudal base ..... *Echeneis naucrates*

Genus *REMORA* Gill, 1862

Remora Gill, 1862, *Proc. Acad. Nat. Sci. Philad.*, 14, p. 239. Type-species, *Echeneis remora* Linné (See Opinion 242, Internat. Comm. Zool. Nomen., 1954).

Remora remora (Linné, 1758)

Echeneis remora Linné, 1758, SYST. NAT., ed. 10, p. 260. Type locality: In Pelago Indico.

Material. Two examples, (*a*), *Ls* 341, *Lt* 411 (Q.V.M. Reg. No. 1976/5/54), (*b*) *Ls* 355, *Lt* 437 (Reg. No. 1976/5/53), collected at a depth of 460 m, 40 km east of Eddystone Point, east coast, Tasmania, on 5 February 1976 by Mr A.W. Yeates.

Host. The fish were taken from the undersurface of a Luth, *Dermochelys coriacea*. (Linné, 1776). *Remora remora*, like *Echeneis naucrates*, has a variety of hosts, other echeneids tending to be more specific (Lachner 1966). In a table of hosts of seven species, segregated by major groups of animals, Cressy and Lachner (1970, p.311) record in a compilation of field data that of 264 hosts of *Remora remora* 2 were sea turtles, the rest comprising 247 sharks, 1 manta, 14 teleosts. Data from the literature compiled by the same authors showed 12+ entries for sharks, with other entries (number unspecified, but fewer than 4) for sea turtles and for two groups of fishes. Of 13 examples of *Remora remora* examined by Strasburg (1964, p. 53), 7 were free-living, the remainder having sharks (4 species) as hosts. In any attempt to rank preferences the relative abundance of the host (together with ease of collection and availability of collected material for examination) must of course be taken into account: with reported cases equalling or exceeding those for teleosts other than Billfishes, turtles stand fairly high in the list. For the occurrence of the present host in Tasmanian waters see Scott and Mollison (1956a, 1956b), Green (1971).

Meristic characters. Disc laminae 17, 17. D. 23, 23. A. 24, 24. P. (left/right) 28/27, 28/27. C. 18, 18. As pointed out by Strasburg, definitive fin counts

(particularly that of the dorsal) are not readily obtained without removal of the thick leathery membrane. That procedure not being acceptable here, the best total that could otherwise be arrived at was obtained by feeling through the membrane, isolating rays as far as practicable by compressing it between them. The uppermost element of the pectoral, a short bony splint that has been reported as having a direct articulation with the girdle, is counted as a ray: attention may be called to a difference found in both individuals between the left and right fins. Counts for our specimens all fall within recognized ranges, which, as noted in available literature, are laminae 16-20 (mode, as found by Strasburg, 18). D. 22-26 (24), A. 21-25 (23), P. 26-30 (27). Munro (1967, p. 543) gives an unlikely P.23.

Dimensions as *TLs*. Smaller specimen (*Ls* 341) noted before larger (*Ls* 355): all 'length to' measurements from tip of lower jaw, which is in advance of upper by 19, 13 *TLs*. Length to tip of lower caudal lobe 1205, 1231, of upper lobe 1191, 1225; to tip of middle caudal rays 1117, 1168. Length to origin of disc, insertion 43, 29, free rim 38, 25; to termination, insertion, 311, 367, free rim 359, 352. Length to origin, termination of second dorsal 639, 611, 924, 887; of anal 592, 606, 908, 896. Length to origin of pectoral at front of base 240, 238, at insertion of median ray 273, 273; length of fin from base 170, 165; length of longest (4^{th}, 3^{rd}) ray 144, 139. Length to origin of pelvic 279, 262; length of spine 136, 144; for lengths of rays, see below. Length to vent 548, 566. Length of longest dorsal ray 141, 141, middle 97, 94, last 38, 44: of anal 155, 146; 100, 99; 31, 44. Interpectoral distance 170, 175. Oblique height of pectoral base 82, 85.

Head 252, 251. Snout 106, 99. Eye 26, 27. Interorbital 166, 166. Direct distance gape to orbit 26, 25; end of rictal groove to orbit 21, 18; superolateral border of head (dorsum here flat) to orbit 12, 17. Length to nostril 76, 97; internarial 175, 141; direct distance nostril to orbit 29, 30. Depth (in parentheses, width) at front of disc 44, 39 (111, 104), front of eye without disc 79, 77, with disc 100, 99 (161, 158), operculum, without disc 135, 132, with disc 161, 152 (185, 180), back of disc 161, 155 (161, 166), vent 158, 158 (141, 132): maximum 173, 161 (176, 169): caudal peduncle (minimum) 72, 68 (38, 34).

Head, trunk, tail. The anteroposterior extension of head, trunk, tail are such that when lengths to opercular border, vent and hypural joint are measured and their logarithms are plotted against logs 1, 2, 3 the points come close to being collinear. For (*a*) the best straight line is $\log L = 1.2501 \log N + 1.9434$; $t = 18.57$*: measured (predicted) lengths, mm, 89 (88), 201 (209), 355 (347): for (*b*) $\log L = 1.2395 \log N + 1.9246$; $t = 14.22$*: measured (predicted) lengths 86 (84), 187 (199), 341 (328).

Disc. *(i). Function.* The remarkable suctorial apparatus (generally regarded as a modification of the first dorsal fin) of the fish known to the Romans as Remora and to the Greeks as Echeneis that has attracted pipular attention since classical times has recently been the subject of structural, functional and developmental study by, among others, Bonnell (1961, 1964, 1966), Sewell (1925), Hora (1923, 1925), Norman (1943). As the outcome of investigations based initially on *Echeneis naucrates* but later extended to cover echenoids in general, the first-named author has suggested it may function also (perhaps even primarily) as an organ for the gathering of information. For an *ad hoc* demonstration of its adhesive capability see Scott (1962, p.263). Some incidental light is cast on the relative action of the fleshy rim (marginal flap of Bonnell 1961) and the tolerably rigid transverse laminae (a matter on which diverse views have been expressed) by the following observations. When one of the present fish, taken from formalin and allowed briefly to drain off, is placed on a sheet of paper, without pressure being exerted, a good liquid print of the periphery is obtained, together with partial prints, at the ends of the disc, of the central rachis and of some of the internal part of the laminae. On the application of a little pressure, complete prints of the laminae become evident as continuous lines without any clear indication of the comblike teeth — of which four well formed rows occur on most laminae,

several laminae at either end, however, having only three rows, or, transitionally, three and an imperfect fourth.

(ii). Length. The length of the disc relative to that of the pectoral has been employed in this family as a specific character; however, its taxonomic significance is qualified by differential growth in the two features. In a scatter diagram with absolute extension of adpressed pectoral plotted against *Ls* the data of Strasburg (1964, fig. 1) indicate that for about a score of individuals over the approximate *Ls* range of 30-150 mm the excess of pectoral length is about 0-2.5 mm, modally round 1.5, with no clear indication, within this range, of increase in value. However, an isolated plot for a specimen some 240 long shows an excess of about 15, or about 6.4% of *Ls*. In both our examples the adpressed pectoral extends beyond the level of the disc (free rim) by 23 mm, or 6.7, 6.5% of *Ls*, or 0.40, 0.39 total length of fin. The extension caudad of the pectoral and the pelvic are nearly the same, the former reaching beyond the latter by half, one-third of an eye diameter. The total longitudinal extension of the disc is from 1.5, 0.9 eye diameter behind tip of upper jaw to behind head by 0.40, 0.40 head length. At its attachment to the dorsum its maximum width (occurring at about two-thirds of its length) is 0.37, 0.39 its attached length; at its free rim 0.43, 0.49 its free length.

(iii). Form. The overall outline of the disc appears not to have been the subject of detailed attention. The outline of a liquid-print of the periphery has been traced in pencil, and its widths have been measured at tenths of the length. The widths have been fitted, for both specimens, with a second degree polynomial. With W = width (mm), N = decile number (counted caudad) the equations obtained are (*a*) $W = 18.77 + 10.598\ N - 0.9912\ N^2$; (*b*) $W = 29.96 + 10.426\ N - 0.9200\ N^2$. Measured and calculated values are set out in table 6. A third degree polynomial is found to yield, in either specimen, early values slightly above, later values well below, measured widths.

(iv). Spatial relation to dorsum. The measured distances between front and back of disc and front and back of head have been given above. It is of interest to observe that the anterior tip of the disc is located at the focus of the parabola formed by the upper jaw and the rest of the head behind it.

(v). Length-number pattern. An interesting length-number pattern is presented by the laminae. As here measured, length, mm, is that of the transverse vertical ridge bounded on either side by its line of junction with the oblique subovate fleshy tab that appears as if attaching it to the inner surface of the fleshy periphery of the cup. Lengths of the laminae from the most anterior backwards to the longest (9th, 11th) are denoted by L, and the serial numbers of these, counting caudad, by N: lengths of the remaining, posterior laminae are denoted by L_1, and their serial numbers, counting cephalad from the hindmost, by N_1. In each of the two sections of the fin an exponential relationship subsists between lengths and number, $L = bN^k$, $L_1 = bN_1{}^k$, conveniently treated as yielding linear graphs with equations $\log L = k \log N + \log b$, $\log L_1 = k \log N_1 + \log b$.

For (*a*) $\log L = 20.5223 \log N + 14.5445$; $t = 49.33$***: measured (in parentheses predicted) lengths 14.5 (14.5), 20.3 (20.7), 24.9 (24.3), 27.1 (26.9), 28.8 (28.7), 30.1 (30.5), 32.3 (31.8), 33.0 (33.1), 33.9 (34.1). $\text{Log } L_1 = 12.6108 \log N + 22.1651$; $t = 25.88$***: measured (predicted) lengths 22.0 (22.2), 26.0 (26.0), 28.5 (28.3), 29.6 (29.8), 31.0 (31.0), 31.8 (32.0), 32.8 (32.8), 33.7 (33.6).

For (*b*) $\log L = 24.0869 \log N + 14.2563$; $t = 143.27$***: measured (predicted) lengths 14.3 (14.3), 21.3 (21.5), 26.0 (25.7), 29.0 (28.8), 31.1 (31.1), 32.7 (33.0), 34.4 (34.6), 35.8 (36.0), 37.2 (37.2), 38.6 (38.3), 39.5 (39.3). $\text{Log } L_1 = 12.7766 \log N_1 + 27.1968$; $t = 11.90$***; measured (predicted) lengths 27.0 (27.2), 31.3 (31.0), 33.0 (33.3), 35.3 (34.9), 36.0 (36.1), 37.1 (37.2).

Head in plan. For both specimens outlines have been traced of the head in plan, viewed both from below and from above, the anterior part of the parabolic curve being provided by the lower jaw and the upper jaw, respectively. The data for each fish have been fitted with a second degree and also with a third degree polynomial. With W = width (mm), N = decile number, counting caudad, the equations for (*a*) are, lower jaw, $W = 23.65 + 9.693\ N - 0.5689\ N^2$; $W = 13.52 + 18.586\ N - 2.4932\ N^2 + 0.11662\ N^3$: upper jaw, $W = 27.11 + 9.175\ N - 0.5436\ N^2$; $W = 18.91 + 16.409\ N - 2.1089\ N^2 + 0.09487\ N^3$. For (*b*), lower jaw $W = 29.93 + 9.671\ N - 0.5833\ N^2$; $W = 24.28 + 14.619\ N - 1.6606\ N^2 + 0.06529\ N^3$: upper jaw, $W = 25.86 + 11.777\ N - 0.7708\ N^2$; $W = 34.45 + 4.2125\ N + 0.8678\ N^2 - 0.09920\ N^3$.

Measured and predicted values of W are set out in table 6.

The tip of the upper jaw is close to the locus of the parabola formed by the lower jaw and the rest of the head.

Pelvic. Equations for log lengths of pelvic rays plotted against logs of their serial numbers are: (*a*) $\log L = 0.3396 \log N^1 + 1.4597$; $t = 25.80$***; measured (predicted) lengths 29.0 (28.8), 36.1 (36.5), 41.4 (41.9), 47.1 (46.1), 49.5 (49.8): (*b*) $\log L = 0.3371 \log N^1 + 1.4878$; $t = 30.63$***; measured (predicted) lengths 30.8 (30.7), 38.8 (38.8), 44.0 (44.5) 50.0 (49.1) 52.5 (52.9). By a convention adopted in Part XIX (1974a, p. 248) first ray is that farthest from the spine (here, shortest).

Coloration. More or less uniform gun metal grey, with in parts some hint of reddish; in (*a*) a trifle dark; operculum somewhat darker, membrane brownish. Upper surface of disc rim lighter with some off-white mottling; lower, concealed surface light brownish mottled white in (*a*), largely whitish with some reddish brown flushes, partly brownish with a little white anteriorly in (*b*); laminae mainly greenish grey, with some light spots and blotches, fleshy tabs joining ridges to cup wall bluish grey, most with small whitish blotch at base and at tip. Dorsal mostly concolorous with tail; in (*b*) a narrow light greyish margin. Anal concolorous with tail in (*a*), in (*b*) the same basally, light greyish external to a line joining middle of anterior ray to base of last ray. Pectoral in (*a*) concolorous with trunk, except for uppermost ray, which is mottled with white proximally; in (*b*) distal one-third (left), half (right) lighter. Ventral greyish at tip. Caudal gun metal in basal half or so, thereafter lighter, save for an obscure darkish arc near tips of median rays. Branchiostegal membrane with hind one-third reddish brown mottled grey; in (*b*) with a few light spots. Some whitish vermiculation on left cheek in (*a*).

Specimen (*a*) exhibits some curious markings quite unrepresented in (*b*). These take the form of lines of white or grey spots, well rounded, 0.5-2.5 in diameter, adjacent ones subequal. On the left side, on which they are less conspicuous, more greyish, they include: three rows (plus a dozen scattered spots) on outer surface of pectoral; a sinuous line from near pectoral tip to meet the dorsal and to continue along its fleshy anterior border; a line from near middle of lower pectoral border down and back almost to midventral line near pelvic tip, thence running back and up to within a little more than an eye diameter of dorsal base at first one-fifth of its length, thereafter descending to midlateral line about at anal termination; some spots, in places briefly forming lines, between pectoral and pelvic and on ventral surface in advance of origin of latter. On right side a line of about ten from anterior one-third of upper border to last one-fifth of lower pectoral border, the general line continued back on the trunk by 15 spots in an upwardly convex arc to midlateral line, thereafter extending back in about 40 spots to shortly in advance of anal termination, followed, after a brief hiatus, by a short, more dorsally set line of 6 spots; a line from just in advance of middle of lower pectoral border almost to midventral line, at level of last one-fifth of fin, thence, just to right of middorsal line, to dorsal origin, continuing along more than one-third base, then ascending on to the membrane to end near middle of distal border of fin. Spots occur on the inner (postaxial)

TABLE 6

Remora remora (Linné, 1758). Widths, mm, at tenths of anteroposterior extension, as measured and as calculated from second degree and third degree polynomials given in the text, of disc, of head with lower jaw constituting the curve anteriorly, and of head with upper jaw constituting the curve anteriorly: standard lengths (*a*) 341 mm, (*b*) 355 mm.

Disc				Head including lower jaw						Head including upper jaw					
(*a*)		(*b*)		(*a*)			(*b*)			(*a*)			(*b*)		
Data	2nd degree	Data	2nd degree	Data	2nd degree	3rd degree	Data	2nd degree	3rd degree	Data	2nd degree	3rd degree	Data	2nd degree	3rd degree
28.8	28.4	29.7	30.4	31.0	32.8	29.5	37.0	38.6	37.3	34.0	35.7	33.3	35.0	36.9	39.5
36.7	36.0	39.5	38.1	42.3	40.7	41.5	48.0	46.9	47.4	43.1	43.2	44.1	49.0	46.3	45.5
40.5	41.7	44.4	44.0	48.0	47.6	49.8	55.0	53.6	55.0	50.9	49.7	51.7	56.2	54.2	52.2
44.5	45.3	47.1	47.9	54.0	53.3	55.2	60.5	59.2	60.4	57.0	55.1	56.7	61.0	60.6	58.8
46.5	47.0	49.0	50.1	58.8	57.9	58.5	63.5	63.5	64.0	59.9	59.4	60.1	64.5	65.8	64.8
47.0	46.7	49.9	50.4	61.0	61.3	60.3	66.0	66.8	66.3	62.0	62.6	61.9	67.2	68.8	69.5
45.5	44.4	50.1	48.9	62.5	63.6	61.3	68.0	68.8	67.6	63.3	64.7	63.0	68.3	70.5	72.4
41.9	40.1	46.9	45.5	63.5	64.8	62.1	68.5	69.7	68.4	64.3	65.8	63.8	69.0	70.7	72.9
35.0	33.9	39.0	38.8	64.4	64.8	63.7	69.0	69.5	68.9	65.5	65.7	64.9	70.1	69.4	70.3
	-	-	-	65.1	63.7	66.5	69.5	68.0	69.7	66.5	64.5	67.0	69.2	66.6	64.1

surface of both pectorals, a score (including two large) on left, upwards of two score forming three lines, one of which extends whole length of fin. On both sides an imperfect line between eye and upper end of pectoral base; a few below eye, a number bordering base of disc, more nearly continuous around posterior half.

Family SYNANCEJIDAE

This family, which includes the venomous stonefishes occurring in northern Australia and having a wide extralimital distribution, is represented in the southern States by a single genus, *Glyptauchen* Günther, 1860, originally referred by Whitley (1931) to a separate family, Glyptauchenidae (not noticed by Greenwood *et al.* (1966) in their provisional classification of the Teleostei), a position he later abandoned (1962). The genus, which is endemic to Australia, was long regarded as monotypic, but has been divided by Whitley (1931) into two species, each with two subspecies that are noted as being typical of well-marked zoogeographical regions. In terms of the currently accepted taxonomic positions, the validity of which remains somewhat problematical, the Tasmanian goblin fish is *Glyptauchen insidiator mirandus* Whitley, 1931.

Genus *GLYPTAUCHEN* Günther, 1860

Glyptauchen insidiator Whitley, 1931

Glyptauchen insidiator Whitley, 1931, *Rec. Aust. Mus.*, 18 (3), 118, pl. 14. Type locality (of nominate subspecies): Kurnell, Botany Bay, New South Wales.

Glyptauchen insidiator mirandus Whitley, 1931

Glyptauchen insidiator mirandus Whitley, 1931, *Rec. Aust. Mus.*, 18 (3), p. 120. Type locality: Tasmania.

Glyptauchen panduratus: Johnston, 1883, *Pap. Proc. R. Soc. Tasm.* (1882), p. 114; *ibid.*, 1891 (1890), p. 31. *Id.* Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p. 70; 1927, *J. Pan-Pac. Res. Inst.*, 2 (4), p. 15. *Id.* Lord and Scott, 1924, SYNOP. VERT. ANIM. TASM., pp. 13, 85. *Id.* McCulloch, 1929, *Aust. Mus. Mem.* 5 (3), p. 391 (Tasmanian record only). Not *Apistes panduratus* Richardson, 1850.

Material. A specimen, *Ls* 64, *Lt* 81, collected 2 km north of Greens Beach, northern Tasmania, on 18 April 1976 by Mr R.H. Green; Q.V.M. Reg. No. 1976/5/127.

Habits. Goblin fishes are seldom collected – 'I have seen only one specimen' (Castelnau 1873, p. 63); in his survey of the genus Whitley (1931) noticed only the holotype of each of the two subspecies of *G. insidiator*; the present example is the first that has come under the notice of the writer – and very little is known regarding their habits. In view of the statement by Whitley 'They are probably sedentary, carnivorous fishes of the rocky zone beyond tidal limits', it is of interest to note the fish here reported was taken in a rock pool at about one-tenth of the littoral range above low water mark. Mr K.J. Atherton informs me that in the course of a scuba dive in George Bay, east coast, in May 1976 he observed a goblin fish of an estimated total length of about 13 cm, swimming at an estimated depth of 8 m. Modal total length is apparently about 100-150 mm; the largest recorded specimen reached 200 mm.

Meristic characters. Br.7. D.XVI/I,7. A.III,6 (what are here counted as the 5th and 6th rays may possibly be the two rami of a single ray, split to base; they lie close together throughout their length, and as far as can be determined without dissection remain distinct). P.14/14. V.I,5. C.15 (11 reaching to hind border). Lat. 1. 27 + 1 on caudal base on left side. About 45 rows of scales between scapular spine

and hypural joint. About 30 scales counting obliquely upward and forward from vent.

Dimensions as *TLs*. Total length 1266. Length to origin, termination of first dorsal 284,805, of second dorsal 828,945, of anal 688,911. Length to origin of pectoral at front of base 297, at insertion of middle rays 398; total length of fin 439; length of longest (4th) ray 375. Length to origin of ventral 359; total length of fin 309. Head 414. Snout 78. Eye 109. Interorbital 109. Depth (in parentheses width) at front of eyes 195 (156), back of eyes 239 (258), occipital depression 217 (258), operculum 313 (234), vent 320 (172); maximum, head 305 (313), body 344 (234); caudal peduncle 109 (19).

Absolute lengths (mm) of spines and rays of all fins other than caudal are included in data on length-position relationships of radial elements discussed below.

General description. Published information on the external features of *Glyptauchen insidiator mirandus* is confined to the original account of the holotype, which is concerned in large part with differences from the nominate subspecies; references in local lists (Johnston 1883, 1891; Lord 1923, 1927; Lord and Scott 1924) being merely reports of occurrence. Supplementing the purely numerical data recorded above, a general account of the Tasmanian form, taking note of all features dealt with in the definitive description of the holotype of the typical subspecies (Whitley 1931), is here offered. Items in square brackets relate, if unmarked, to the holotype of *G. i. mirandus*, if marked *i* to the holotype of *G. i. insidiator*.

Approximate number of transverse series of scales between scapular spine and hypural joint 45 [40; *i* 30]. Head 2.42 [2.83; *i* 2.48], greatest depth 2.91 [2.73; *i* 2.83] in *Ls*. Eye 1.0 [*i* equal to] interorbital. Larger preopercular spine 4.62 [*i* 4.82] in head, shorter [*i* shorter] than upper opercular spine, 3.73 [*i* 4.56]. Longest, 6th [9th; *i* 9th] dorsal spine 1.62 [1.83; *i* 1.95] in head. Height of soft dorsal 1.91 [*i* 2.16], of anal 1.74 [*i* 1.91] in head – both our measurements taken obliquely, representing length of longest ray. Caudal 1.56 [*i* 1.58] in head.

Dorsal profile subvertical, very gently convex, to level of front of orbit; virtually horizontal to just behind level of back of orbit; descending vertically to form anterior border of the characteristic occipital excavation; floor extending horizontally, about at level of upper border of pupil, for about one pupil diameter; posterior border rising steeply, slightly convexly; a short dip between its end and dorsal origin; a single moderately convex arc, height of chord about one-tenth length, below dorsals; caudal peduncle somewhat concave. Ventral profile to just past middle of eye shallowly sinuous; virtually a single moderately convex sweep to anal termination, with some measure of flattening between ventral and anal fins; caudal peduncle somewhat concave. Dorsal profile noticeably less arched than as depicted for *G. i. insidiator* (Whitley 1931, pl. 14), its curve more nearly approaching, but being a trifle more convex than, that of the standard figure (Richardson 1850, pl. 1) of the typical Western Australian *G. panduratus panduratus* (figure used in Scott *et al.* 1974, to illustrate the South Australian subspecies, *G. p. deruptus* Whitley, 1931). Head entirely naked: much of it plicate, vermiculate, minutely mammillate, or in brief linear segments crenulate. Its height at middle of eye equal to height at middle of occipital depression, and to postorbital length; width equal to length without snout; length of supraorbital platform subequal to direct length from its front edge to upper lip.

A typical cottoid bony genal stay, originating close below, shortly in advance of, orbit near 9 o'clock (left side viewed), extending almost horizontally, passing close to orbit, to become continuous with uppermost spine of preoperculum: comprising (*a*), on preorbital, a roughly rectangular elevated area presenting a short but stout cordate spine directed down and back, overhanging maxilla near middle of its length, and a somewhat smaller boss about below nostril, the two connected by an irregular

elevation traversed by a longitudinal crenulated crescentic ridge; (*b*) a large curved spine, originating near base of spine of (*a*), extending back and slightly down nearly to level of front of pupil, a median ridge, on left side minutely crenulate; (*c*) a smaller spine, originating near middle of (*b*) between it and orbit, partly in contact with it and extending beyond it; (*d*) a downward and backward continuation of the anterior arc of the circumorbital rim, swinging out from orbit near 4 o'clock (left side viewed) and continuing down and back on to cheek at an angle of some 40°, beginning as a thin ridge, broadening, behind middle of pupil, to constitute a spine, tip curving down towards lower half of interval between first (uppermost) and second preopercular spines, whole structure enveloped in membrane; (*e*) wedged in between (*d*) and bottom of orbit a slender almost horizontal spine, its median ridge an offshoot of extended orbital ridge near point at which it departs from orbit; (*f*) a rather small straight (right) slightly curved (left) spine, originating just beyond (*d*) and in the same general line as that spine before it curves down terminally, wholly or almost wholly borne on base of the (much larger) uppermost preopercular spine, its own base in contact above with a slightly preconvex, generally subvertical buttressing ridge beginning about at level of lower one-third of eye, regularly increasing in height as it descends. This genal stay is not expressly referred to in the original descriptions of *G. i. insidiator* and *G. i. mirandus*, and the only elements of it receiving mention (in the nominate subspecies) are (*a*) and (*b*), on the preorbital, the latter (in our example ensheathed in membrane) being noted as erectile. As depicted in the figure of *G. i. insidiator* (which shows an apparently continuous subhorizonal bony ridge from below middle of eye backward, but presents a possible indication of only one small spine) (*b*) has much more the character of a large simple free spine than in our fish; this is true also of the figure of *G. p. panduratus*.

Arising above upper lip, about a lip width from it, occupying whole region between nostrils, two large thumb-like spines, subvertical in lower half, bowed backward above, extending to level of front of orbit; contiguous in middle half of length, slightly divergent proximally, markedly divergent distally; proximal six-sevenths wholly enveloped in black vertically plicate integument, blunt tips naked, rugose, bright pink [described for *G. i. insidiator* as nasal spines ending in two knobs]. Externad of the nasal spine, originating a little above level of its base, separated from it by the whole narial area, a spine curving up and back, its chord at about 40° to horizontal, to constitute circumorbital rim between 9 and 11.30 o'clock (left side viewed), ending above in an obtuse free point, from the base of which a supraocular shelf continues backward, but little curved, to level of hind border of eye, two blunt projections in its course and a terminal one; beyond last, rim continues back and down to end, in lateral view, as a short straight segment extending back horizintally behind orbit to constitute rest of side wall of dorsal cephalic platform. This remarkable platform, extending from level of tips of nasal spines to just beyond hind border of orbit, grossly trapezoidal or lyrate; anterior, posterior borders 0.7, 0.9 of fore-and-aft extension, the last 0.32 head; virtually linear lateral border constituted by supraorbital ridge, anterior border somewhat proconvex, formed as far as tips of nasal spines by a curved continuation of front of supraorbital ridge, hind border by two convex ridges with median notch; whole structure overall plane, but with raised rims as noted (not, narrowly, between nasal spines), and two strong acute longitudinal ridges arising immediately behind tips of nasal spines, diverging backward, finally continuous with posterior rim midway between notch and corner; markedly overhanging ocular region, forming shelf above floor of occipital depression.

Preoperculum with five main spines: first (uppermost) strongest, straight, at end of genal stay, last spine of which overrides its base, extending horizontally halfway to opercular border, a second minute spine at lower border of base; second about half length of first, below last genal spine, subequal in length to it, a very minute sliver of bone, resembling exposed tip of main spine just below its base; third small, below curved tip of penultimate genal spine; fourth smaller, a little closer to third than third to second; fifth, at lowest point on border, flat obtuse, broadly triangular: between fifth spine and angle of mouth a semicylindrical elevation that may perhaps

represent a rudimentary, adnate spine. On the broad longitudinally striated opercular lobe two long slender high, largely adnate spines, first slightly curved, inserted near preopercular border above base of uppermost preopercular spine by a distance subequal to length of that spine, running out and somewhat down to branchiostegal membrane, its length slightly greater than eye diameter; second originating immediately above first, a little behind it, similar in general form and size, running back and very slightly up to end just beyond first, but short of opercular border. Line of upper margin of membranous opercular angle continued forward by a flat adnate spine, wider than, about half as long as, the opercular spines; followed anteriorly by a similar spine with pronounced medial ridge, extending to within half its own length of orbit. Immediately above these spines three large broad, ridged petiolate spines: hindmost below interval between first and second dorsal spines, beneath fin base by little more than its own length, with two pronounced medial ridges; next basally in contact with hindmost, smaller, its tip beneath insertion of first dorsal spine, its upper border briefly constituting the dorsal profile immediately in advance of dorsal fin; foremost a slightly larger spine with strongly elevated borders met by a strong medial ridge, arising directly from hinder part of floor of occipital depression, immediately in front of second spine and intimately associated with it (on left side partly overlapping it, on right side with ridge constituting its posterior border continuing on to adjacent spine, there becoming confluent with medial ridge of latter): the inner borders of the front two spines, separated basally by about a third of an eye diameter, standing high above dorsum, their subvertical walls flanking a rectangular trough, a little longer than wide, extending from occipital depression to just in advance of insertion of first dorsal spine, the floor rising steeply backward. A strong blunt scapular spine, adherent for most of its length, overlapped basally by membranous opercular flap; with several curved basal ridges, in large part minutely crenulate.

[What are here spoken of as the anterior two of three spines near dorsal origin are treated in account of holotype of *G. i. mirandus* as a single spine 'almost divided' so as to have two points. This certainly represents a tenable interpretation of the situation on left side of fish; however, on right side the two elements, though contiguous, seem more clearly to be characterizable as separate entities — a suggestion supported by the general similarity of each element both to the adjoining spine, and, as noted below, to spine of first lateral line scale.]

Snout with anterior profile steep, twice as wide as long, shorter than eye. Eye large, 3.8 in head, equal to interorbital, posterior part of shelf-like supraorbital ridge briefly constituting dorsal profile, barely above interorbital ridges here. Mouth small, gape about 45°, maxilla considerably expanded posteriorly, greatest width subequal to direct distance from orbit, or about half eye; reaching just to orbit [*G. i. insidiator*, below anterior third eye]. Throughout most of its extent integument of lower lip depends below lip in a flap, deepest near middle of mandible, here almost one-third length of latter. Teeth in upper jaw villiform, in a band of about 8-10, band subequal in width for most of its length, narrowing rather abruptly in posterior one-fifth. Teeth in lower jaw villiform, in two bands divided by narrow bare symphysial ribbon, width of band subequal to that of upper jaw, greatest width just behind anterior one-third of length, only slightly narrower near symphysis, narrowing to slender pennon in posterior half. Teeth on palatines and on vomer villiform, in both cases in a band not greatly narrower than bands in jaws, palatine and vomerine series virtually continuous. A well developed palatal frenum, its attached border in contact for most of its extent with dental band, its free border gently sinuous; covered with microscopic vertical ridges.

Nostrils exceptionally large and complex externally. Anterior midway between orbit and midfrontal line, flanking large nasal spine, circular narial opening at level of middle of eye: the external structure is essentially a trumpet with a large reflexed lobe attached; trumpet flaring widely, its distal twice its proximal diameter, latter equal to its height, free outer margin running unbroken from 7 o'clock (left

side viewed) anticlockwise almost to 7 o'clock where it becomes continuous with the free margin of a fold arising from base of tube near 12 o'clock, this border then swinging outwards and upwards to the left to delimit a large somewhat reniform lamella, greatest (vertical) extent rather more than half eye, extending above trumpet rim by about trumpet diameter, border continuing downward and inward; broadening out from a sheet to a three-dimensional mooring to become confluent with both base and rim of trumpet near 12 o'clock. Opening of posterior nostril above, slightly externad of, that of anterior nostril; external structure (largely hidden in frontal view by large lamella of anterior nostril when erect) a tall cylinder, the two free subvertical borders convex, either, as on right side, diverging widely, and, with upper border sinuous, presenting a somewhat ear-like appearance, or, as on left side, doubly involuting to form two contiguous tubes; base of outer fold inserted slightly below that of inner; height about one and a half times width, about half pupil.

Floor of occipital depression bounded on each side by the anterior of the two spines continuing forward general sense of upper opercular border; divided by a pair of low longitudinal ridges into three subequal strips; inner two-thirds of middle strip becoming the predorsal interspinous trough. Branchiostegals seven, sixth and seventh small, close together. Gill membranes free, united across isthmus.

Most of the body covered with large imbricate cycloid scales, where present below smaller. Naked areas: whole of head; a strip, narrowing posteriorly, along spinous dorsal base (skin here largely logitudinally plicate); lateral surface in advance of a proconcave arc joining origin of lateral line and base of innermost ventral ray; ventral surface forward of half a dozen strong transverse plications immediately behind insertion of ventral; all fins; pectoral base. Lateral line descending slowly, evenly to level of vent, thereafter approaching horizontal; each scale bearing a well developed spine, anterior larger, more erect; no pore detected [no rounded flap as described for *G. i. insidiator* recognized]; first scale and its spine, situated between and close behind hinder spine collinear with upper pectoral border and outer petaloid spine below dorsal origin, much smaller than, but rather similar to, these, the similarity recognizable, but less pronounced, in next few spines also.

For fin counts see Meristic characters, above; for lengths of all spines and all rays other than caudal see sections on length-number patterns, below. Dorsal originating behind occipital depression, above middle of postorbital head; base 1.54 in *Ls*; soft base 4.44 in spinous [about 4; *i* about 6]: anterior spines shorter, stouter than as depicted for *G. p. panduratus*, more closely approaching those figured for *G. i. insidiator*. Anal originating below 13th dorsal spine, terminating with very brief membranous attachment below 6th [last] dorsal ray; base 1.91 base of soft dorsal; spines stout, third measurably longer than second, but not projecting far beyond it. Pectoral large, reaching to anal origin; measured with base just longer than, without just shorter than, head; all rays divided except uppermost, tips of upper subtriangular, flattish, of lower digitiform; 6th longest; general outline a continuous curve [as in figure of *G. p. panduratus*], upper two rays not abruptly trucate [as in figure of *G. i. insidiator*]. Ventral broadly based, rounded, spine inserted below 4th [in advance of 5th; *i* below 5th] dorsal spine, extending as far as pectoral. Caudal with major part of hind border, constituted by rays 2-9 of the 11 main rays, truncate, remaining rays shorter; greatest extent of distal divided portion (found in middle rays) rather less than one-fourth ray length; slender terminally pointed pads extending briefly up bases of most rays, on left two median much the largest, flanking last lateral line scale (bearing tubule, no spine), on right still larger median cushion, interradial, without tubule.

Coloration. The coloration is highly complex, exhibiting at once many strongly contrasting areas and many delicate gradations. Notes on the specimen made shortly after preservation in alcohol are here summarized.

Head. Chiefly black, with exceptions as follows: (*a*) light greyish patch extending back from mouth to include lower half of branchiostegal membrane; (*b*) upper half of operculum light fawn, lightest at angle, a conspicuous central splash of deep pink, with some diffuse continuation above, recumbent spines banded deep and light grey; (*c*) upper lip with a row of 5 small pinkish patches in mesial one-third, rest blackish; (*d*) lower lip light grey, the dependent flaps blackish, small pinkish area below symphysis; (*e*) frontal region with several quite small pinkish markings, tips of nasal spines bright pink, remainder black; (*f*) orbital platform dusky flesh, minutely dotted white; (*g*) occiptal depression largely pink, somewhat silvery in front, the mesial trough black, the small region between it and base of first dorsal spine fawn with touches of pink; (*h*) most of ventral surface immaculate, dusky with tinge of greenish; (*i*) preopercular and genal spines mainly black or blackish, their tips where exposed light grey; (*j*) two spines collinear with upper opercular border variegated with pastel tints of light grey, dark grey, white, pink; (*k*) spines between (*j*) and dorsal base brownish or deep fawn proximally, lighter distally, with some touches of pink.

Body. General colour of lateral surface dark brown, gradating into black, four conspicuous markings: (*a*) a conspicuous ovoid white spot just behind scapular spine; its major axis subequal to eye, running back and slightly up; (*b*) small white spot, having almost a glazed appearance, half a pupil diameter down from dorsal profile below interval between 4th and 5th spines; (*c*) similar spot between 11th and 12th spines; (*d*) behind a line running down and slightly forward between insertions of last rays of dorsal and anal a sharply contrasting wide bar of slightly dusky deep fawn, its anterior border narrowly pink (this marking continuous with light areas on dorsal and anal). Ventral surface between anal and ventral fins smoky, in advance of this somewhat lighter greyish.

Fins. Spinous dorsal chiefly dark blackish brown; a pinkish area on proximal part of membrane, and, less pronounced, on spines back to 9th spine, highest, about half fin, between 2nd and 5th spines; oblique pink strip, nearly an eye diameter wide, from near tip of 8th spine to near base of 14th; some small distal smudges of pink in hind half of fin. Soft dorsal with proximal one-third black, middle one-third white, with short brownish bars along ray borders for about one-fourth to one-fifth of their length, the anterior border of this region pinkish, directly continuous with pink border of caudal peduncle marking; distal one-third blackish, one small pink spot, briefly pinkish at tip. Anal similar to soft dorsal, pink border of light region again continuous with that on caudal peduncle. Pectoral largely dark brownish; lowest five rays black, white at very tip; proximal half of upper half of fin very complexly patterned with small pink, white and grey markings, the best defined short longitudinal bands; some pinkish diffusing back from this area towards hind border; tips of rays white. Ventral almost uniformly black. Distal one-fourth of caudal membrane dark brown; rest pure white between median rays, whitish very faintly tinged brownish between outer rays; for more than basal half of their length inner rays dark brown or black, outer grey, then with one or two rather obscurely formulated short light cross bars, thereafter brownish, deepening distally to blackish, extreme tips grey.

Length-number patterns of rays and spines. (*a*). *Dorsal spines.* The lengths of the dorsal spines and their sectional serial numbers are found to yield satisfactory linear graphs when the absolute length is plotted against the logarithm of the serial number. The pattern, comprising one ascending and two descending sections, is an exceptional one in two respects. First, it is the absolute, not as is commonly the case the logarithmic, length of the spine that is a linear function of its serial number. Secondly, whereas the usual situation in the descending portion of the fin is that where there are two (or more) sections each constitutes a separate entity such that, with its members counted in reverse (cephalad) and their lengths plotted against the logarithms of these inverse ordinal numbers (N^1), the resultant graph is linear, ascendant, in the present instance the two descending sections are not such separate entities, but are linked in such a way that the appropriate cephalad count begins with the last (16th)

spine of the fin and continues without interruption to the front spine of the first descending section (7th), which thus comes to be on log 10, there accordingly being, instead of the two ascending graphs each beginning at log 1, a single ascending graph with a point of inflexion at the end of the first and the beginning of the second section (here on log 3).

The equation for the ascending spines $\{x/x$ = I-VI$\}$ is $L = 13.93 \log N + 4.57$; $t = 33.39$***; measured (in parentheses predicted) lengths, mm, 4.5 (4.6), 8.7 (8.8), 11.3 (11.2), 13.4 (13.0), 14.0 (14.3), 15.3 (15.4). For the anterior set of descending spines $\{x/x$ = VII-XIII$\}$, $L = 8.580 \log N^1 + 4.50$; $t = 22.52$***; 9.7 (9.7), 10.5 (10.5), 11.0 (11.2), 11.9 (11.7), 12.2 (12.2), 12.8 (12.7), 13.0 (13.1): for $\{x/x$ = XIV-XVI$\}$, $L = 6.326 \log N^1 + 5.33$; $t = 29.13$*; 5.3 (5.3), 7.3 (7.2), 8.3 (8.3). With as abscissal values the common logarithms of the relevant natural numbers and as ordinate values spine lengths in mm derived by calculation from the three equations (thus achieving some convenient smoothing), the areas under the curves are, in sequence backwards 7.66, 4.53, 3.27, *i.e.*, the area under the ascending segment is equal, to a good approximation, to the sum of the areas under the descending segments.

(*b*). *Dorsal rays.* With log ray length on log serial number (N) or log inverse serial number (N^1) for sets $\{x/x$ = 1-3$\}$, $\{x/x$ = 7-4$\}$ the parameters of log N, log N^1 are 0.1384, 0.5724, the independent terms 1.0786, 0.6988 ; t 15.86*, 59.71***; measured (calculated) lengths 12.0 (12.0), 13.4 (13.2), 13.9 (14.0); 11.5 (11.1), 9.5 (9.4), 7.1 (7.4), 5.0 (5.0). Areas under ray intervals 1-2, 2-3 are approximately equal (0.331, 0.299); those under intervals 7-6, 6-5, 5-4 are approximately in the ratio 1:1:½ (0.236, 0.243, 0.126): no direct value is of course available for the interval between rays 3 and 4; however extrapolations of the equations yield in each case a one-half value (0.154, 0.128).

(*c*). *Pectoral rays.* Three sets are recognized, one ascending $\{x/x$= 1-4$\}$, and two descending $\{x/x$ = 10-5$\}$, $\{x/x$ = 14-11$\}$. With arithlog plotting, as for dorsal spines, the respective coefficients of N, N^1, N^1 are 14.563, 10.446, 7.148, the intercepts on the ordinal axis 14.85, 13.96, 7.28 ; t = 15.89**, 35. 27***, 129.25***; measured (calculated) lengths of rays 15.0 (14.9), 19.1 (19.2), 21.4 (21.8), 24.0 (23.6); 21.9 (22.1), 21.3 (21.3), 20.5 (20.3), 19.0 (18.9), 16.9 (17.1), 14.0 (14.0); 11.6 (11.6), 10.7 (10.7), 9.4 (9.4), 7.3 (7.3). In successive graphs the mean area below the curve in one interval is approximately in the ratio 4:3:2 — actual areas, followed in parentheses by areas calculated by taking the mean of the total area considered (intervals 4 -5, 10-11 not represented in graphs) as unity, and assuming the indicated ratio, being 1.890 (1.905), 2.818 (2.857), 3.860 (3.809).

(*d*). *Anal rays.* The first three rays form an ascending, the last three a descending, series. Equations: $\log L = 0.09837 \log N + 1.1171$; t = 43.47*; lengths 13.1 (13.1) 14.0 (14.0), 14.6 (14.6); $\log L = 0.4661 \log N^1 + 0.7389$; t = 31.38*; 5.5 (5.5), 7.5 (7.6), 9.2 (9.1). With length sets of as few as 3 members, plotted against logs 1-3, it is possible for both loglog and arithlog graphs to yield linear fits that are formally significant. This is the case in one instance here, t values for arithlog formulations being 28.44*, 9.65 ; the first equation ($L = 3.127 \log N + 13.09$) giving calculated lengths equal to measured values.

(*e*). *Anal spines.* Equation: $\log L = 0.3829 \log N + 0.9595$; t = 78.75**; lengths 9.1 (9.1), 12.0 (12.0), 14.0 (14.0). The areas under the graphs are approximately in the ratio 3:2 (0.307, 0.196).

(*f*). *Ventral rays.* A log length-log number relation subsists for the set $\{x/x$ = 1-4$\}$; $\log L = 0.3654 \log N + 0.9684$; t = 28.47***; lengths 9.3 (9.3), 11.9 (12.0), 14.1 (13.9), 15.3 (15.4). The first ray is defined as that farthest from the spine (Part XIX, 1974, p. 248). Measured lengths of spine, fifth ray (for which an equation is trivial) are 11.1, 12.0 mm. The area under the graph of the interval between rays

1 and 2 (0.374) approaches equality with the sum of the corresponding intervals between rays 2 and 3 (0.207) and rays 3 and 4 (0.146).

Discussion. In a number of cases in which a comparative datum is available this has been incorporated in the foregoing account. Some differences disclosed are evidently attributable to individual variation. Attention may here usefully be called to features to which taxonomic significance has been attached in relevant specific and subspecific diagnoses.

In the diagnosis of *G. insidiator* it is noted as differing from *G. panduratus* chiefly in having (*a*) a much more arched back, (*b*) deeper body, (*c*) shorter anterior dorsal spines, (*d*) fewer and smaller preopercular spines, (*e*) fewer (2 instead of 3) distinct spines on either side near dorsal origin, (*f*) longest dorsal spine 9th (*cf.* 7th); (*g*) differently arranged colour pattern. With the situation interpreted on the basis of published data (not on examination of actual material), our specimen is found to provide no support for (*a*), (*b*), (*e*); it is in agreement for (*c*) and probably for (*g*). With respect to (*d*) our specimen occupies a somewhat anomalous position, the definitive marginal spines numbering 5 as in *G. insidiator* (6 in *G. panduratus*), but being much smaller than figured for either species (while Whitley speaks of the spines in *G. insidiator* being smaller than those in *G. panduratus*, a comparison of figures suggests the former are more massive). The longest dorsal spine, (*f*), is here the 6th. The armament of the genal stay is decidedly more obvious in the local fish than is figured for *G. insidiator*, but its spinous elements are somewhat less developed than as depicted in Richardson's figure of *G. panduratus*.

The chief points of difference reported as distinguishing *G. i. mirandus* from *G. i. insidator* are enumerated below, followed in parentheses by a specification of our fish. (*a*) scales between scapular spine and hypural joint about 40; about 30 (about 45); (*b*) nasal spines sharp, ending in knobs (not knobs, not sharp but bluntly pointed); (*c*) transverse ridges joining supraorbital ridges forming an oblique shelf overhanging occipital depression; front wall of depression vertical (as in former); (*d*) anterior spine on each side near origin of dorsal almost divided so that each has two points; not so divided (deeply divided, or, as here interpreted, representing two spines, see above); (*e*) soft dorsal base about one-quarter spinous base; about one-sixth (0.23); (*f*) pectoral equal to head, less than head (measured from front of base greater, measured from insertion of middle rays less, than head); (*g*) origin of ventral in advance of 5th dorsal spine; below 5th (below 4th); (*h*) rosy patch on operculum extending into occipital depression; not so (as for former); (*i*) more whitish blotches on the dorsal and pectoral than in *G.i. insidiator* (dorsal lacks whitish blotches altogether, but has two extensive pinkish areas; pectoral with much less white than in *G.i. insidiator*); (*j*) two large white blotches on back below spinous dorsal; absent (two small well-separate white spots here). Other differences in colour pattern between our specimen and the figured holotype of *G. i. insidiator* include: black arc across outer half of rayed dorsal in our fish a wide bar, greatest width about two-thirds an eye diameter, subequal to greatest width of black bar of anal in both fish; much less white in pectoral; no white on membrane between first and second anal spines; less extensive white patch behind scapula; much less light colour on lateral surface of postorbital head; white behind head not diffuse, but rounded, very much smaller.

The excavation of the spinous dorsal membrane is depicted as much more extensive in *G. panduratus* than in *G. insidiator*: in our fish the outline of the fin is quite different from either, the membrane extending to tip of spine and running back in a virtually straight line to front of next spine, so that the outline formed by membrane and distal free part of succeeding spine constitutes a symmetrical V, its width subequal to its depth throughout posterior two-thirds of fin, but somewhat greater between the first four or five spines.

On the evidence provided by this fish it is considered inadvisable to propose any

variation of the currently accepted classification of *Glyptauchen*: it seems apparent, however, further specimens will need to be examined and a direct comparison of adequate material with a wide geographical range will need to be undertaken before the taxonomic position becomes stabilized on a satisfactory basis. The crisscross pattern of resemblances and differences that has now become apparent certainly raises some question as to whether the distinctions drawn between the recognized species are consistently of a higher order than those drawn between their subspecies. It may well prove that the currently recognized *Glyptauchen panduratus panduratus* (Richardson, 1850) Western Australia), *G. p. deruptus* Whitley, 1931 (South Australia), *G. insidiator insidiator* Whitley, 1931 (New South Wales) and *G. i. mirandus* Whitley 1931 (Tasmania) are best regarded as four subspecies of Richardson's species.

REFERENCES

Advocate, 1936: Unusual fish. Issue of 2 December 1936. *Advocate*, Burnie.

_____, 1976 : Rare fish poser. Issue of 13 January 1976; photograph.

Bonnell, B., 1961 : Structure and action of the sucker of *Echeneis*. *Nature* 191, 4786, 403, fig. 1.

_____, 1964 : Adhesive disk of *Echeneis naucrates*. *Nature*, 203, 4941, 203.

_____, 1966 : Oval disk of echeneid fishes. *Nature*, 212, 5063, 736-737, figs 1-3.

Cressey, R.F. and Lachner, E.A., 1970 : The parasitic copepod diet and life history of disk fishes (Echeneidae). *Copeia*, 1970 (2), 310-318.

Castelnau, F., 1873 : Contribution to the ichthyology of Australia. No. 4 — Fishes of South Australia. *Proc. zool. acclim. Soc. Vict.*, 2, 59-82.

Fisher, R.A., 1932 : STATISTICAL METHODS FOR RESEARCH WORKERS. Oliver and Boyd, Edinburgh.

Fowler, H.W., 1953 : On a collection of fishes made by Mr Marshall Laird at Norfolk Island. *Trans. R. Soc. N.Z.*, 81 (2), 237-267, figs 1-12.

Garrick, J.A.F. and Schultz, L.P., 1963 : A guide to the kinds of potentially dangerous sharks; 1-60, figs 1-33. *In* : Gilbert, P.W. (ed.), SHARKS AND SURVIVAL. Heath & Co., Boston.

Gilbert, C.R., 1967a : A review of the hammerhead sharks (family Sphyrnidae). *Proc. U.S. Nat. Mus.*, 119 (3539), 1-88, pls 1-10, figs 1-22.

_____, 1967b : A taxonomic survey of the hammerhead sharks (family Sphyrnidae). *In* : Gilbert, P.W., Matthews, R.F. and Rall, D.I. (eds), SHARKS, SKATES AND RAYS, part 1, art.3, 69-77; vol.624 pp. John Hopkins, Baltimore.

Green, R.H., 1971 : Sea turtles round Tasmania. The first record of the green turtle *Chelone mydas* (Linné, 1758) and the hawksbill turtle, *Eretmochelys imbricata brissa* (Rüppell) from Tasmanian waters. *Rec. Qeeen Vict. Mus.*, 38, 1-4.

Greenwood, P.H., Rosen, D.E., Weitzman, S.H. and Myers, G.S., 1966 : Phyletic studies of teleostean fishes, with a provisional classification of living forms. *Bull. U.S. Nat. Hist.*, 131 (4), 330-456, text figs 1-9, pls 21, charts 1-32.

Günther, A., 1870 : CATALOGUE OF THE ACANTHOPTERYGIAN FISHES IN THE COLLECTION OF THE BRITISH MUSEUM, 8. British Museum, London.

_____, 1881 : AN INTRODUCTION TO THE STUDY OF FISHES. A. & C. Black, Edinburgh.

Hall, R., 1913 : Notes on Derwent estuary fishes. *Pap. Proc. R. Soc. Tasm.* (1912), 1-6.

Hancock, D.A., 1976 : Mercury in fish. *Aust. Fisher.*, 35 (1), 4-7, 37, fig. 1.

Herald, E.S., 1953 : Family Syngnathidae: pipefishes, 231-278, figs 36-44. *In* : Fishes of the Marshall and Marianas Islands, Schultz, L.P. & Collaborators. *U.S. Nat. Mus. Bull.*, 202 (1), i-xxxii + 1-685, pls 1-74, figs 1-90.

Hora, S.L., 1923 : The adhesive apparatus of the 'sucking-fish'. *Nature*, 111, 668.

_____, 1925 : The adhesive apparatus of the 'sucking-fish'. *Nature*, 115, 47.

Johnston, R.M., 1883 : General and critical observations on the fishes of Tasmania; with a classified catalogue of all known species. *Pap. Proc. R. Soc. Tasm.* (1882), 54-144.

_____, 1891 : Further observations on the fishes and fishing industries of Tasmania, with a revised list of indigenous species. *Pap. Proc. R. Soc. Tasm.* (1890), 22-46.

Kershaw, J.A., 1913 : Additions to the fish fauna of Victoria. No. 4. *Vict. Nat.*, 30 (5), 95-96, pl. 6.

Lachner, E.A., 1966 : Family Echeneidae : diskfishes, 74-80, pl.131. *In* : Fishes of the Marshall and Marianas Islands, 3, Schultz, L. P. & Collaborators. *U.S. Nat. Mus. Bull.*, 202 (3), i-vi + 1-176, pls 124-148, figs 133-156.

Lord, C.E., 1923 : A list of the fishes of Tasmania. *Pap. Proc. R. Soc. Tasm.* (1922), 60-75.

_____, 1927 : A list of the fishes of Tasmania. *J. pan-Pac. res. Inst.*, 2 (4), 11-16.

_____ and Scott, H.H., 1924 : A SYNOPSIS OF THE VERTEBRATE ANIMALS OF TASMANIA. Oldham, Beddome & Meredith, Hobart.

Lucas, A.H.S., 1890 : A systematic census of indigenous fish, hitherto recorded from Victorian waters. *Proc. R. Soc. Vict.* (n.s.), 2, 15-47.

_____, 1891 : On the occurrence of certain fish in Victorian seas, with descriptions of some new species. *Proc. R. Soc. Vict.*, 2 (3), 8-14, pl. 3.

McCulloch, A.R., 1909 : Studies in Australian fishes, No. 2. *Rec. Aust. Mus.*, 7 (4), 315-321, pls 90-91, fig. 18.

_____, 1911 : Report on the fishes obtained by the F.I.S. 'Endeavour' on the coasts of New South Wales, Victoria, South Australia and Tasmania. Part 1. *Zool. res. Endeavour*, 1 (1), 1-87, pls 1-16, text figs 1-20.

_____, 1915 : Notes on, and descriptions of Australian fishes. *Proc. Linn. Soc. N.S.W.*, 40 (2), 259-277, pls 35-37.

_____, 1929 : A check-list of the fishes recorded from Australia. *Aust. Mus. Mem.*, 5 (1-4) (part 4, index, 1930), i-x + 1-534.

_____ and Phillips, W.J. 1929: Notes on New Zealand Fishes. *Rec. Aust. Mus.*, 14 (1), 18-22, pl. 4, text fig. 1.

_____ and Waite, E.R., 1916 : Additions to the fish fauna of Lord Howe Island. No. 5. *Trans. R. Soc. S. Aust.*, 40, 437-451, pls 40-43.

_____, 1918 : Some new and little-known fishes from South Australia. *Rec. S. Aust. Mus.*, 1 (1), 39-78, pls 2-7, figs 26-31.

Macleay, W., 1882 : Descriptive catalogue of the fishes of Australia. Parts 3, 4. *Proc. Linn. Soc. N.S.W.*, 6 (1), 1-138, pls 1-2; and 6 (2), 202-387.

_____, 1884 : Supplement to the descriptive catalogue of the fishes of Australia. *Proc. Linn. Soc. N.S.W.*, 9 (1), 2-64.

Marshall, T.C., 1964 : FISHES OF THE GREAT BARRIER REEF AND THE COASTAL WATERS OF QUEENSLAND, 1-566, colour pls 1-72, b.w. pls 1-64, figs 1-11.

Maul, G.E., 1956 : Monografia dos peixes do Museu Municipal do Funchal. Ordem Discocephali. *Bol. Mus. Funchal*, 9 (23), 5-75. (n.s.)

Mercury, 1976 : Rare moon fish on N.W. Coast? Issue of 13 January, 1976. *Mercury*, Hobart.

Mees, G.F. 1962 : Additions to the fish fauna of Western Australia — 3. *W. Aust. Fisher. Bull.*, 9 (3), 23-30.

Mollison, B.C., 1956a, 1956b : See Scott, E.O.G. and Mollison, B.C.

Morton, A., 1888 : Description of two new fishes. *Pap. Proc. R. Soc. Tasm.* (1887), xlii, 77-78.

_____, 1897 : Untitled note on a Tasmanian example of *Lampris luna*. *Pap. Proc. R. Soc. Tasm.* (1896), 99.

Munro, I.S.R., 1955 : THE MARINE AND FRESH WATER FISHES OF CEYLON. Department of External Affairs, Canberra.

_____, 1956 : Handbook of Australian fishes, 2, 9-12. *In* : *Fisher. newsl.* (now *Aust. Fisher.*), 15 (8).

_____, 1957 : Handbook of Australian fishes, 15, 61-64. *In* : *Fisher. newsl.* (now *Aust. Fisher.*), 16 (9).

_____, 1958 : Handbook of Australian fishes, 20, 81-84. *In* : *Fisher. newsl.* (now *Aust. Fisher.*), 17 (2).

_____, 1967 : THE FISHES OF NEW GUINEA. Department of Agriculture, Stock and Fisheries, Port Moresby.

Norman, J.R., 1939 : Remoras or sucking-fishes. *Nature*, 143, 52-55, figs 1-4.

Owen, R., 1853 : DESCRIPTIVE CATALOGUE OF THE OSTEOLOGICAL SERIES CONTAINED IN THE MUSEUM OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, MAMMALIA PLACENTALIA, 2, 351-954. Taylor & Francis, London.

Richardson, J., 1850 : Notices of Australian fish. *Proc. zool. Soc. Lond.*, 18, 58-77, pls 1-3.

Schultz, L.P., 1950 : Notes on the blennioid fish genera *Runula* (subfamily Petroscirtinae) and *Tripterygion* and *Helcogramma* (family Clinidae) of the American tropical Pacific. *J. Wash. Acad. Sci.*, 40, 266-268, 1 table. (n.s.)

_____, 1960 : Family Clinidae : scaled blennies. Subfamily Tripterygiinae, 281-300, pl. 121, fig. c, text figs 109-114. *In* : Fishes of the Marshall and Marianas Islands, 2, Schultz, L.P. & Collaborators. *U.S. Nat. Mus. Bull.*, 202 (2), 1-vii + 1-438, pls 75-123, figs 91-132.

Scott, E.O.G., 1934-1976. Observations on some Tasmanian fishes. Parts I-XXII : in this journal (except Part XVI, 1969, *Aust. Zool.*, 15 (2), 160-177, figs 1-2) Contributions here cited : 1935, Part II, 63-73, pl. 5. 1939, IV, 139-159, figs 1-2. 1942, V, 45-54, pl. 7. 1953, VI (numbered V in error), 141-166, figs 1-4. 1960, IX, 87-102, fig. 1. 1961, X, 49-65, figs 1-3. 1963, XI, 1-29, figs 1-8. 1964, XII, 85-106, fig.1. 1966, XIV, 93-115, fig.1. 1967, XV, 189-220, figs 1-3. 1969, XVI (see above). 1970, XVII, 35-50, fig.1. 1971, XVIII, 119-143, fig. 1. 1974a, XIX, 247-292, figs 1-2. 1974b, XX, 171-197, figs 1-4. 1976, XXII, 157-217, pl. 1.

_____, 1968 : First Tasmanian record of the long-snouted pipefish, *Syngnathus peocilolaemus* Peters, 1869. *Tasm. Fisher. Res.*, 2 (2), 4-7.

_____, 1973 : A Tasmanian record of *Sphyrna (Sphyrna) zygaena* (Linné, 1758) (Sphyrnidae), with a consideration of the species of hammerhead sharks in Australian waters. *Rec. Queen Vict. Mus.*, 48, 1-22, fig.1.

Scott, E.O.G. and Mollison, B.C., 1956a : The Indo-Pacific loggerhead turtle in Tasmanian waters. *Nature*, 178, 372.

_____, 1956b. The Indo-Pacific redbrown loggerhead turtle, *Caretta caretta gigas* Deraniyagala, and the leathery turtle, *Dermochelys coriacea* (Linné) in Tasmanian waters. *Pap. Proc. R. Soc. Tasm.*, 90, 59-63, pl. 1.

Scott, T.D., 1957 : A new blenny (Tripterygiidae) and pipefish (Syngnathidae) from Kangaroo Island, South Australia. *Trans. R. Soc. S. Aust.*, 80, 180-183, figs 1-2.

_____, 1962 : THE MARINE AND FRESH WATER FISHES OF SOUTH AUSTRALIA. Government Printer, Adelaide.

Scott, T.D., Glover, C.J.M. and Southcott, R.V., 1974 : THE MARINE AND FRESHWATER FISHES OF SOUTH AUSTRALIA. Government Printer, Adelaide.

Sewel, R.B.S., 1925 : The adhesive apparatus of the 'sucking-fish'. *Nature*, 115, 48-49.

Smith, J.L.B., 1950 : THE SEA FISHES OF SOUTHERN AFRICA. Central News Agency, Cape Town.

Snedecor, G.W., 1950 : STATISTICAL METHODS APPLIED TO EXPERIMENTS IN AGRICULTURE AND BIOLOGY. Iowa State College Press, Iowa.

Thompson, D'A. W., 1942 : ON GROWTH AND FORM. 2 vols, 1-viii + 1-1116, 556 ill. Cambridge University Press, Cambridge.

Waite, E.R., 1906 : Descriptions of and notes on some Australian and Tasmanian fishes. *Rec. Aust. Mus.*, 6 (3), 194-210, pls 34-36.

_____, 1913 : Fishes of the genus *Tripterygion* and related genera in New Zealand. *Rec. Canterb. Mus.*, 2 (1), 1-16, pls 1-5.

_____, 1921 : Illustrated catalogue of the fishes of South Australia. *Rec. S. Aust. Mus.*, 2 (1); 1-208, pl. 1, 293 text figs.

_____, 1923 : THE FISHES OF SOUTH AUSTRALIA. Government Printer, Adelaide.

Waite, E.R. and Hale, H.M., 1921 : Review of the lophobranchiate fishes of South Australia. *Rec. S. Aust. Mus.*, 1 (4), 293-324, figs 39-56.

Whitley, G.P., 1929 : R.M. Johnston's memoranda relating to the fishes of Tasmania. *Pap. Proc. R. Soc. Tasm.* (1928), 44-68, pls 2-4.

_____, 1930 : Five new generic names for Australian Fishes. *Aust. Zool.*, 6 (3), 250-251.

Whitley, G.P., 1931a : New names for Australian fishes, *Aust. Zool.*, 6 (4), 310-334, pls 25-27, text fig.

_____, 1931b : Studies in ichthyology. No. 4. *Rec. Aust. Mus.*, 18 (4), 96-133, pls 11-16, figs 1-2.

_____, 1940 : THE FISHES OF AUSTRALIA. PART I. THE SHARKS, RAYS, DEVIL-FISH, AND OTHER PRIMITIVE FISHES OF AUSTRALIA AND NEW ZEALAND. Royal Zoological Society of New South Wales, Sydney.

_____, 1941 : Ichthyological notes and illustrations. *Aust. Zool.*, 10 (1), 1-50, pls 1-2, figs 1-32.

_____, 1943 : Ichthyological descriptions and notes. *Proc. Linn. Soc. N.S.W.*, 68 (1), 114-149, figs 1-12.

_____, 1944 : New sharks and fishes from Western Australia. *Aust. Zool.*, 10 (3), 252-273, figs 1-6.

_____, 1945 : New sharks and fishes from Western Australia. Part 2. *Aust. Zool.*, 11 (1), 1-42, pl. 1, figs 1-15.

_____, 1948 : A list of the fishes of Western Australia. *W.A. Fisher. Dept Bull.*, 2, 1-35.

_____, 1950 : The opah or moonfish in Australia. *Aust. Mus. Mag.*, 10 (3), 76-78, frontispiece and 1 fig.

_____, 1962 : MARINE FISHES OF AUSTRALIA. 2 vols. Jacaranda Press, Brisbane.

_____, 1964a : A new Queensland Blenny (Pisces : Clinidae). *Aust. Nat.*, 12 (4), 15.

_____, 1964b : Name-list of the fishes recorded from Australia. Presidential address, appendix B. *Proc. Linn. Soc. N.S.W.*, 89 (1), 32-60 (list), 11-127 (address).

_____, 1964c : Fishes from the Coral Sea and the Swain Reefs. *Rec. Aust. Mus.*, 26 (5), 145-195, pls 8-10, figs 1-15.

_____, 1964d : New records of fishes from Australia. *Aust. Nat.*, 12 (4), 7-9, figs 1-4.

_____, 1965 : Illustrations and records of fishes. *Aust. Zool.*, 13 (2), 103-120, figs 1-13.

_____ and Payne, G.H., 1947 : Testing a shark repellant. *Aust. Zool.*, 11 (2), 151-157, pls 12-13, fig. 1.

_____ and Phillipps, W.J. 1939 : Descriptive notes on some New Zealand fishes. *Trans. R. Soc. N.Z.*, 69 (2), 228-236, pls 21-22.